Self-Selection: Major, Occupation, Migration

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Roadmap

1. Introduction

2. Migration

3. Occupation (The Roy Model)

4. Major

Recall A *Simple* Version of The Education Model

- Suppose that individuals are distinguished by ability, z_i
  - Drop the subscript i hereafter to be concise
- Individuals decide whether to obtain education, which costs c
- Wage of an individual:
  - No education: $w_0(z) = z$
  - Education: $w_1(z) = \alpha_0 + \alpha_1 z$, with $\alpha_0 < c$
  - $\alpha_0 > 0$: return from education, irrespective of ability
  - $\alpha_1 > 1$: returns from education by magnifying ability
- Individuals make their schooling choices to maximize wage
- $\Rightarrow$ All individuals with $z \geq z^* \equiv \frac{c-\alpha_0}{\alpha_1 - 1}$ will obtain education
  - For those with z^*, two choices are indifferent: $z^* = \alpha_0 + \alpha_1 z^* - c$
- $\Rightarrow$ High-ability individuals are (positively) self-selected into education
  - Note if $\alpha_0 > c$ and $\alpha_1 < 1$, we can have negative selection

Illustration

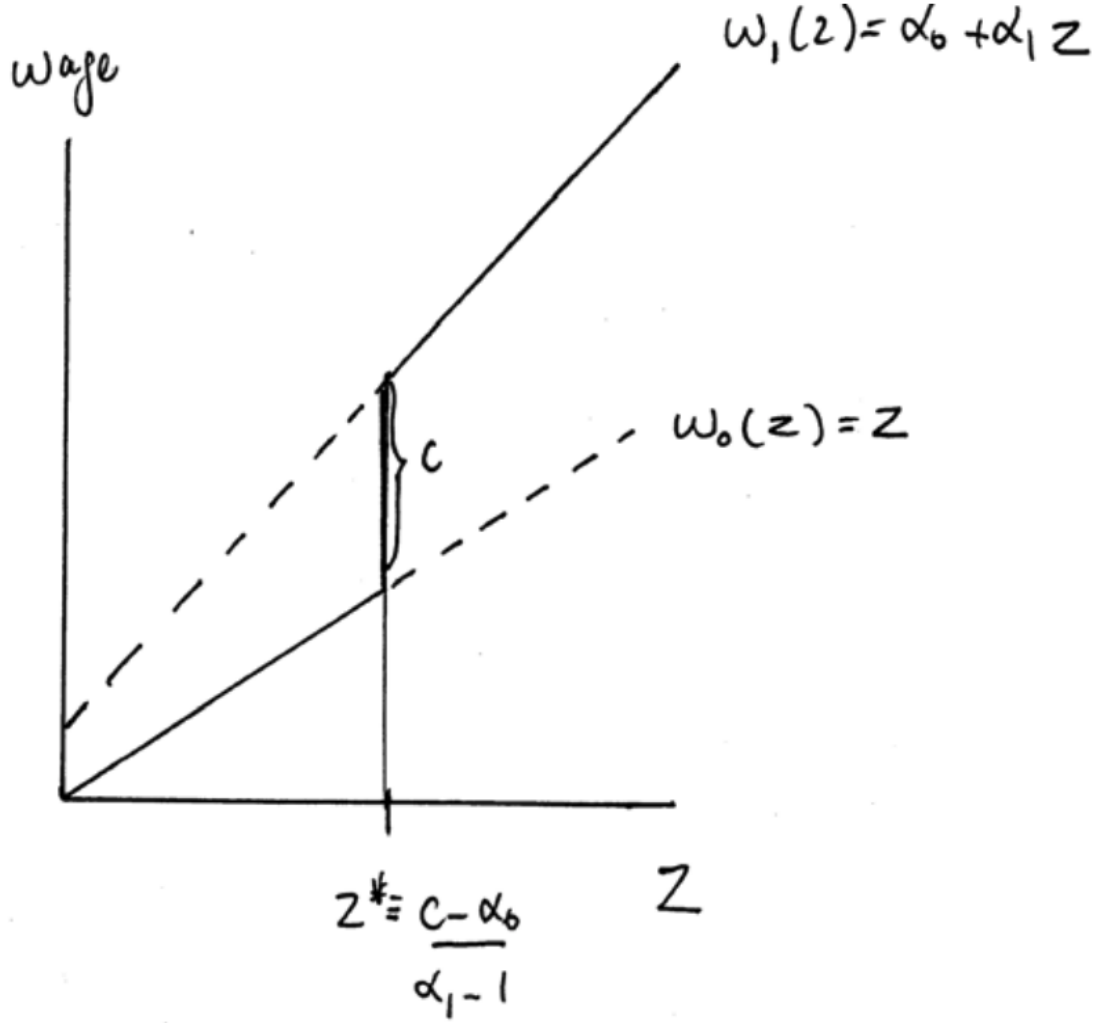

FIGURE 1.7. Selection in the One-Factor Model.

(You can also see why self-selection generates selection bias here: a simple comparison between those w/ and those w/o education is not comparing apple with apple!)

Generalization

- Above simple model: only one ability, two options, and two corresponding wage functions
- Now think about, say, majors
  - Each major is an option
  - Each major has its own skills/abilities
  - Each major has its own skill price (wage) on the labor market
- $\Rightarrow$ Multi-dimensional human capital/ability (z_m)
- $\Rightarrow$ Major-specific skill returns (w_m)
- Yet, the self-selection is the same: $\max_m \{z_1 w_1, z_2 w_2, \ldots, z_M w_M\}$
  - More generally, $\max_m \{w_1(z_1), w_2(z_2), \ldots, w_M(z_M)\}$ or $\max_m \{w_1(\mathbf{z}), w_2(\mathbf{z}), \ldots, w_M(\mathbf{z})\}$
  - Option-specific costs are abstracted for brevity
  - Often say based on "comparative advantage" *(a rather ad-hoc term)*

Application of the Roy Framework

- It's call Roy model b.c. Roy (1951) gave the first narrative description of a framework of this kind (hunting vs. fishing)
- Roy's general framework has been applied to a variety of labor market settings, including
  - choice of schooling (Willis and Rosen, 1979)
  - major and occupation choice (Kirkeboen et al., 2016)
  - choice of industry (Heckman and Sedlacek, 1990)
  - female labor force participation (Heckman, 1974)
  - internal and international migration (Borjas, 1987)
  - training program participation (Ham and LaLonde, 1996)
  - ...
- In each application, the researchers replace the choice of "occupation" in Roy's original paper with a parallel choice to enter
  - Core: observed economic relationships should generally be viewed as endogenous outcomes of numerous optimizing decisions
  - *(Can even combine two or more into a dynamic setting)*

The Nobel Price for Self-Selection (Intro for the Public)

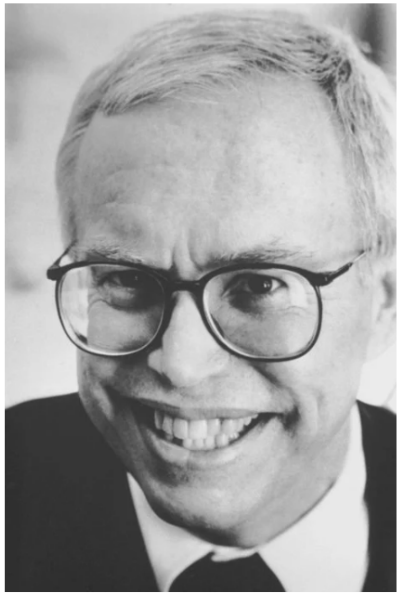

Photo from the Nobel Foundation archive.

