Human Capital: Training

Xuanli Zhu
Keio University

Autumn, 2024

Roadmap

1. Introduction

2. Becker's Theory

3. Acemoglu and Pischke's Theory

4. Acemoglu and Pischke's Formal Model $*$

5. Recent (Puzzling) Empirical Evidence

Company Information Session for New Graduates

Japanese-style Job-Offer Ceremony (Orientation)

New-Graduates Training in Japan

Beyond Schooling

- Many workers increase their productivity by learning new skills and perfecting old ones while on the job
- On-the-job Training: apprenticeship, internship, workshop, ...
- Learning-by-doing: learning during work (e.g. Pokeman)
- Difference between OJT and LBD: if explicit investment (e.g. foregone time, training resources) is made
- Today we focus on OJT-type of training
- Key difference with education:
  - now two agents involved: worker & firm; both can invest
  - training cost and wage are determined conjointly

Questions

- Who should/would pay for training? In what ways?
- How do (i) nature of training and (ii) labor market competitions affect training decisions?

Roadmap

1. Introduction
2. Becker's Theory
3. Acemoglu and Pischke's Theory
4. Acemoglu and Pischke's Formal Model $*$
5. Recent (Puzzling) Empirical Evidence

Training as Firm's Investment

- Think training as an investment by a firm, then it pays off if $\sum_{t=0}^{T-1} \frac{R_t}{(1+r)^{t+1}} \geq \sum_{t=0}^{T-1} \frac{C_t}{(1+r)^{t+1}}$
- Return: labor's production
- Costs: direct training costs; foregone production
- Assume two periods and a certain level of training is given at $t = 0$:

$$P_0 + \frac{P_1}{(1+r)} \geq W_0 + k + \frac{W_1}{(1+r)}$$

  - $P_1 > P_0$; k is training costs
  - I.e. net gain from training: $P_0 + \frac{P_1}{(1+r)} - W_0 - k - \frac{W_1}{(1+r)} \geq 0$

- Also need to compare net gain with the payoff without training: $P_0' + \frac{P_1'}{(1+r)} - W_0' - \frac{W_1'}{(1+r)}$, with $P_0' > P_0$ and $P_1' < P_1$

General Human Capital

- In a competitive labor market, the wage rates paid by any firm are determined by (marginal) products in other firms
  - That's why we say under competitive markets, firms are "price takers," taken market prices as given
- General human capital means those skills or abilities useful in many, if not all, firms
  - E.g. English, business manner, ..., cognitive skills, social skills, ...
- General training increases general human capital
- Consider the case that the production is via (perfectly) general human capital, then $W = P$ at any time

Firm Will Not Invest in General Training

- Given the market price, firms' net gain from training:
  $P_0 + \frac{P_1}{(1+r)} - P_0 - k - \frac{P_1}{(1+r)} = -k$
- Becker thus suggests that firms would provide general training only if they did not have to pay any of the costs
- I.e. if worker accept a W_0 such that $W_0 = P_0 - k < P_0$
  - Note that saying to accept a $W_1 < P_1$ will be a cheap talk
  - Note if P_0 is very low, W_0 can be close to 0 or even negative
- Worker would find it profitable to do so when
  $P_0 + \frac{P_1}{(1+r)} - k > P_0' + \frac{P_1'}{(1+r)}$
  - More formally consider a utility max problem as the one in Week01
  - Credit constraints can hamper workers' investment incentive
- Intuition:
  - A worker is the full residual claimant of the returns from training, and thus has the right incentives to invest (by sacrificing initial wage)
  - There are externalities of training; Non-training firms are free-riders

Specific Human Capital

- Specific training increase productivity more in firms providing the training than in other firms
  - E.g. help new employees to familiarize with their organization
- Specific human capital is useful only in certain firms
  - Firm-specific human capital is useless outside the firm
- Much human capital are neither completely specific nor completely general, e.g. occupation- or industry-specific ones

Firm Will Invest in Specific Training

- Assume the human capital at initial is general and the training is completely specific
- Thus $W_0 = P_0$, $W_1 = P_0$
- Firm's gain from training: $\frac{P_1 - P_0}{(1+r)} - k$
- Thus firm will invest if $\frac{P_1 - P_0}{(1+r)} > k$ (and if better than not-investing)
- Worker has no incentive to invest: the wage does not alter
- Note that now workers are paid below their marginal products
- Also now firms would like to prevent trained worker quits!

