Aalto University
School of Business

Topics in Labor Economics II

Compensating Differentials

Marko Terviö (Aalto University)

Fall 2024

ECON-L6310

Helsinki GSE

Introduction

How do differences in abilities and tastes translate into differences in wages?

1. Scaling, Superstars, Matching
2. Compensating differentials
   Direct impact of a job on utility, beyond income-leisure tradeoff
   Edge case: impact of a job on future earnings. File under general OTJ experience/learning/training.

Close-ups in this lecture

- Rosen (1986) Classic equilibrium framework
- Sorkin (2018) Job market network model

Compensating Differentials

The basic features behind individual wage levels

- Individual productivity: talent, education, experience...
- Firm or job productivity
- Job amenities related to both worker and firm reservation wage
  Worker tastes for amenities
  Firm-side costs for providing amenities
- Any of the above may interact (matching)

In the simplest model any Firm FEs are a puzzle. Just because a firm is more productive, why does it have to pay more for inputs? (Firm FEs in a firm surplus regression would not be a puzzle)

Amenities / disamenities

- comforts / annoyances
- safety / hazards
- flexibility, predictability
- location
- mandated and tax-subsidized benefits

Interpreting FEs from linked wage panel data

- Firm FEs: effective at producing output, not so good at job amenities
- Worker FEs: effective at producing output, not fussy about amenities

Compensating Differentials

Compensating Differentials aka Equalizing Wage Differentials

If job characteristics are exogenous, taste for an amenity can be modeled as variation in opportunity cost

Often job characteristics can be affected at cost
Distribution of job amenities is endogenous
Observed jobs are a selected sample of potential jobs, just like workers in any sector or type of job

Job amenity is anything that makes an hour of labor in one job more attractive than in another (lowers reservation wage)

Examples: job amenities and wage differentials

- The taste for doing science. Stern (2014)
  Small sample of post-docs, accepted v rejected offers by person
- Flexibility / predictability. Goldin and Katz (2016)
  Career-family balance preferences highly correlated with gender.
  Tech change $\rightarrow$ lower cost of providing flexibility for pharmacists
  $\rightarrow$ influx of women and low gender wage gap
- Work-from-home, hours flexibility. Mas and Pallais (2017)
  Field experiment at a call center.
  Average worker willing to give up 8 percent of wage to WFH,
  a tail of workers with high valuations
- Stated-preference experiments. Maestas, Mullen, Powell, von Wachter, and Wenger (2023)

Rosen (1986) model with two job types

Two levels of disamenity $D \in \{0, 1\}$ hazard, annoyance, . . .

No productivity differences between workers or jobs

Distribution of workers with preferences U over consumption C and disamenity D

Distribution of firms with costs B in avoiding the disamenity

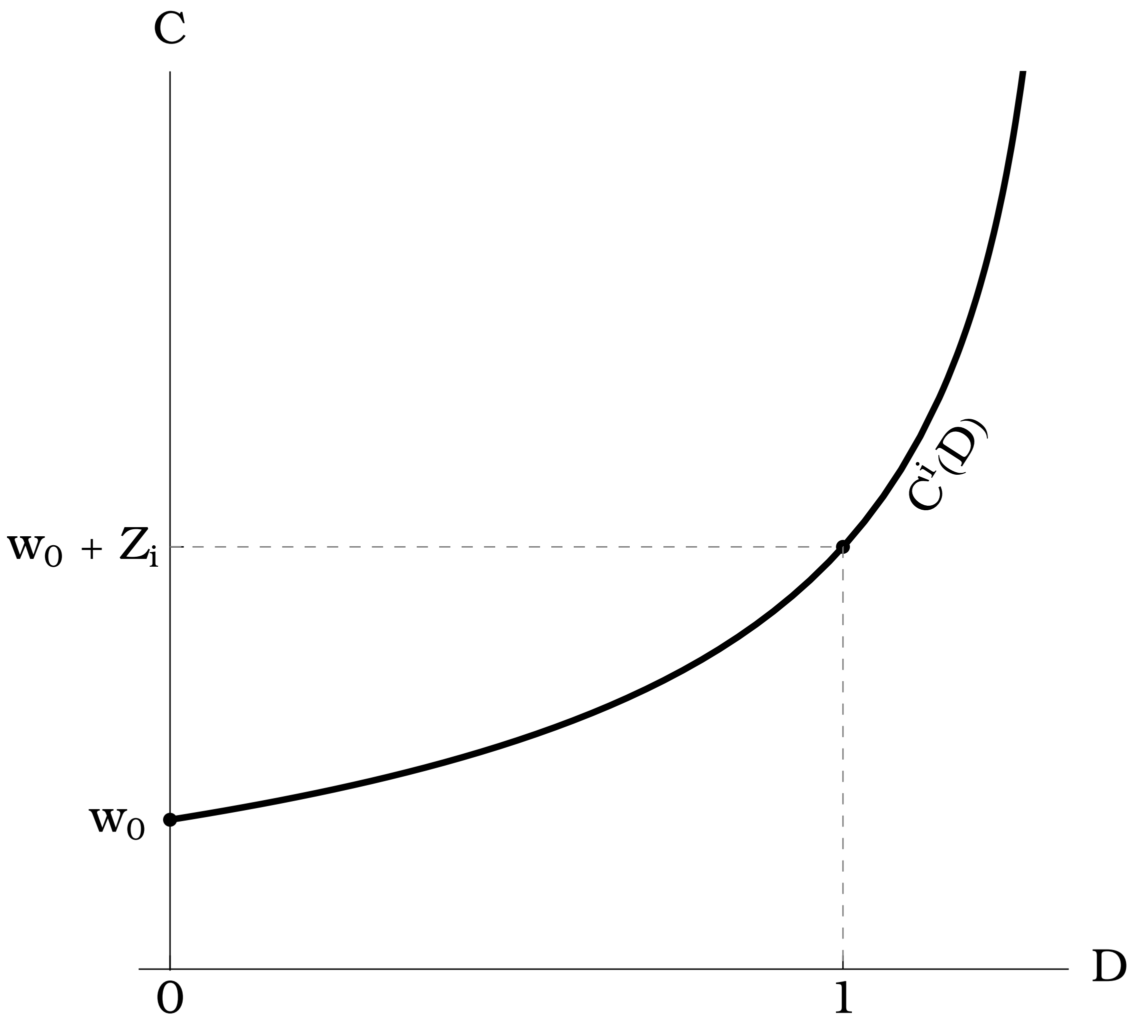
Equilibrium:

Compensating differential $w_1 - w_0 = \Delta W$

Fraction of workers and jobs with $D \in \{0, 1\}$

Disamenity is equivalent with “lack of amenity”, with B as the saved cost from not offering the amenity

Rosen (1986) model with two job types



Individual preferences $U^i(C, D)$

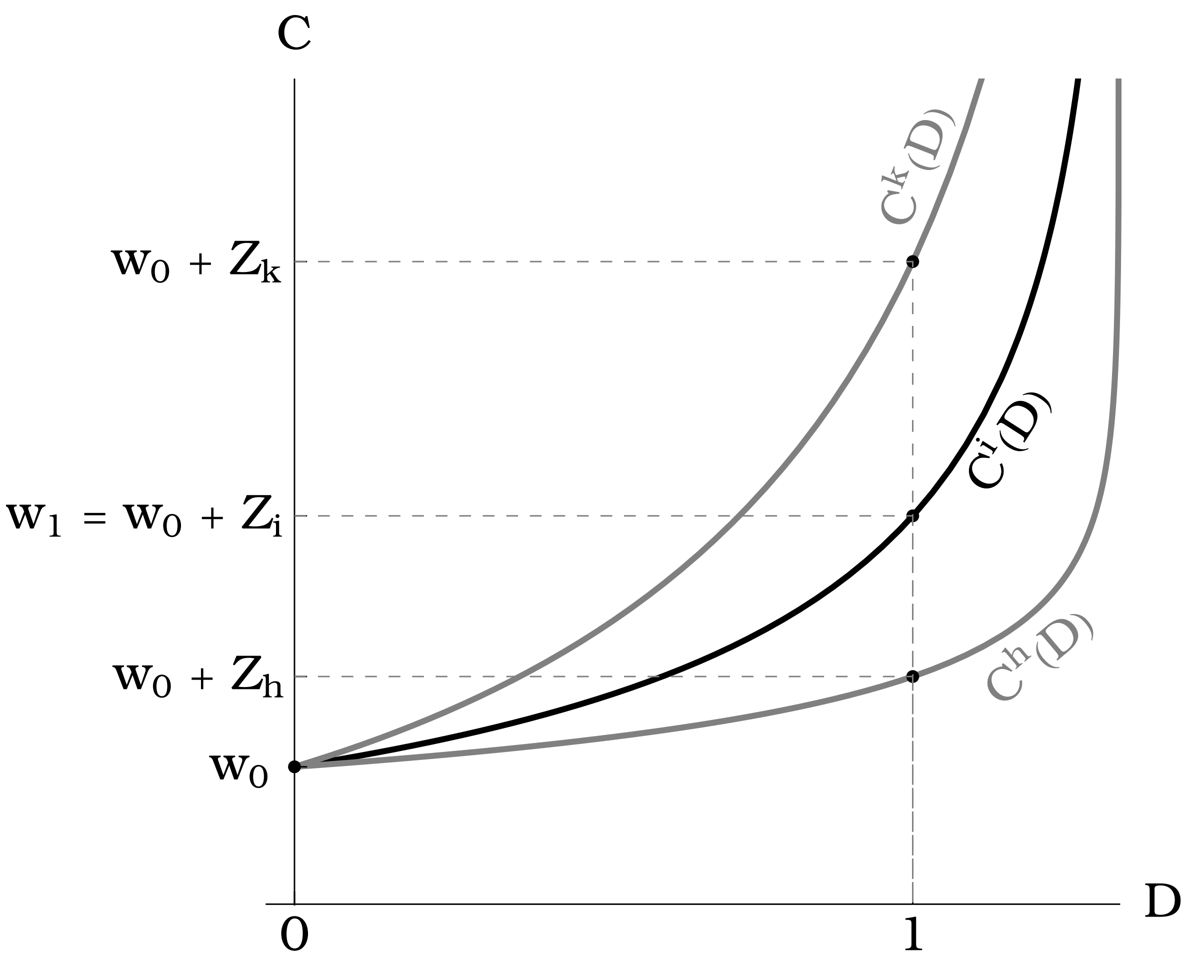
$U^i_C > 0$, $U^i_D \leq 0$

Bid curve for job with D:

$C^i(D) = C$ s.t. $U^i(C, D) = U^i(w_0, 0)$

$Z_i := C^i(1)$ is the compensating differential required by i

Rosen (1986) model with two job types

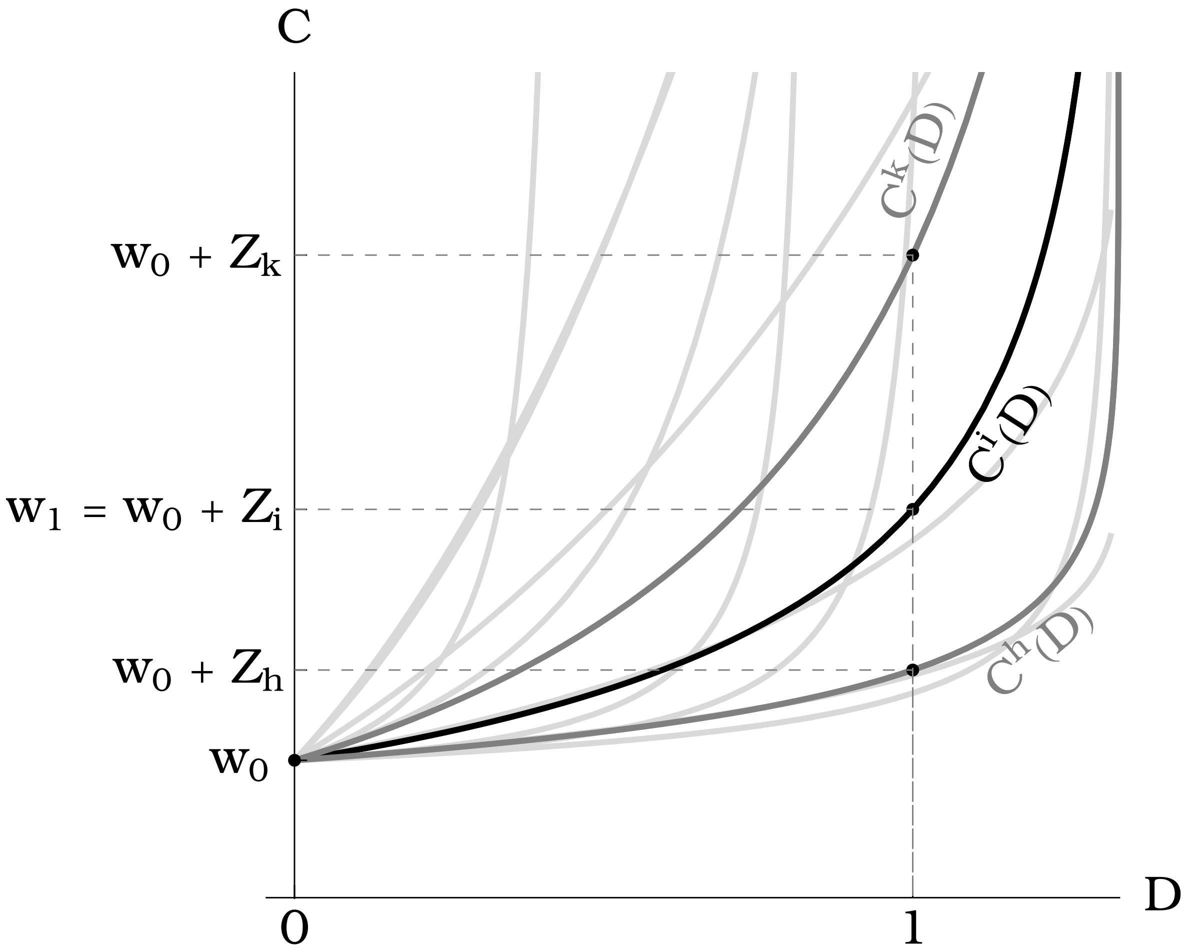


Type k will select a job with $D = 0$, earns wage w_0

i is the marginal worker, $Z_i = \Delta W = w_1 - w_0$, indifferent between job types

h is an inframarginal worker, earns rent $Z_h - \Delta W$ at a job with $D = 1$

Rosen (1986) model with two job types



Distribution of preferences U gives rise to distribution of tastes Z

Rosen (1986) model with two job types

Distribution of worker tastes for amenity $G(z) := \Pr(Z \leq z)$ ("cost" of accepting the disamenity)

Distribution of firm amenity costs $F(b) := \Pr(B \leq b)$ (cost of modifying the job to avoid the disamenity)

In equilibrium, the share of workers with $Z \leq \Delta W$ matches the share of jobs where $B \geq \Delta W$

Equilibrium compensating differential from

$$G(\Delta W) = 1 - F(\Delta W)$$

$\implies$ share of disamenity jobs $G^* = G(\Delta W^*)$

Rosen (1986) model with two job types

In equilibrium, workers with low distaste for disamenity are matched with firms (jobs) with low cost of avoiding the disamenity.