James J. Heckman

Prize share: 1/2

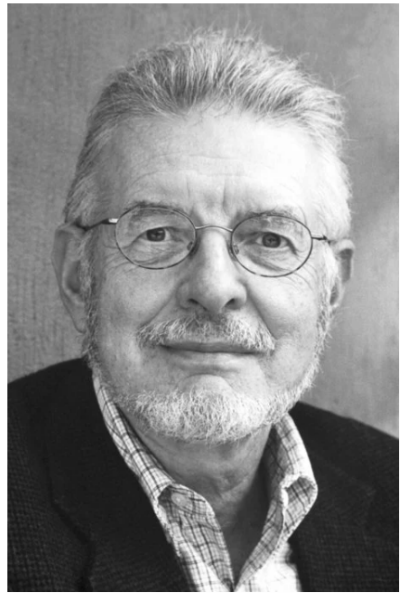

Photo from the Nobel Foundation archive.

Daniel L. McFadden

Prize share: 1/2

The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2000 was divided equally between James J. Heckman "for his development of theory and methods for analyzing selective samples" and Daniel L. McFadden "for his development of theory and methods for analyzing discrete choice"

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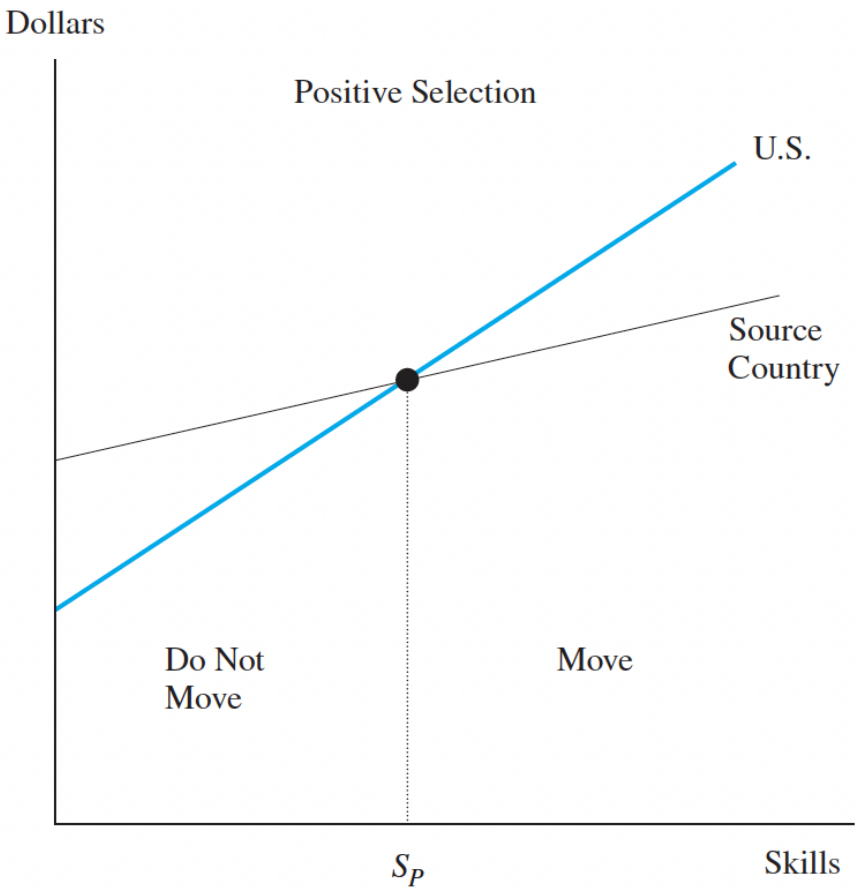
Who Would Migrate?

- Consider immigrants migrating from home country (say, India, China, or other Asian countries) to US (or Japan)
- Where would these immigrants locate in their home country's skill distribution?
- Borjas (1987) formalized the Roy framework and applied it to migration
- Tradeoff: income in home country vs. income in US - migration cost
- *(Of course, in practice, immigration policies, purchasing power, and idiosyncratic preference all matter a lot! In fact, they are often included in more advanced models!)*

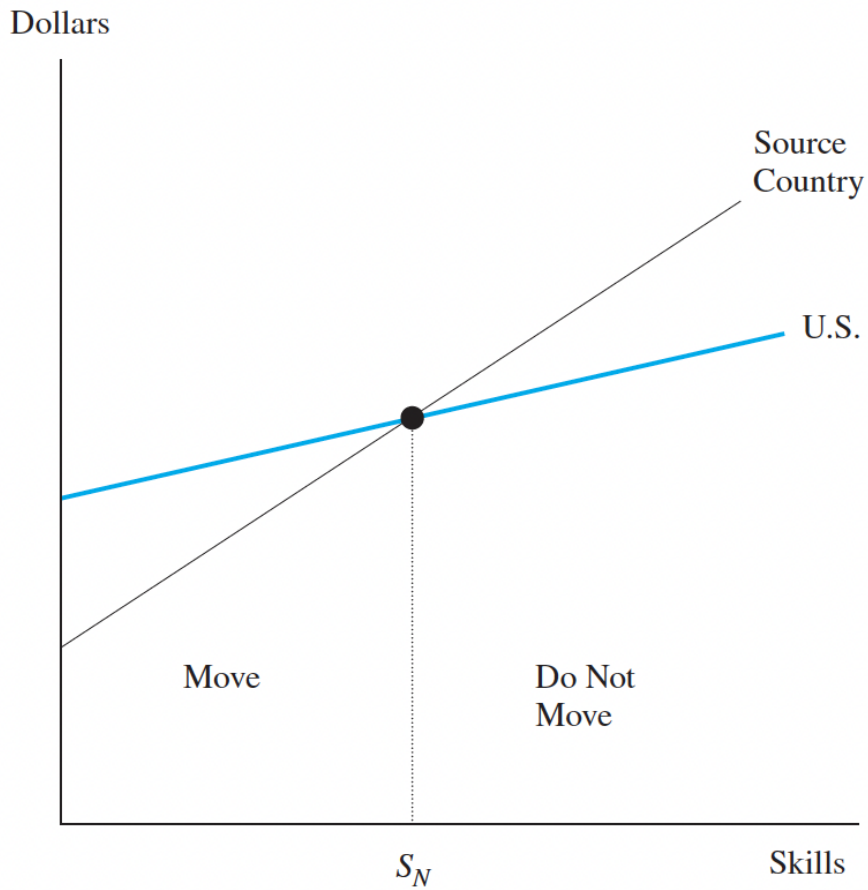
Self-Selection of Immigration

FIGURE 8-4 The Self-Selection of Immigrants

(*a*) If the return to skills is higher in the United States than in the source country (so that the wage–skills line is steeper in the United States), the immigrant flow is positively selected. Workers with more than s_P efficiency units find it profitable to move. (*b*) If the return to skills is lower in the United States, the immigrant flow is negatively selected. Workers with fewer than s_N efficiency units emigrate.