Roadmap

1. Introduction

2. Becker's Theory

3. Acemoglu and Pischke's Theory

4. Acemoglu and Pischke's Formal Model $*$

5. Recent (Puzzling) Empirical Evidence

Daron Acemoglu (find more memes about Daron)

(Despite winning Nobel price this month for studies on institutions, his early career work had been focused on training under imperfect labor markets)

Motivation

- The predictions from Becker's model seem to be at odds with reality
- Many training programs is rather general and firms do bear a significant fraction of the costs
  - Most skills may be ind/occ specific thus "general" in some sense
  - Majority studies do not find workers pay for the costs by taking lower wages (e.g. paid MBA or training programs in large firms)
- In Germany & Japan, firms voluntarily offer very general training
  - German apprenticeship system
  - Japanese new graduate general training system
- The question: what do we miss in Becker's theory?
  - It was in fact mentioned in Becker (1962), but somehow was only taken seriously after AP's work
  - Note we are not going to deny Becker's theory, which still provides a good description of reality in many cases, but to build on it

The Idea

- Firms had no incentive to invest general training b.c. their benefits will be taken entirely by workers (via labor market competition)
- $\Rightarrow$ If there is imperfect labor market competition, then firms can suppress wage and gain from general training
  - I.e., if external wage structure is somehow distorted, then firms can suppress internal wage structure such that $W_1 < P_1$
  - Such distortion is generated in the case of specific training
- Acemoglu and Pischke (1998, 1999a,b) show that such imperfectly competitive labor market can occur in many cases
  - A.k.a "frictional labor market" b.c. imperfect competition due to market frictions that are missing in perfectly competitive market
  - A.k.a firms do not take prices as given but have some power on wage determination

A. Search Friction

- Search friction says it is costly for the worker to find a employer
- Say the search cost is c, then workers quit and find new employers will earn $P_1 - c$
- Thus workers will be indifferent between staying and receiving $W_1 = P_1 - c$ and switching employer
- Then firm will now have incentive to invest if $\frac{c}{(1+r)} > k$
  - The higher c, the more likely firms will invest

B. Asymmetric Information

- Outside employers may be unable to ascertain whether a worker actually possesses general skills, or in what amount or quality
- Say among all job seekers, there are share p with P_1 and share $1-p$ with P_0
- Then outside employers without knowing the productivity will pay $pP_1 + (1-p)P_0$
- Then firm will now have incentive to invest if $\frac{(1-p)(P_1-P_0)}{(1+r)} > k$
  - The lower p, the more likely firms will invest

Summary & Implications

- (a) In whatever settings, firms will only provide training when it's profitable
- (b) It's profitable when there is labor market imperfections so that firms do not need to pay workers' full marginal products
- Implication 1. with larger labor market frictions, workers have less incentive to invest while firms have more incentive to invest
- Implication 2. wage growth falls short of productivity growth after firm training
- AP suggest this is why Germany and Japan distinguish with US and UK (using mainly indirect or anecdotal evidence)
  - Less fluid labor markets
  - More firm provided training
  - Less wage inequality

One Exception

- Under a cooperative regime, the firm and worker can conduct joint value maximization:
  - First conduct optimal training investment
  - Then split the profits (and costs) using 1st period wage
  - This solves the imbalanced incentive problems
- Now, compressed external wage structure can suppress joint investment
  - B.c. if the match somehow breaks and the worker switch employer, the increased production from training will not be fully paid off
  - I.e. the potential joint benefits becomes smaller
- Further, if $v(\tau) > f(\tau)$, i.e. if a worker can switch to other firms where the trained skills are better used, then larger search costs reduce joint training investments (Engbom, 2022)

Roadmap

1. Introduction

2. Becker's Theory

3. Acemoglu and Pischke's Theory

4. Acemoglu and Pischke's Formal Model $*$

5. Recent (Puzzling) Empirical Evidence

Setup

- Agents
  - Homogenous workers
  - homogenous firms
- Time:
  - Two periods
  - Assume no discounting for convenience
- Decisions
  - Training investment potentially by both types of agents
  - Workers can choose to quit into another employer at 2nd period
- Market: Imperfectly competitive labor markets
  - Often also called frictional markets as perfectly competitive markets have no frictions
  - Under frictions, wage is not (fully) determined by outside competitive wages, but via bargaining

Settings

- **Period 1** ("early career"):
  - Firms and workers are matched in pairs
  - The firm and the worker choose how much to invest in general human capital τ with cost $c(\tau)$ ($c' > 0$, $c'' < 0$, $c'(0) = c(0) = 0$)
  - Production function is $f(\tau)$ ($f' > 0$, $f'' < 0$)
  - The production in $t = 1$ is normalized to 0 ($f(\tau = 0) = 0$)
  - The firm pay the worker W
- **Period 2** ("late career"):
  - At beginning of $t = 2$, the worker either stays with the firm at $t = 1$ or quits and matches with an outside employer
  - If the worker stays, she produces $f(\tau)$ gets $w(\tau)$
  - If the worker finds new employer, she gets an outside wage $v(\tau)$