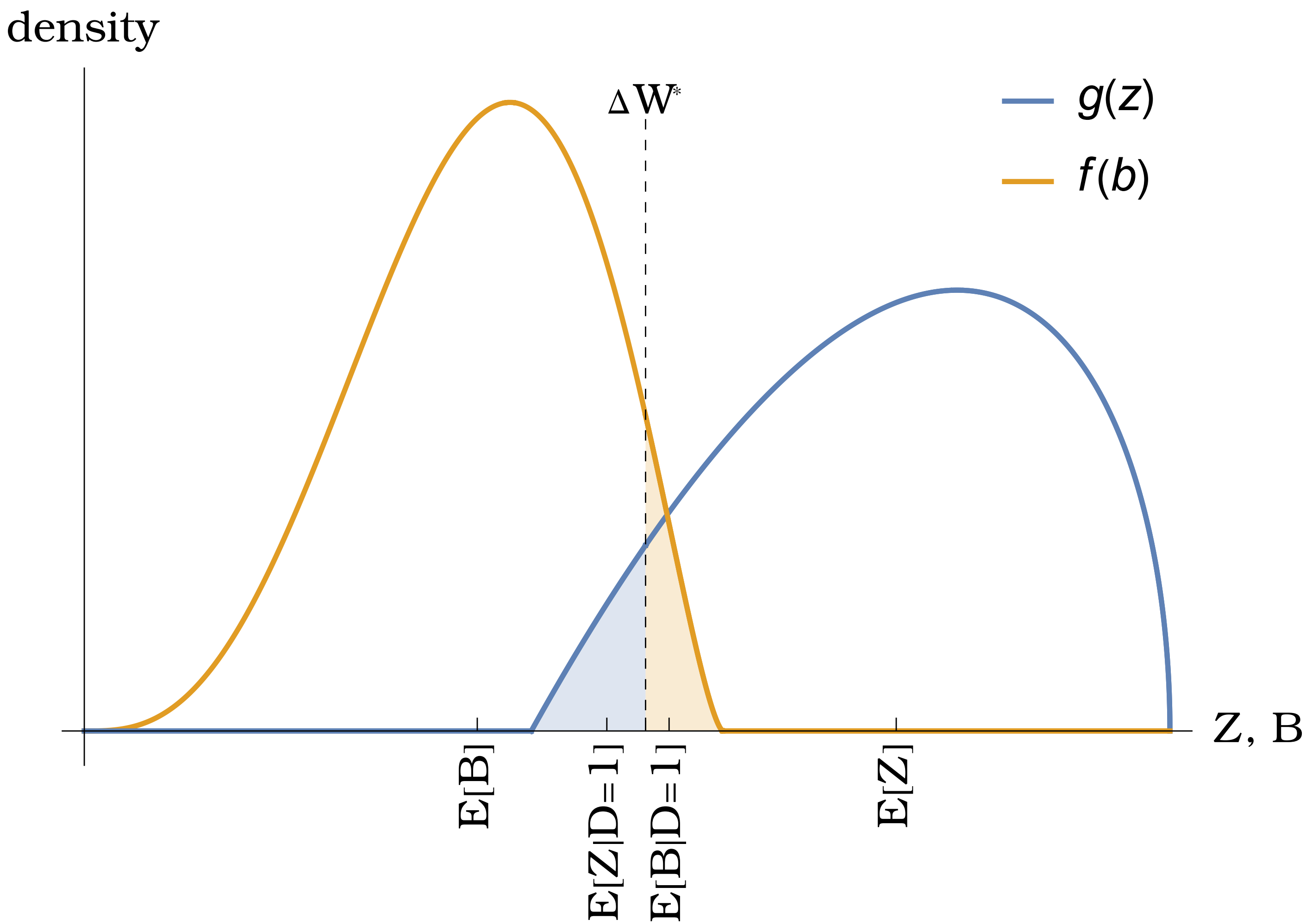
i.e., workers who prefer the wage premium ΔW to the lack of disamenity self-select to $D = 1$

		Firms	
		$B < \Delta W$	$B \geq \Delta W$
Workers	$Z \leq \Delta W$		$w_0 + \Delta W$, $D = 1$
	$Z > \Delta W$	w_0, $D = 0$	