(*a*) Positive Selection



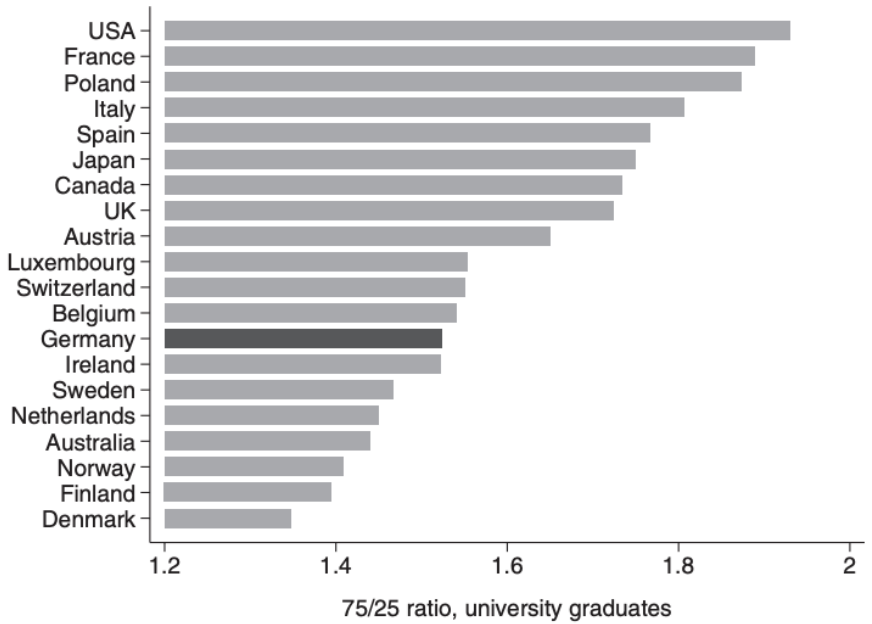
(*b*) Negative Selection

(Relative payoff for skills across countries determines what skill-type workers migrate)

Migration Destinations of German College Graduates

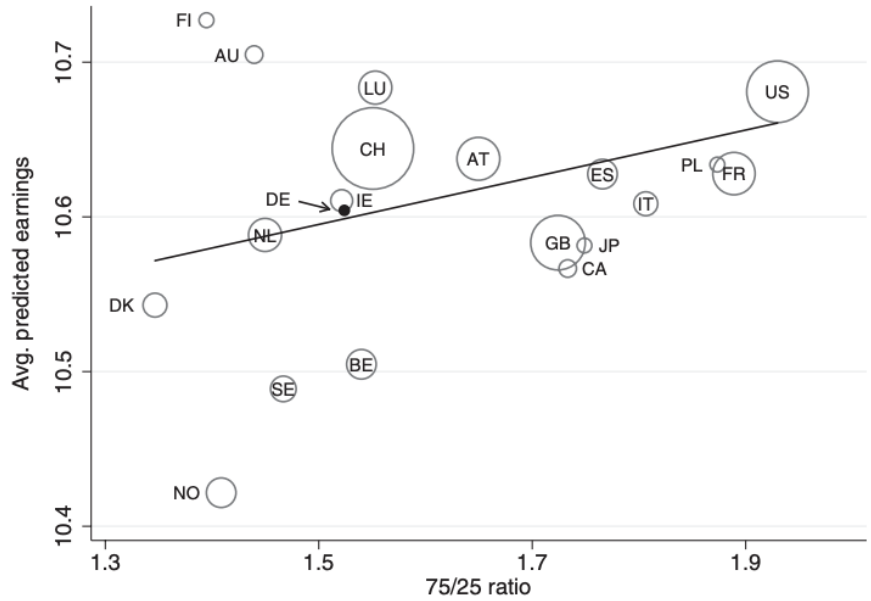
Parey et al. (2017)

FIGURE 1.—EARNINGS INEQUALITY AMONG THE HIGH SKILLED: RATIO OF 75TH TO 25TH PERCENTILE IN THE EARNINGS DISTRIBUTION OF UNIVERSITY GRADUATES



The figure shows the ratio of the 75th to the 25th percentile in the earnings distribution of university graduates. Authors' calculations based on country-specific earnings surveys (see online appendix table A.3), showing averages over the period 1998 to 2010. Details on data sources and the construction of inequality measures are reported in section IIIB and data appendix B.1.

FIGURE 3.—PREDICTED EARNINGS AND INEQUALITY ACROSS DESTINATIONS



The figure shows average predicted earnings for migrants to each country and the corresponding 75:25 inequality ratio. Circle sizes are proportional to the number of migrants in each destination. The regression line reported in the figure is estimated in a weighted regression with weights equal to the number of migrants in each country. The slope coefficient is equal to 0.153 with a standard error of 0.081. An unweighted regression has a slope equal to 0.103 with a standard error of 0.101. For country labels, see data appendix table B.2.

(Predicted earnings is constructed through a Mincer regression with a rich set of personal characteristics; Credit constraints and other migration barriers are unlikely to be binding)

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The Roy Model

- Each agents possesses two skills (S_1, S_2) with associated skill prices p_1 and p_2 (taken as given)
- Assume skill 1(2) is useful only in occupation/sector 1(2): earnings are $W_1 = p_1 S_1 + 0 S_2$, $W_2 = 0 S_1 + p_2 S_2$
- An agent chooses occupation one ($o = 1$) if her potential earnings are greater there, i.e., $p_1 S_1 > p_2 S_2$
- Assume the population join distribution of skills is $F(S_1, S_2)$
  - E.g. S_1 and S_2 are log normal with μ_1, μ_2, σ_1^2, σ_2^2 , and $\sigma_{12} = \rho\sigma_1\sigma_2$
- What will $F(S_1|o = 1)$ and $F(S_2|o = 2)$ look like?
  - Do the people who work in 1 or 2 have highest skills 1 or 2 in the population?
- What will $F(W_1|o = 1)$ and $F(W_2|o = 2)$ look like?
- Here, we show a graphical treatment (Sattinger, 1993, sec 3.C)

Positive Correlated Skills in Population ($\rho_{12} > 0$)