Constrained Regime

- In the constrained regime, we assume a worker cannot pay for training as she cannot take a wage cut
  - This can be due to credit constraint or contractural problem (i.e. firm cannot commit on training)
- Thus only firms can invest
- Under **Perfectly Competitive Labor Market**: $w(\tau) = f(\tau)$
  - $\Rightarrow \hat{\tau} = 0$, $f(0) = w(0) = 0$, and $W = 0$ (The Becker's Case)
- Under **Frictional Labor Markets**: $v(\tau) < f(\tau)$
  - The surplus of the initial pair at $t = 2$ is $f(\tau) - v(\tau)$, where $v(\tau)$ is the worker's outside option and we assume firm's outside option is 0
  - Under Nash Bargaining: $w(\tau) = v(\tau) + \beta\left[f(\tau) - v(\tau)\right]$, where $\beta \in [0, 1]$ is workers' bargaining power
  - Thus firms take $\Delta(\tau) \equiv f(\tau) - w(\tau) = (1 - \beta)[f(\tau) - v(\tau)]$ as profit

Constrained Regime + Frictional Labor Market

- A firm's problem at $t = 1$ is to maximize PV by choosing training level and taking the bargaining at $t = 2$ as given:

$$\begin{aligned}\max_{\tau} \pi(\tau) &\equiv [f(\tau) - w(\tau)] - c(\tau) \\ &= (1-\beta)[f(\tau) - v(\tau)] - c(\tau)\end{aligned}$$

- FOC: $\underbrace{(1-\beta)\left[f'(\hat{\tau}) - v'(\hat{\tau})\right]}_{\text{marginal benefits}} = \underbrace{c'(\hat{\tau})}_{\text{marginal costs}}$
- $\Rightarrow$ Firms will invest in training, i.e. $\hat{\tau} > 0$, iff $f'(0) > v'(0)$
- Intuition:
  - As $w'(\tau) = \beta f'(\tau) + (1-\beta)v'(\tau)$, $f'(\tau) > v'(\tau)$ means $f'(\tau) > w'(\tau)$
  - A unit of more training increases more production than wage, thus raising profits $\Delta(\tau)$, until it matches with the (marginal) training costs