There is a real cost of providing a job without the disamenity

Equilibrium spending in disamenity reduction is socially optimal

Rosen (1986) model with two job types



When the share of disamenity jobs is small the marginal worker may have extreme tastes. Some people quite like the night shift

Compensating wage differentials: Hours

If hours are not observed they can get lumped in with disamenities

- Inasmuch as a job has long hours for technological reasons (e.g., person-level fixed costs) this is correct
- Unobserved variation in hours driven by worker tastes (leisure vs consumption) shows up as compensating differentials; this is selection bias

Compensating differentials: Classic frameworks

Rosen's (1986) model with two job types is a stepping stone to Rosen's (1974) hedonic pricing model, where suppliers have cost functions over a continuum of qualities $\rightarrow$ offer curves

Hedonic pricing models combine heterogeneous buyer tastes for qualities and heterogeneous supplier costs in producing the qualities. Popular in urban economics (housing market).

Roback (1982) Location amenities
Housing ("land") scarce in each location,
firms and workers choose where to locate

Summers (1989) Value of mandated benefits

Sorkin (2018) Ranking firms

LEED panel based Firm FEs capture both firm productivity (+) and firm desirability as employer (-). How important are these?

Job amenities and their values not directly observed

Modeling idea: Voluntary EE worker moves to lower pay reflect firm-level amenities

Technical idea: “Ranking firms by revealed preference”
Graph theory applied to the flows of job switchers between firms

Finds 70% of variance in firm FE due to compensating differentials

Sorkin (2018) Ranking firms

Data: LEHD 2000/4-2008/1

UI-based panel covers 27 US states

400k large-enough firms (that's 160 billion directed pairs)

Plenty of higher-to-lower pay EE job switching

37% of movers take a pay cut

52% of moves to firm with lower FE come with a pay cut

How to tell apart amenity-induced "endogenous" job switching?

Switching out of a growing firm interpreted as not laid off

Switching to higher wage growth job can be observed

Sorkin (2018) Ranking firms

Attractive firms are those that attract workers from attractive firms...

Number of EE-movers at firm k that came from firm j: M_{kj}

The relative choice probability over any firm pair j, k is

$$\frac{M_{kj}}{M_{jk}} = \frac{p_k}{p_j}$$

How to infer $\mathbf{p}$? No direct moves between most j, k pairs.

Sorkin (2018) ranks firms by their eigenvector centrality in the worker flow network

Classic method for measuring the influence of nodes in a network

Famous application: PageRank (WWW pages and hyperlinks)

Intuition from the random surfer parable by Page and Brin (1998)

Graph theory interlude: Eigenvector centrality

Firms are nodes, worker flows define a directed weighted graph where M_{kj} is the weight of the edge from j to k

Define the $(n \times n)$ probability transition matrix $\mathbf{T} = \text{diag}(\mathbf{M1})^{-1}\mathbf{M}$

Define $\mathbf{p}$ as the steady state distribution of workers in the "random job switcher" parable. Then...

$$\mathbf{Tp} = \mathbf{p} \iff (\mathbf{T} - \mathbf{I})\mathbf{p} = \mathbf{0}$$

so $\mathbf{p}$ is proportional to the dominant eigenvector of $\mathbf{T}$

If $\mathbf{T}$ irreducible then $\mathbf{p}' = \frac{1}{n} \lim_{t\to\infty} \mathbf{1}'\mathbf{T}^t$

Irreducible $\mathbf{T}$ means no subsets of firms where the surfer gets stuck
Much less restrictive than "all firms pairwise connected" $\mathbf{T} + \mathbf{T}' > \mathbf{0}$

Worker flow network: 3-firm example

Job switcher matrix $\mathbf{M}$, ones vector $\mathbf{1} = [1\ 1\ 1]'$

$$\mathbf{M} = \begin{bmatrix} 0 & 2 & 3 \\ 0 & 0 & 2 \\ 6 & 2 & 0 \end{bmatrix} \implies \text{diag}(\mathbf{M1})^{-1} = \begin{bmatrix} \frac{1}{5} & 0 & 0 \\ 0 & \frac{1}{2} & 0 \\ 0 & 0 & \frac{1}{8} \end{bmatrix}$$

For example, the number of movers from firm 3 to 2 was $M_{23} = 2$

Normalizing $\mathbf{M}$ by the row sums (outflows) yields transition matrix

$$\mathbf{T} = \begin{bmatrix} 0 & \frac{2}{5} & \frac{3}{5} \\ 0 & 0 & 1 \\ \frac{3}{4} & \frac{1}{4} & 0 \end{bmatrix}$$

Now $\mathbf{p}' = \lim_{t \to \infty} \frac{1}{3}\mathbf{1}'\mathbf{T}^t \approx \frac{1}{3}\mathbf{1}'\mathbf{T}^{100} = [0.33\ 0.24\ 0.43]$

Worker flow network: 3-firm example

What does it mean for a firm to be attractive?