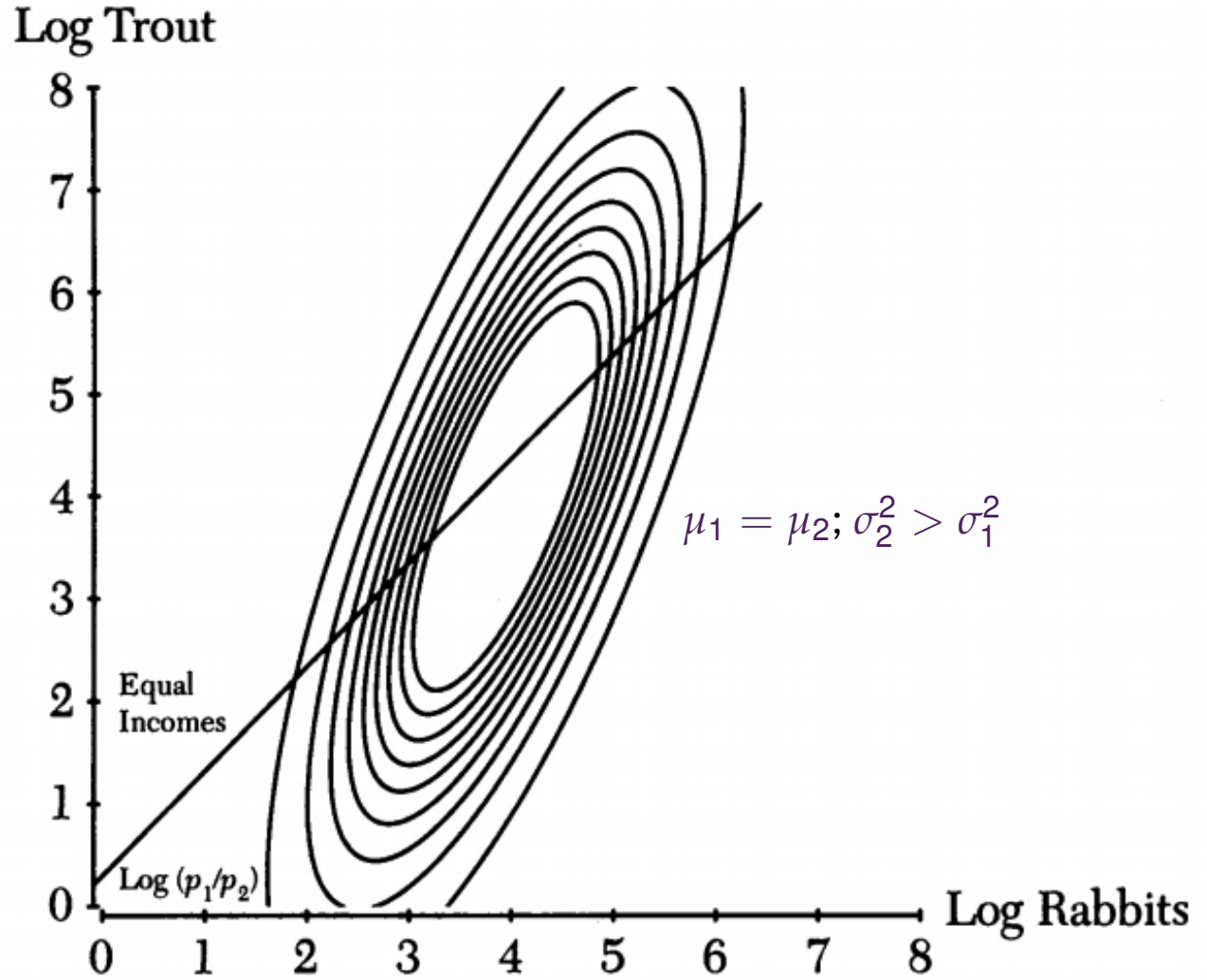


Figure 1. Contour Plot of Density of Sector Performances

(A certain contour line indicates combinations of (S_1, S_2) with same density)

(The 45° line: $p_2 S_2 > p_1 S_1 \Rightarrow S_2 > (p_1/p_2) S_1 \Rightarrow \log(S_2) > log(p_1/p_2) + log(S_1)$)

$F(S_1|o=1)$ and $F(S_2|o=2)$

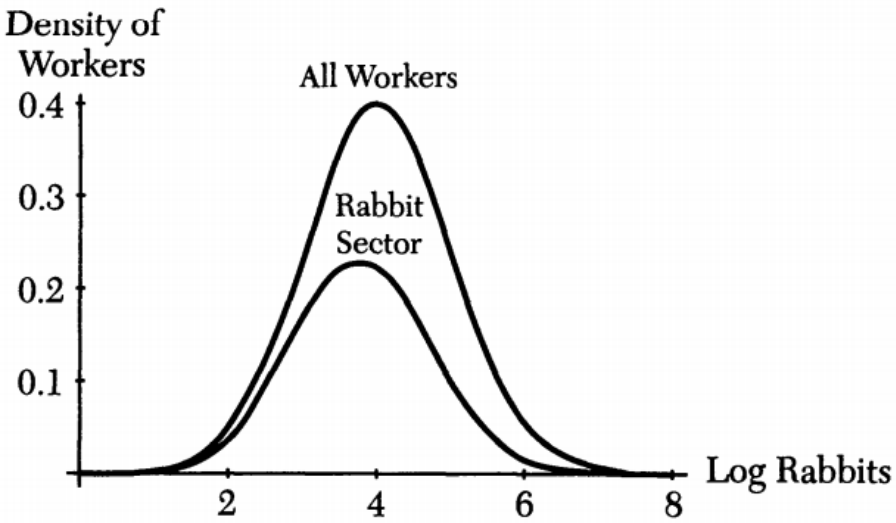


Figure 3. Rabbit Hunting Abilities Among All Workers and Among Rabbit Hunters

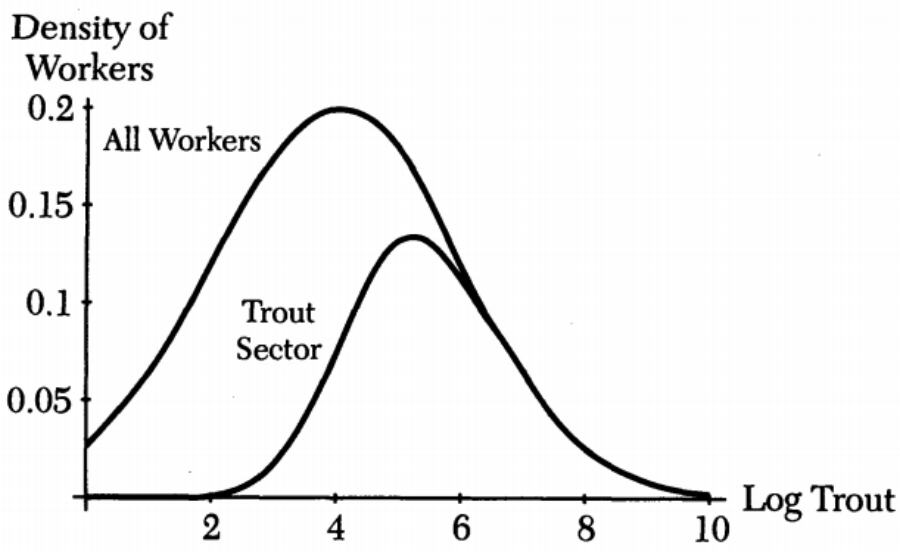


Figure 4. Trout Fishing Abilities Among All Workers and Among Trout Fishers

(While agents who choose trout fishing are best fishers in general, agents who select rabbit hunting are not best hunters in population, but with "comparative advantages" on hunting)

(What will happen if negative correlated skills in population?)