Illustration

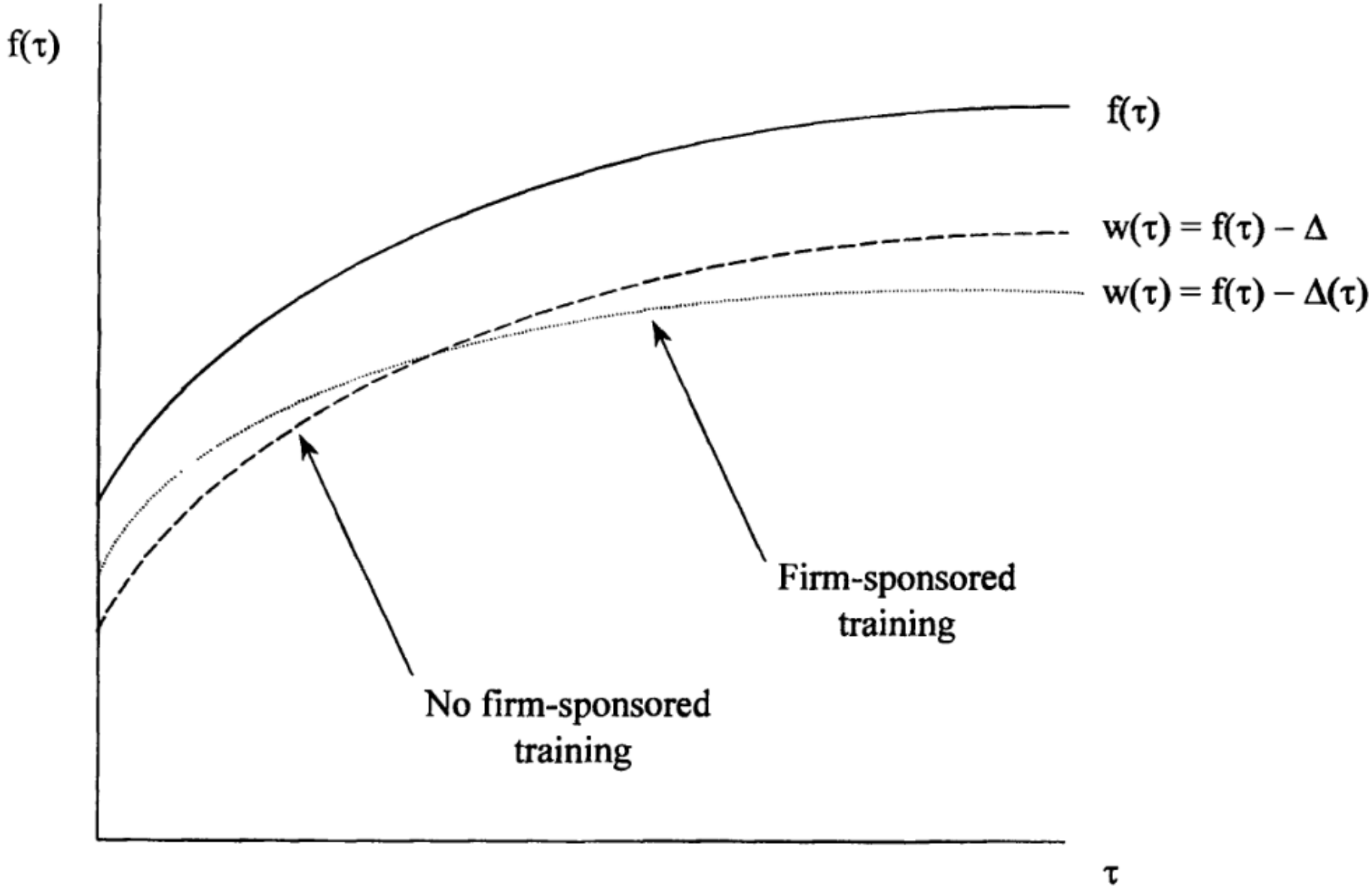


FIG. 1.—Wage structure and training

Why $v'(\tau) < f'(\tau)$? A. Search Friction

- Assume a worker looking for a new firm needs quit and search:
  - with probability p_w, successful;
  - with probability $1 - p_w$, unemployed and receive 0
- Even she successfully finds a new employer, the new wage will be determined by bargaining: $w_2(\tau) = \beta f(\tau)$
  - Assume both side have outside option 0
- $\Rightarrow v(\tau) = p_w \beta f(\tau)$
- $\Rightarrow v'(\tau) = p_w \beta f'(\tau) < f'(\tau)$
- The distortion thus comes from two dimensions:
  - Potential unemployment
  - Future bargaining

Why $v'(\tau) < f'(\tau)$? B. Asymmetric Information

- Assume among workers, p proportion have low ability $\eta = 0$ (normalized) and $1 - p$ proportion have high ability $\eta = 1$
- Assume the production function: $f(\tau, \eta) = \tau\eta$
- Incumbent firm trains at $t = 1$ and learns the worker's type and offers a wage $w(\tau, \eta)$ for $t = 2$
- Outside firms do not know worker ability but observe the level of training received
- Assume λ proportion of matches separate exogenously at the end of period 1
- $\Rightarrow v(\tau) = \frac{\lambda(1-p)\tau}{p+\lambda(1-p)}$ (expected productivity of workers who separate)
- $\Rightarrow v'(\tau) = \frac{\lambda(1-p)}{p+\lambda(1-p)} < f_\tau(\tau, \eta) = \eta = 1$

Cooperative Regime

- Assume with probability q, the match breaks exogenously at the end of period 1
- The firm and worker conduct joint value maximization:

$$\max_{\tau}(1-q)f(\tau)+qv(\tau)-c(\tau)$$

  - If not separated, they produce $f(\tau)$ as joint value
  - If separated, the worker get $v(\tau)$ and the firm get 0
- FOC: $(1-q)\left(f'(\tau_c)-v'(\tau_c)\right)+v'(\tau_c)=c'(\tau_c)$
  - Note $\tau_c > \hat{\tau}$ though still less than first-best unless $f(\tau)=v(\tau)$
  - The only inefficiency now is from the positive externalities on potential future employers (Acemoglu, 1997)
- Rewrite FOC: $(1-q)f'(\tau_c)+qv'(\tau_c)=c'(\tau_c)$
  - Now $v'(\tau_c) < f'(\tau_c)$ means less marginal benefits from investment

Roadmap

1. Introduction
2. Becker's Theory
3. Acemoglu and Pischke's Theory
4. Acemoglu and Pischke's Formal Model $*$
5. Recent (Puzzling) Empirical Evidence

Evidence fom PIAAC Data (2011-2018) (Black et al., 2023)