Notice $\mathbf{p}$ is distinct from inflow shares [0.4 0.27 0.33]

Suppose the random job switcher starts at, say, firm 1

The initial probability vector for the switcher is then $\mathbf{e_1} = [1\ 0\ 0]'$

After the first random switch it is

$$\mathbf{e_1'T} = \begin{bmatrix} 0 & 0.4 & 0.6 \end{bmatrix}$$

After two random switches it is

$$\begin{bmatrix} 0 & 0.4 & 0.6 \end{bmatrix} \mathbf{T} = \mathbf{e_1'T}^2 = \begin{bmatrix} 0.45 & 0.15 & 0.4 \end{bmatrix}$$

After three rounds, $\mathbf{e_1'T}^3 \approx [0.3\ 0.28\ 0.42] \ldots$etc

This converges to $\mathbf{p}'$ from any starting firm when $\mathbf{T}$ irreducible

Sorkin (2018) Ranking firms

Strongly connected set of the firms in the job switcher data retained. This amounts to making the transition matrix irreducible.

Procedure to yank endogenous worker flows out of observed flows.
- Sector-specific job reallocation and destruction rates to rationalize observed flows
- Firm size adjustment: multiplier from firm offer intensity, which inferred from ENE movers (assumed to accept the first offer)

Raw **p** transformed to Firm amenity values via conditional logit (extreme value distributed error term)

Sorkin (2018) Ranking firms

TABLE I

SUMMARY STATISTICS AND THE VARIANCE OF EARNINGS

	All (1)	$\geqslant$15 people-years (per year) (2)	Strongly connected by EE (3)	Strongly connected by EE (restrictions) (4)
Sample size				
People-years	504,945,000	411,088,000	409,550,000	408,961,000
People	105,921,000	91,142,000	90,895,000	90,803,000
Employers	6,155,000	484,000	476,000	472,000
Summary statistics				
Mean log earnings	10.43	10.48	10.48	10.48
Variance of log earnings	0.70	0.67	0.67	0.67
Ensemble decomposition				
Employers			0.21	
People			0.57	
Xb			0.11	

Var(earnings) = Cov(employer FE,earnings) + Cov(person FE,earnings) + Cov(covariates,earnings) + (residual variance)

Sorkin (2018) Ranking firms

TABLE II

EARNINGS DECLINES, VALUE CHANGES, AND FIRM-LEVEL PAY

	All	EE	ENE
Panel A: $\Pr(y\downarrow)$			
Unconditional	0.429	0.374	0.469
Unconditional (nominal)	0.402	0.343	0.445
When moving to a			
. . . higher-paying firm	0.297	0.268	0.321
. . . lower-paying firm	0.578	0.515	0.618
Panel B: $\Pr(\Psi\uparrow)$			
Unconditional	0.530	0.570	0.501