$F(W_1|o=1)$ and $F(W_2|o=2)$

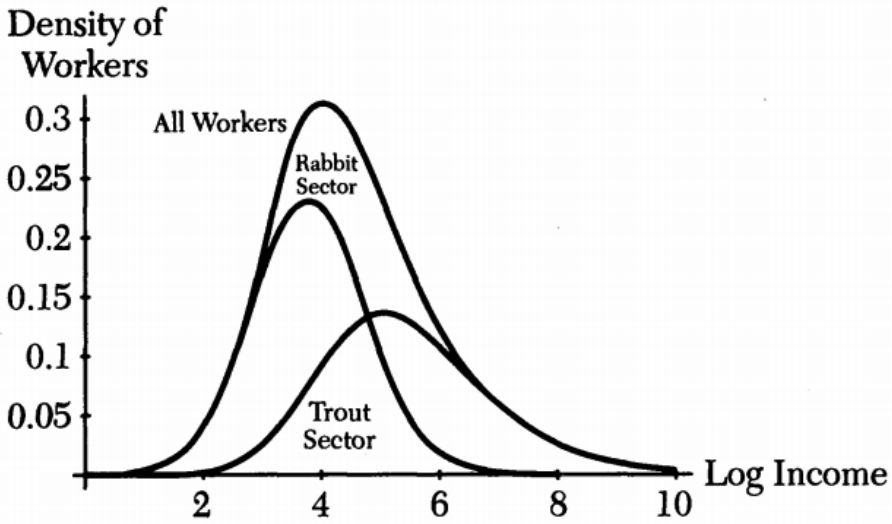


Figure 5. Aggregate and Sectoral Distributions of Income

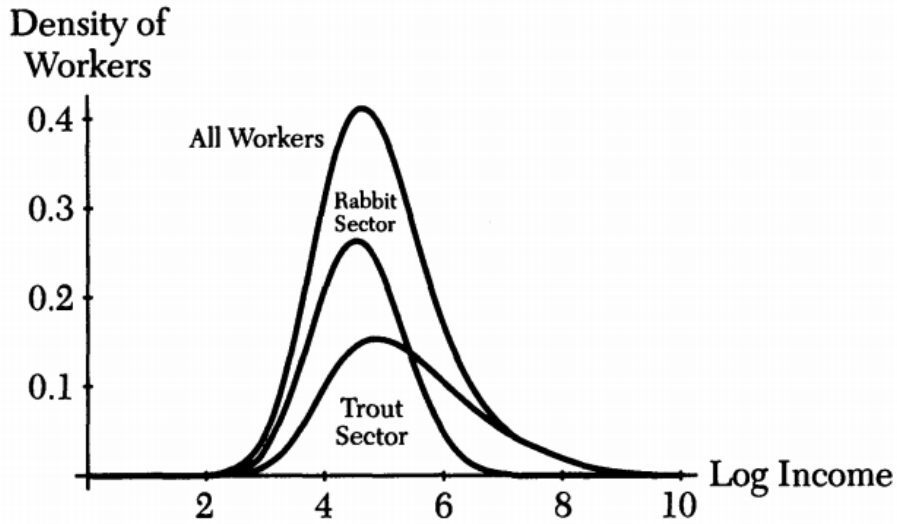


Figure 6. Aggregate and Sectoral Distributions of Income, Case ii with $\rho_{12} < 0$

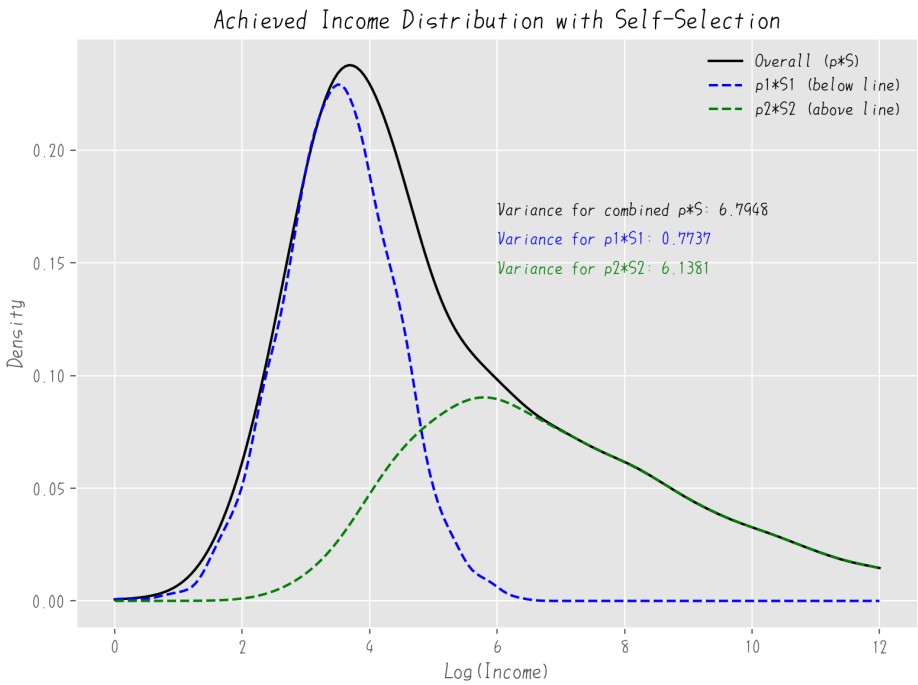
Positively correlated skills: more disparity

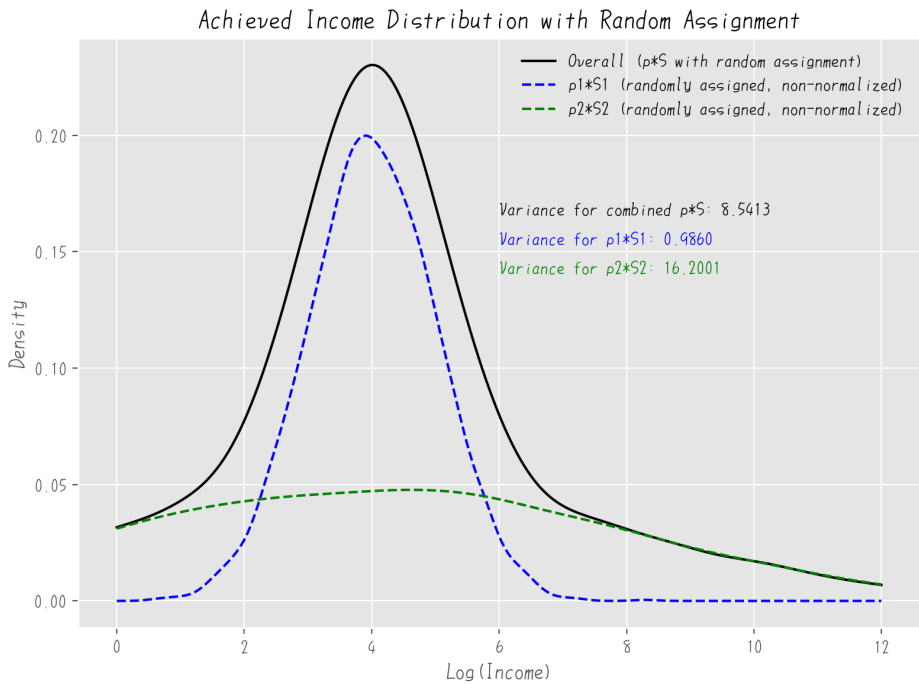
Negatively correlated skills: less disparity

(In both cases, upper tail is dominated by workers in the high variance sector, and vice versa)

Self-Selection vs. Random Assignment

(Play the model by yourself through this notebook)





(Heckman and Honore (1990) prove that, under log normal, the pursuit of comparative advantage reduces both within and overall earnings inequality compared to the case of random assignments; and aggregate log earnings distributions are right skewed)