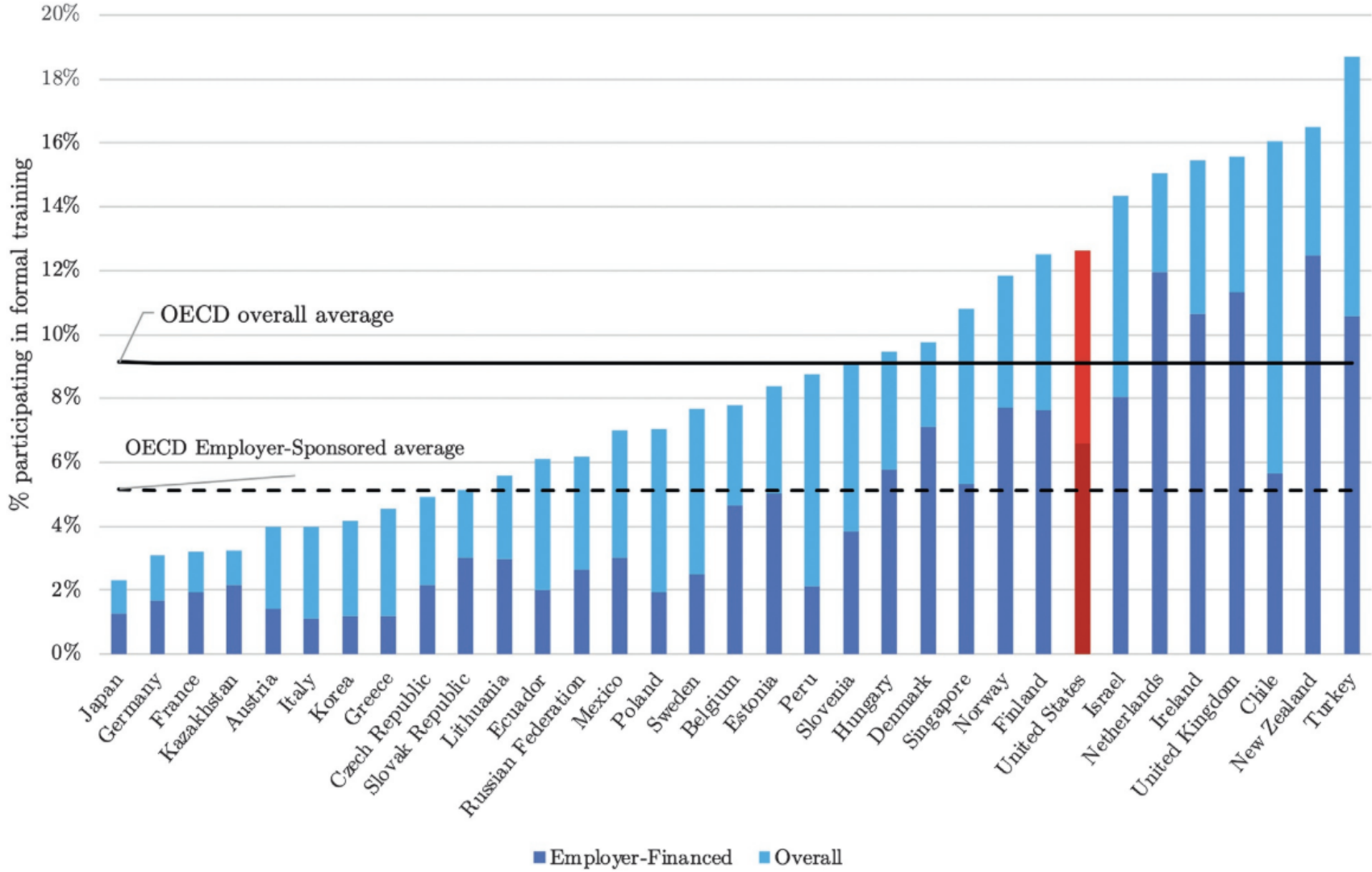


FIG. 1

Formal training incidence across countries. *Note:* The formal training measure is taken from the *PIAAC* sample of 25–59-year-olds working full-time in the private sector. OECD averages are (unweighted) country averages of available OECD member states.

(Formal training: study aimed at a formal qualification, whether part-time or full-time)

Evidence fom PIAAC Data (2011-2018) (Black et al., 2023)