Earnings y, Firm FEs Ψ

Sorkin (2018) Ranking firms

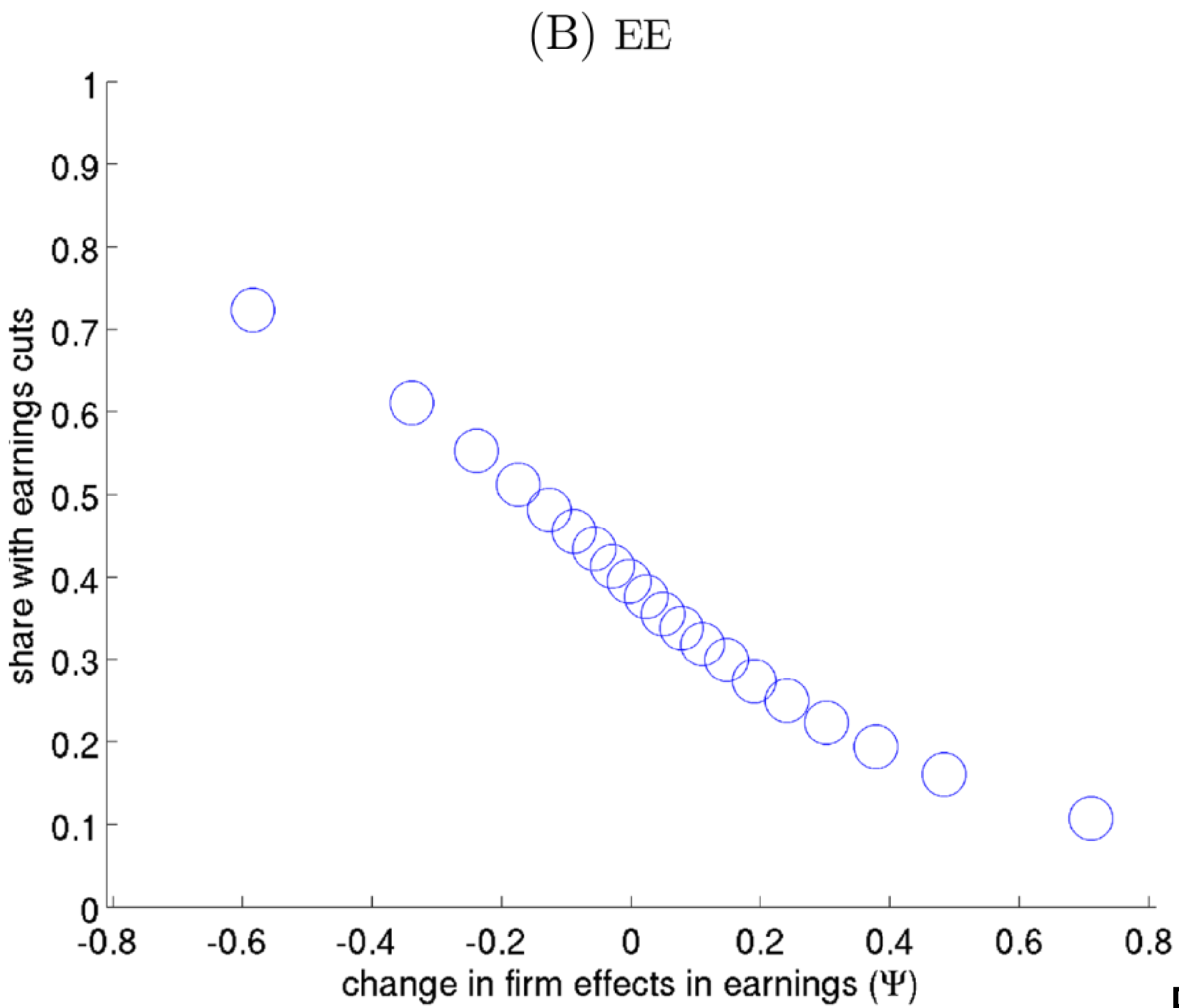


Figure 1B

Sorkin (2018) Ranking firms

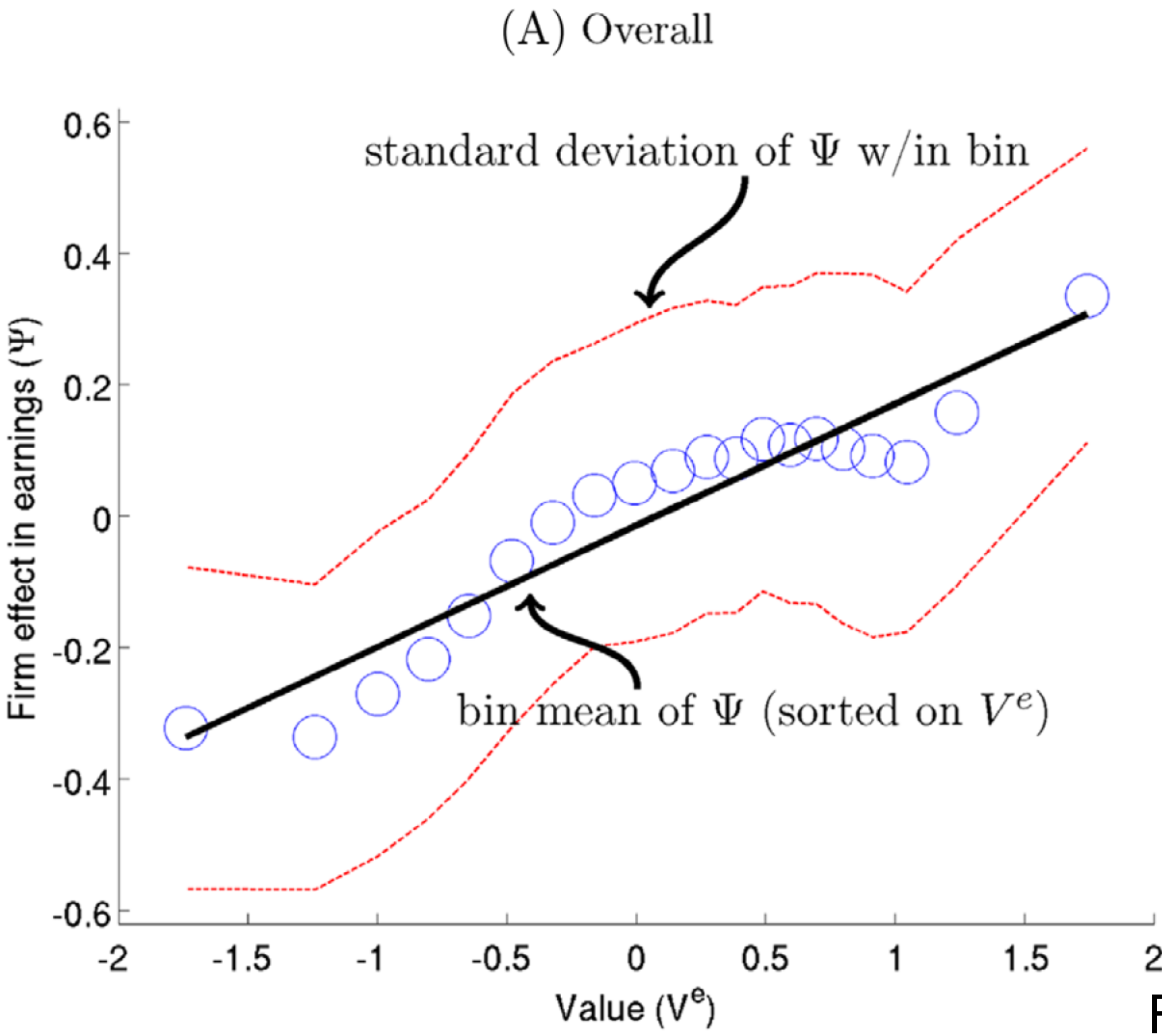


Figure 5A

Sorkin (2018) Ranking firms

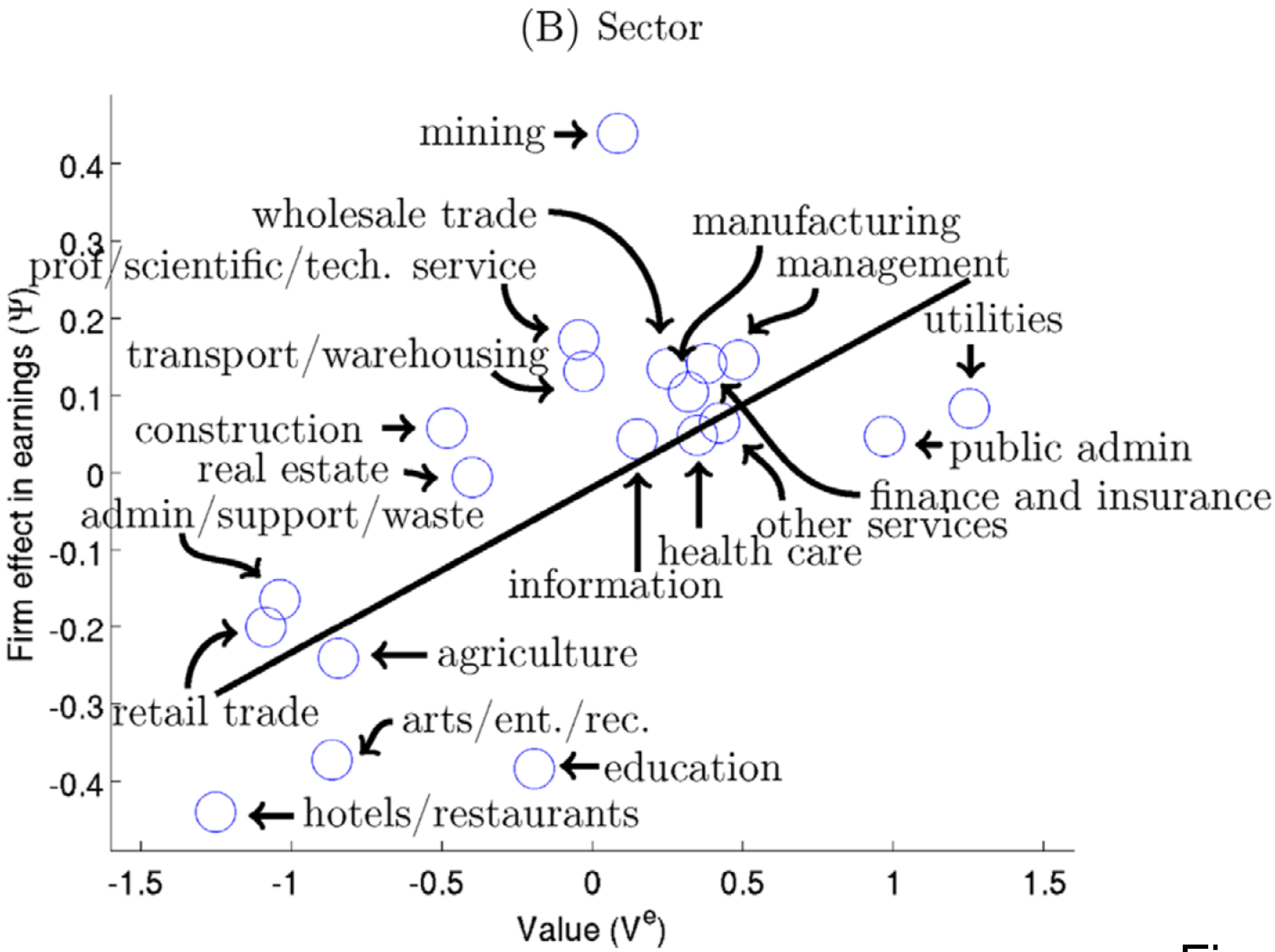


Figure 5B

Sorkin (2018) Ranking firms

Robustness

- Worker-level hours not observed. At sector-level, variation in hours explains 15% of compensating differentials.
- Expected earnings growth as the pull factor can be ruled out
- Results stable when restricting to subsets (gender, region, age)

PSA: A bunch of pairwise connections would *not* be a network.
In a network, the structure of higher-degree connections matter.

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Historical interest

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