Positive Correlated Skills + An Increase in p_2

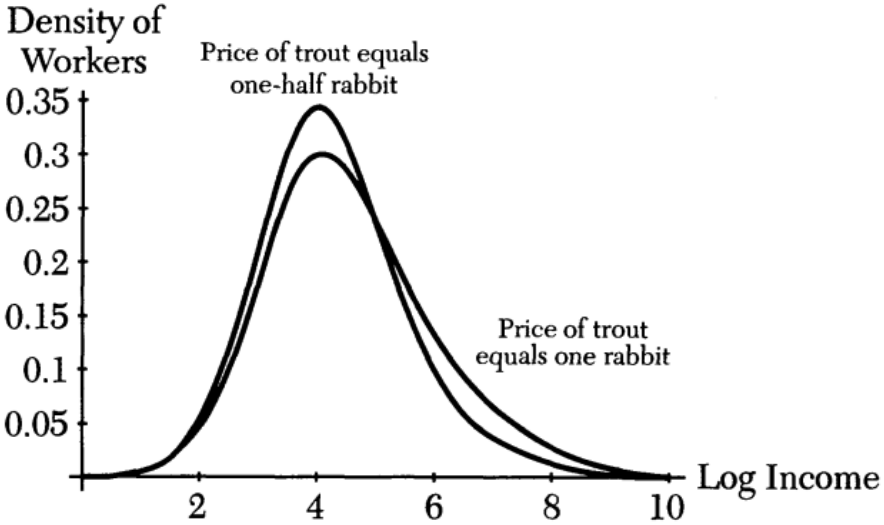


Figure 8. Shift in Earnings Distribution from Change in Price of Trout

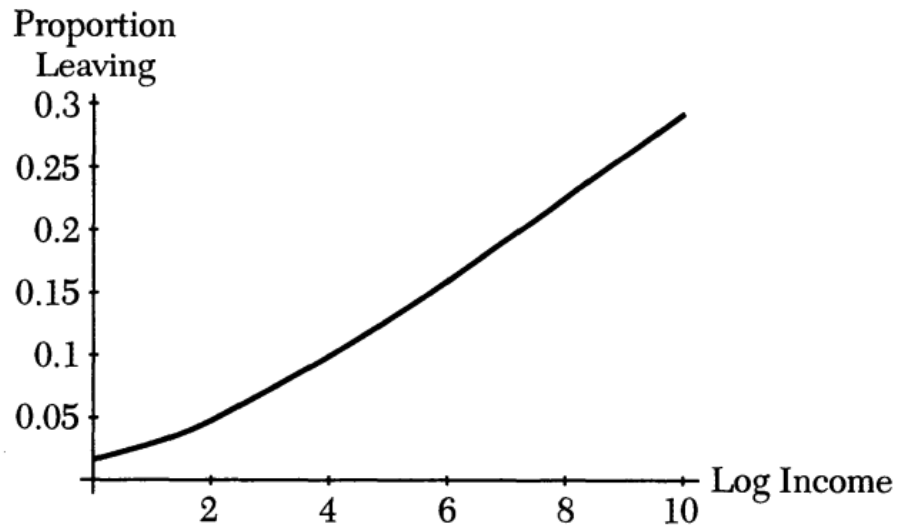


Figure 9. Proportions of Workers Leaving Rabbit Sector

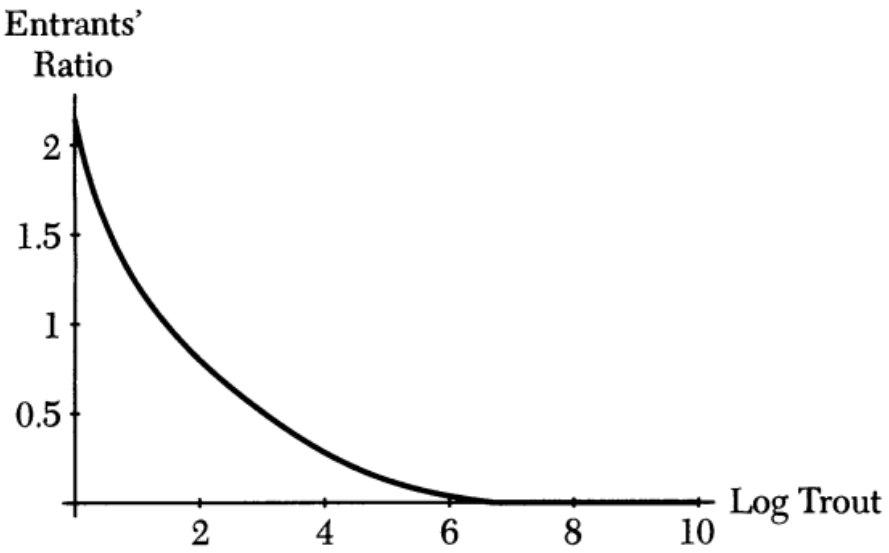


Figure 10. Ratios of New Entrants to Current Trout Fishers

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Return to Major/Fields of Study

- Estimating return to majors is again subject to the problems of selection based on unobservables (and unordered choices)
- Kirkeboen et al. (2016) leverages the centralized admission system in Norway: unpredictable admission cutoffs for different fields as IV
- Their findings:
  - Widely different payoffs across fields, rivaling college wage premium
  - Field of study matters more than rank of institution
  - Individuals choosing fields based on comparative advantage