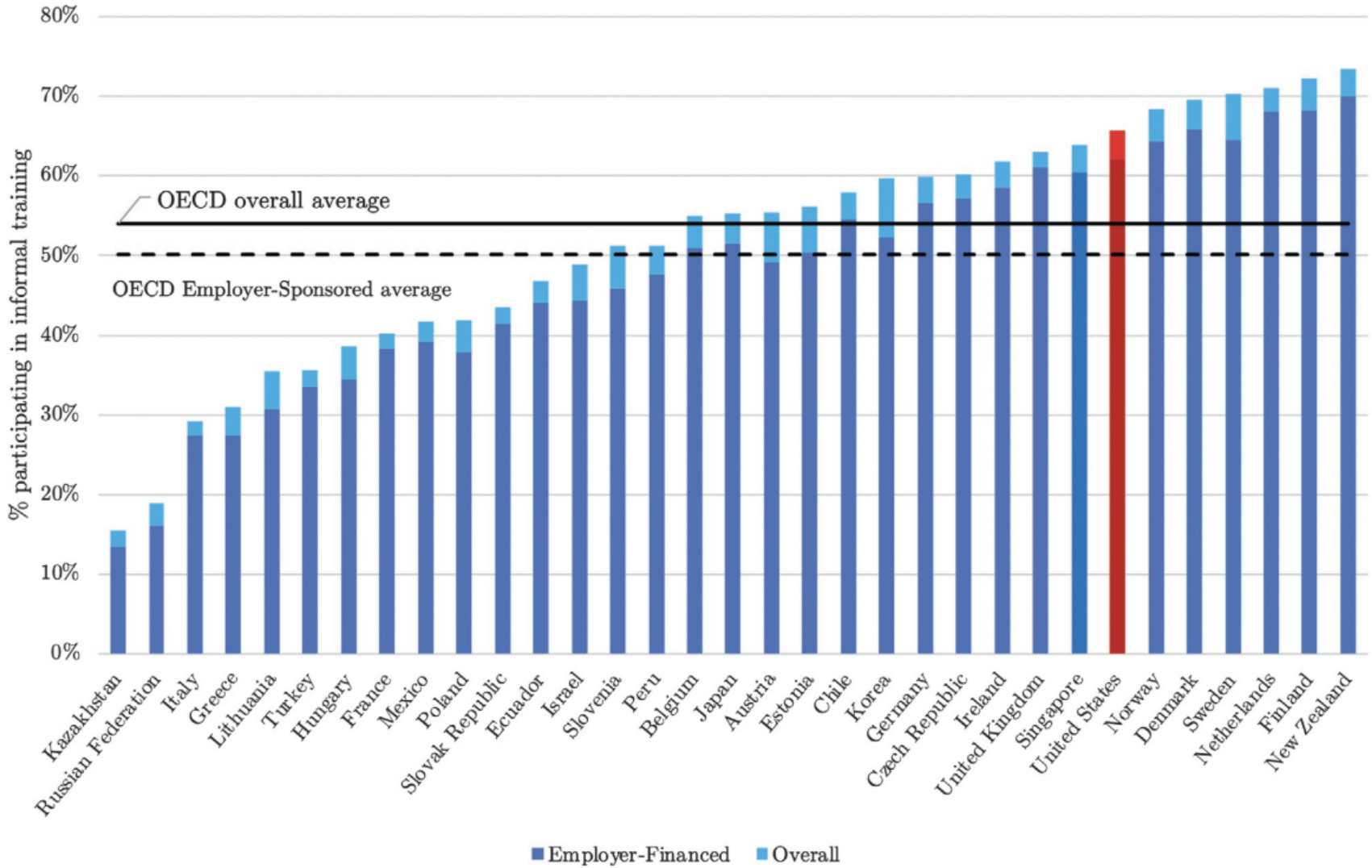


FIG. 2

Informal training incidence across countries. *Note:* The informal training measure is taken from the *PIAAC* sample of 25–59-year-olds working full-time in the private sector. OECD averages are (unweighted) country averages of available OECD member states.

(Informal training: courses, sessions, seminars or workshops w/o formal qualification)

Evidence fom PIAAC Data (2011-2018) (Black et al., 2023)