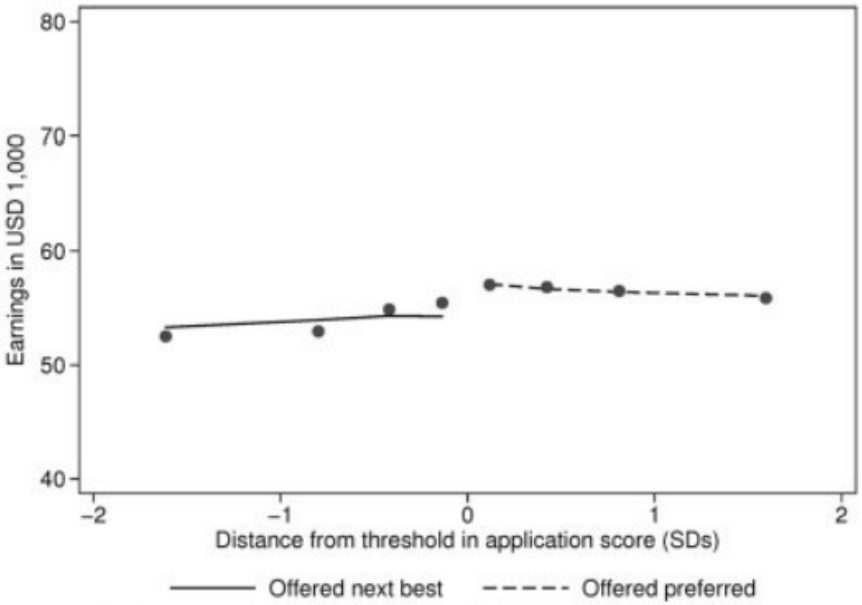
Admission Cutoffs

TABLE I

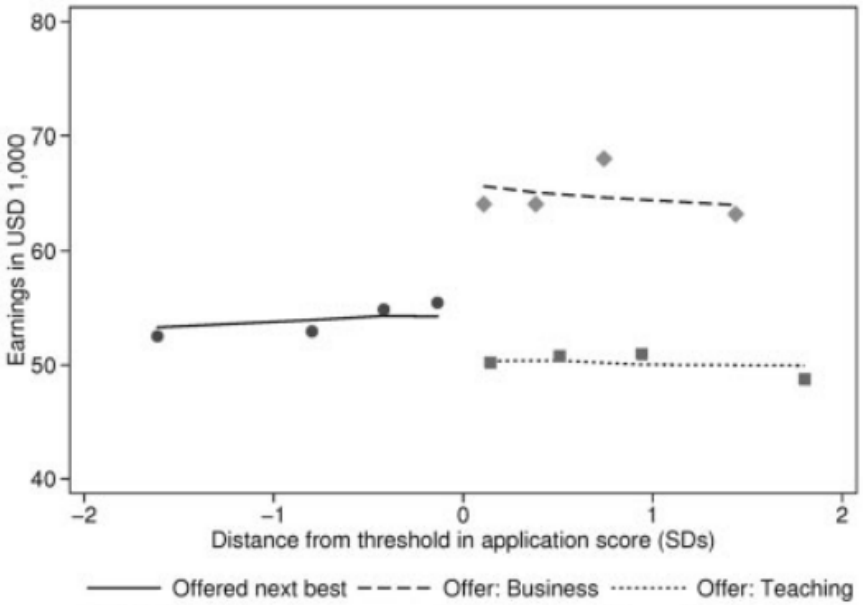
ILLUSTRATION OF IDENTIFICATION OF PAYOFFS

Course Ranking	Inst.	Field	Cutoff
Panel A: Fields			
1st best	A	1	57
2nd best	B	1	52
3rd best	A	2	48
4th best	A	3	45
	Application score = 49		
Local Course Ranking			
Preferred	A	2	Yes
Next-best	A	3	No
	Application score = 47		
Local Course Ranking			
Preferred	A	2	No
Next-best	A	3	Yes

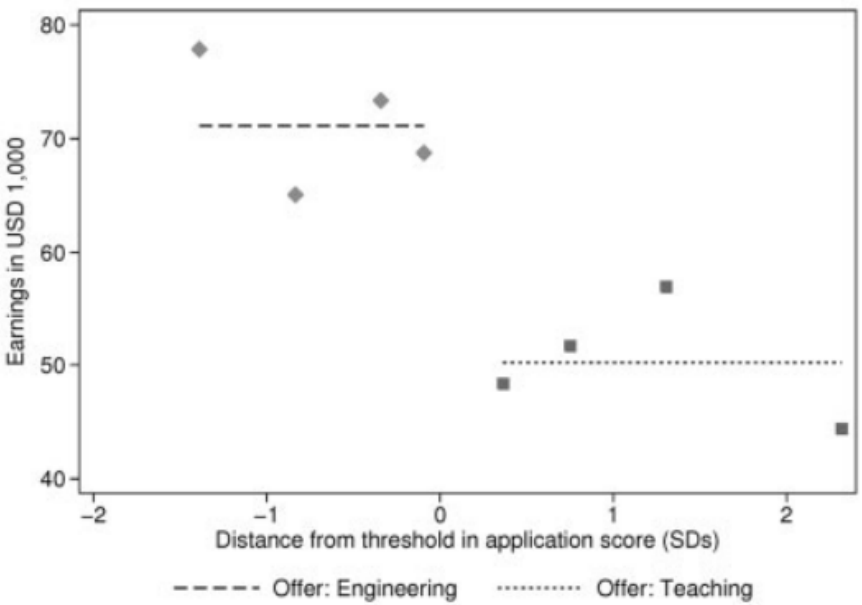
Average Earning around Admission Cutoffs



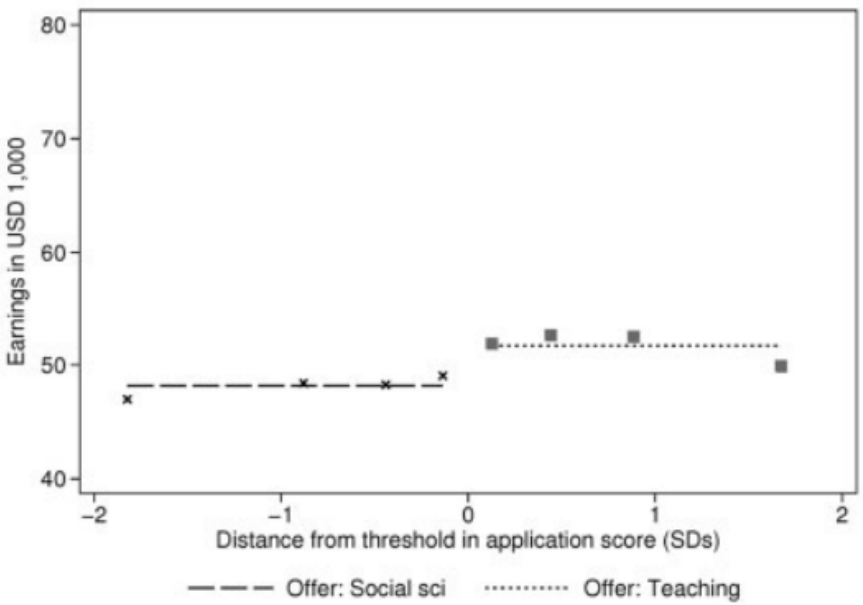
(a) Offered preferred (pooled) vs. next-best (pooled)



(b) Offered business or teaching vs. next-best (pooled)



(c) Offered Teaching vs. next-best Engineering



(d) Offered Teaching vs. next-best Social Science

Distribution of Earning Payoffs (Offer - Next-Best)