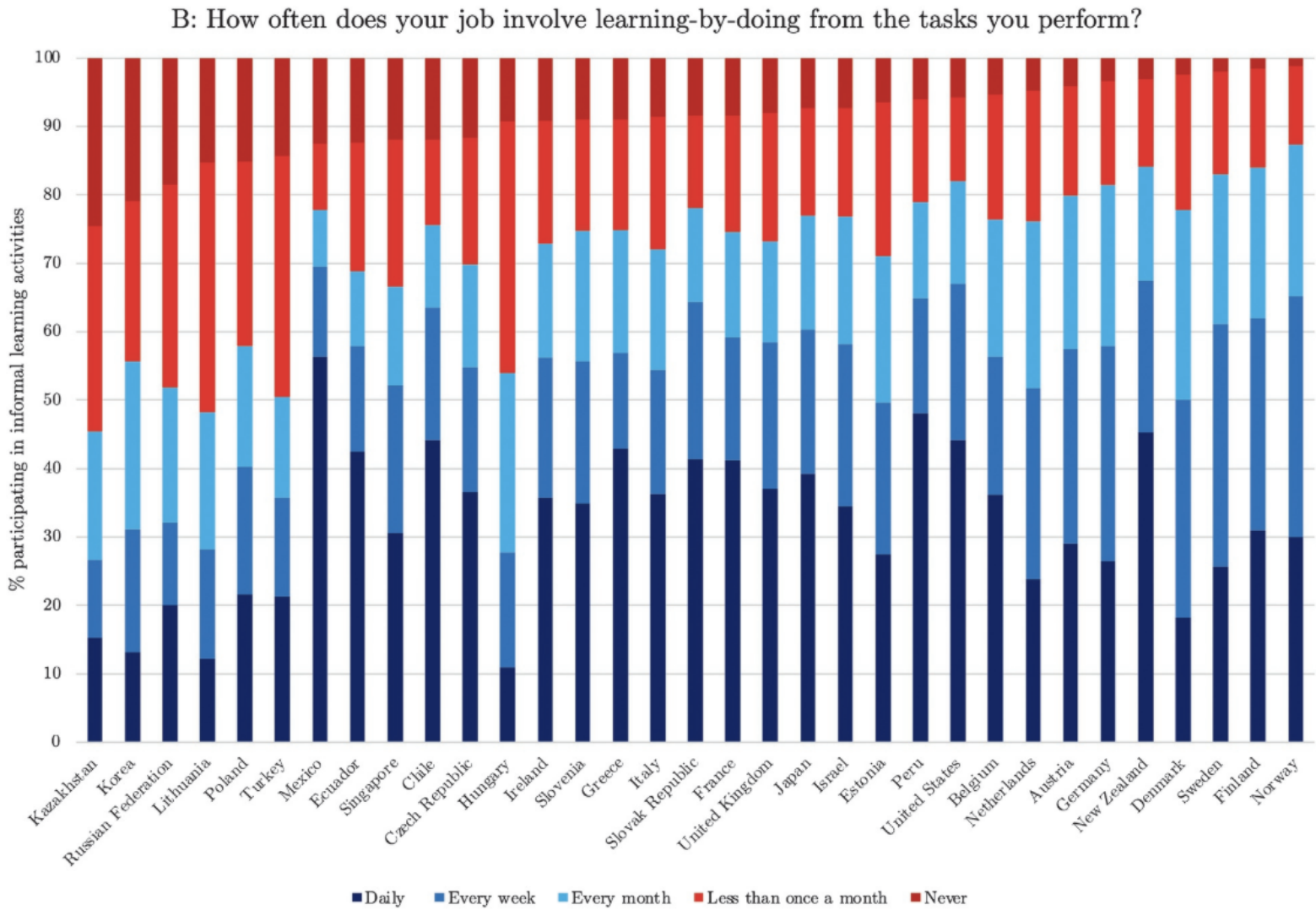


FIG. 3—Cont'd

(Learning by doing: how often repetition itself leads to improved performance in a work task)

Evidence fom PIAAC Data (2011-2018) (Black et al., 2023)

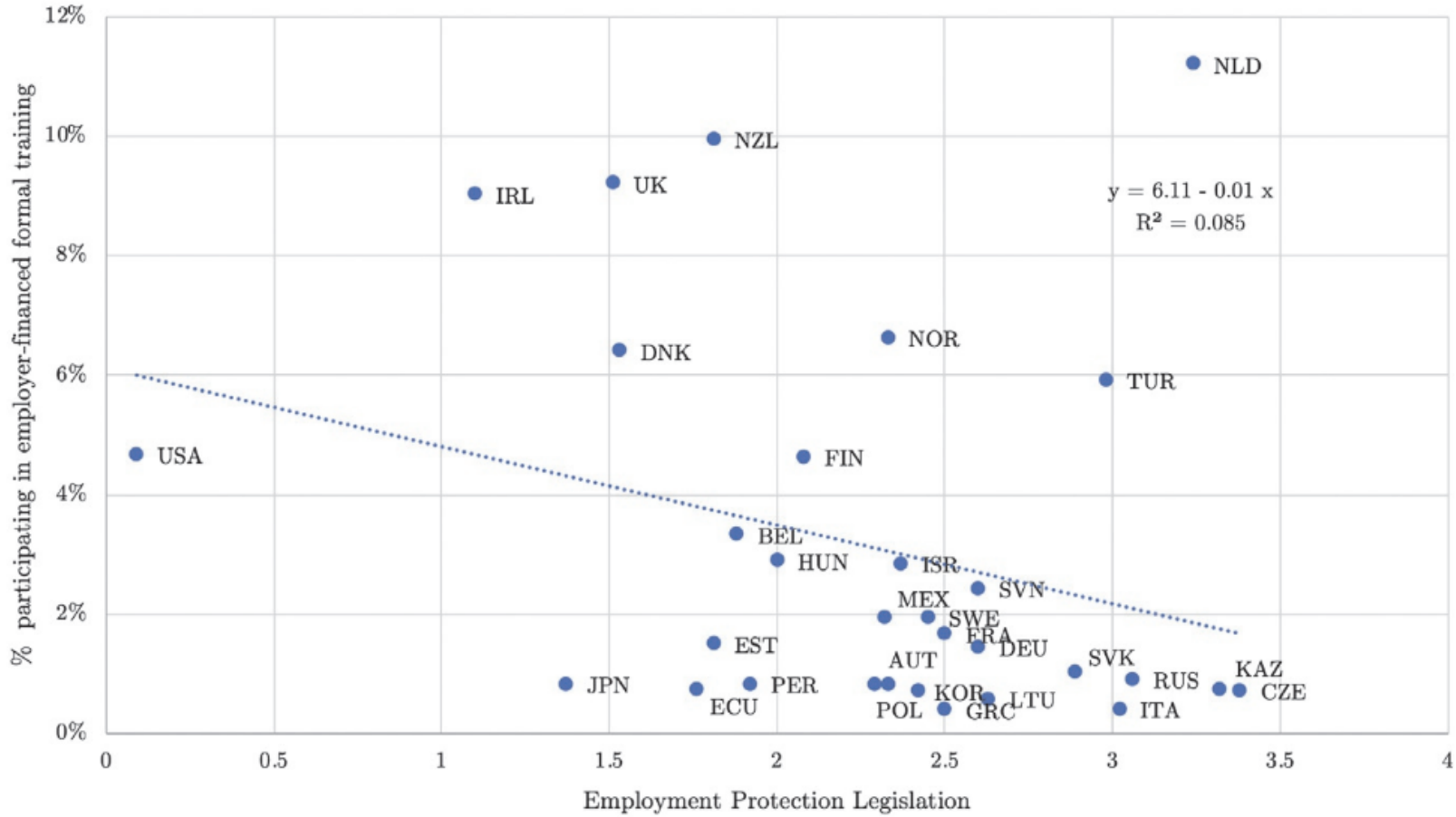


FIG. 4

Employment regulation and employer-financed formal training across countries.
Note: Employment Protection Legislation (EPL) is the OECD's measure of strictness of employment protection—individual dismissals (regular contracts). The underlying scale runs from zero to six with higher scores representing stricter regulation (https://stats.oecd.org/Index.aspx?DataSetCode=EPL_R). EPL is measured in 2011. The participation measure comes from the answer to PIAAC question B_Q11 and is based on full-time, private-sector workers aged 25–59. Formal training is measured in 2011. The empirical correlation