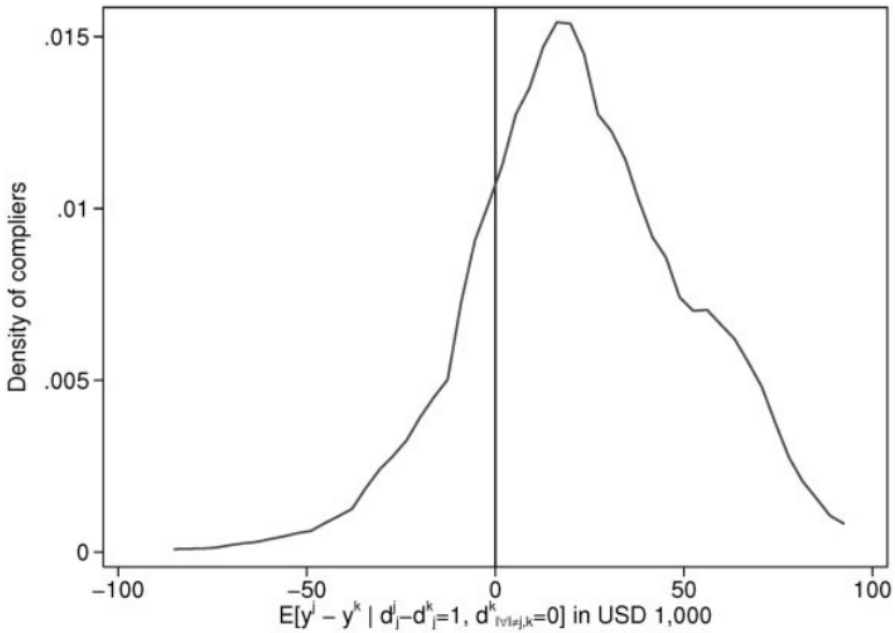


FIGURE VIII

Distribution of Estimated Payoffs ($1,000) to Field of Study

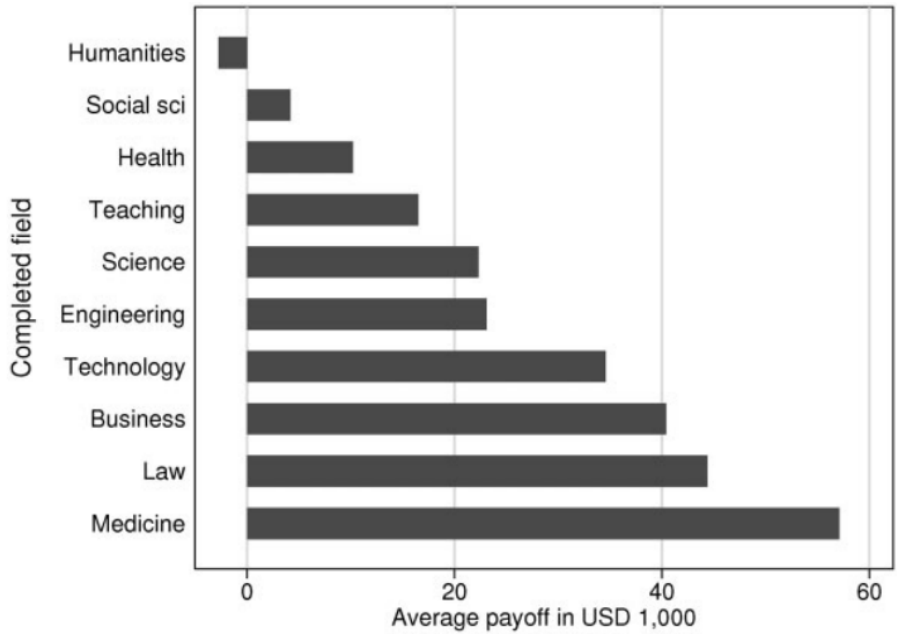


FIGURE IX

Average Estimated Payoffs ($1,000) by Completed Field

Distribution of payoffs among the compliers for every combination of preferred field and next-best alternative

Weighted averages of payoffs to different completed fields across next-best fields

Distribution of Earning Payoffs Differences (A,B vs B,A)

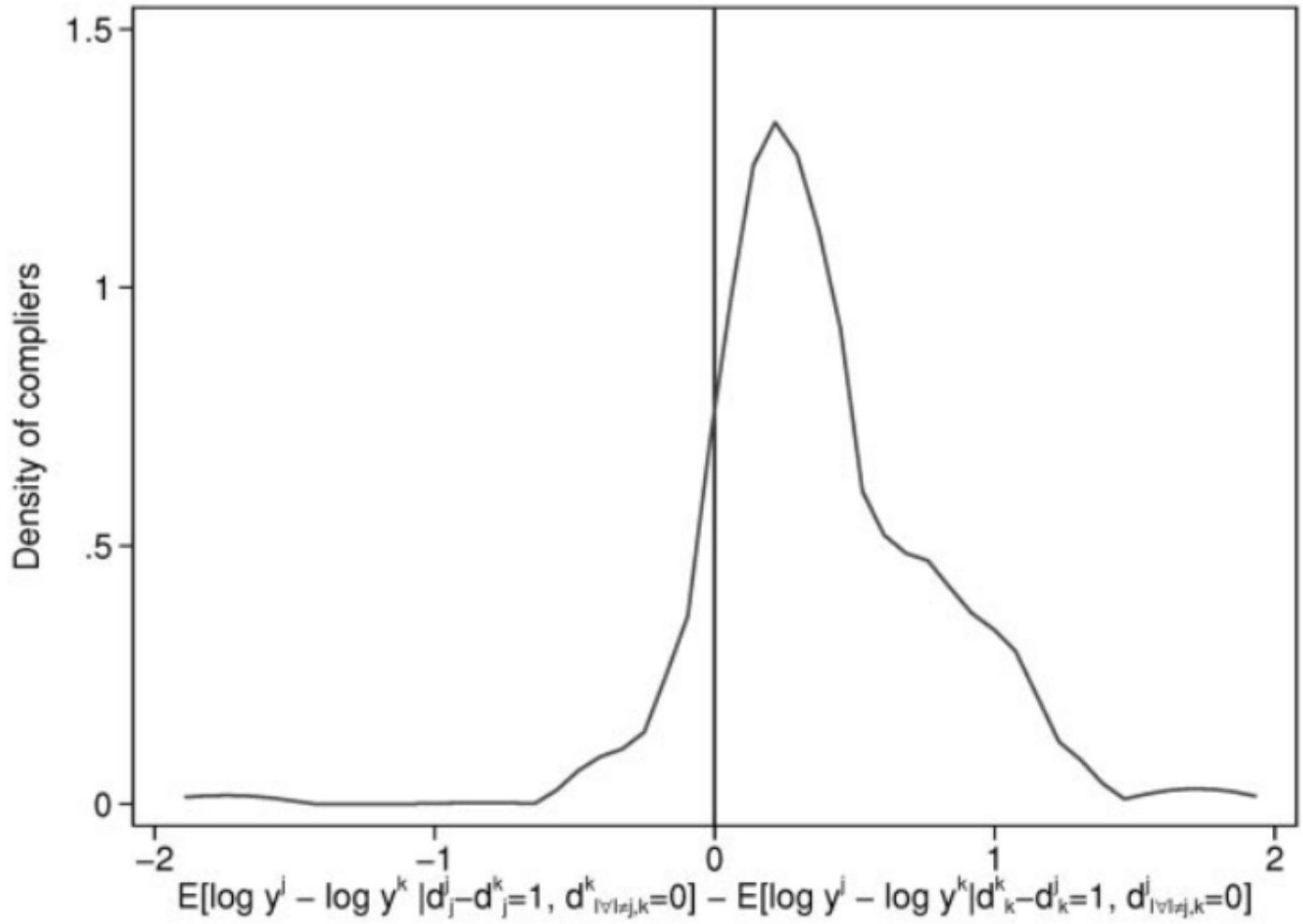


FIGURE XII

Testable Implication of Sorting Based on Comparative Advantage

(Distribution of [payoffs of A-B among those whose preferred choices are A,B - payoffs of A-B among those preferred choices are B,A])

Reference

Borjas, G. J. (1987). Self-selection and the earnings of immigrants. *American Economic Review 77*(4).

Ham, J. C. and R. J. LaLonde (1996). The effect of sample selection and initial conditions in duration models: Evidence from experimental data on training. *Econometrica: Journal of the Econometric Society*, 175–205.

Heckman, J. (1974). Shadow prices, market wages, and labor supply. *Econometrica: journal of the econometric society*, 679–694.

Heckman, J. J. and B. E. Honore (1990). The empirical content of the roy model. *Econometrica: Journal of the Econometric Society*, 1121–1149.

Heckman, J. J. and G. L. Sedlacek (1990). Self-selection and the distribution of hourly wages. *Journal of Labor Economics 8*(1, Part 2), S329–S363.

Kirkeboen, L. J., E. Leuven, and M. Mogstad (2016). Field of study, earnings, and self-selection. *The Quarterly Journal of Economics 131*(3), 1057–1111.

Parey, M., J. Ruhose, F. Waldinger, and N. Netz (2017). The selection of high-skilled emigrants. *Review of Economics and Statistics 99*(5), 776–792.

Roy, A. D. (1951). Some thoughts on the distribution of earnings. *Oxford economic papers 3*(2), 135–146.

Sattinger, M. (1993). Assignment models of the distribution of earnings. *Journal of economic literature 31*(2), 831–880.

Willis, R. J. and S. Rosen (1979). Education and self-selection. *Journal of political Economy 87*(5, Part 2), S7–S36.