Evidence fom PIAAC Data (2011-2018) (Black et al., 2023)

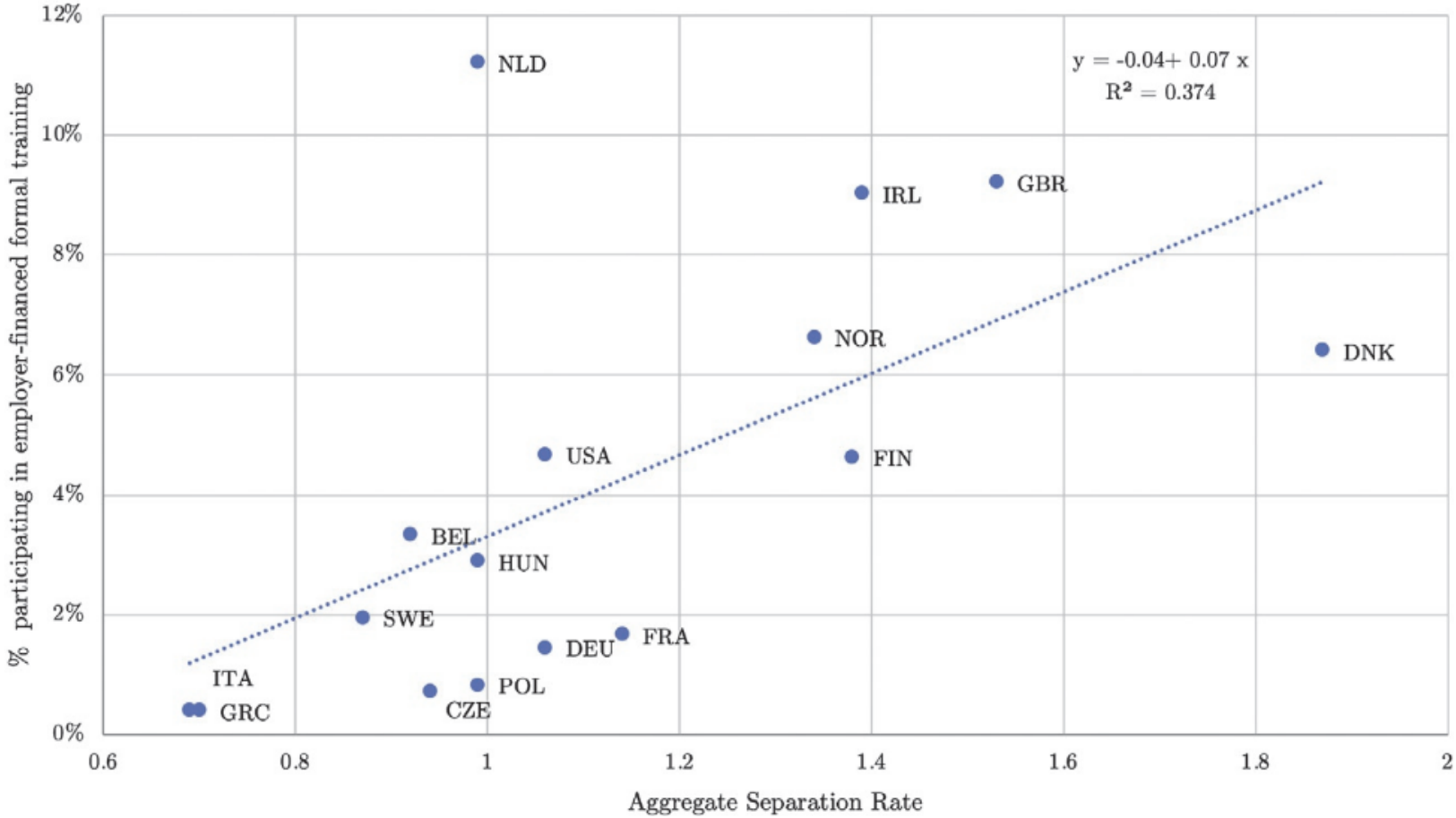


FIG. 5

Separation rates and employer-financed formal training across countries. *Note:* The monthly aggregate separation rate comes from table 2 in Hobijn and Şahin (2009). Separation rates are measured during 1990–2006. The participation measure comes from the answer to PIAAC question B_Q11 and is based on full-time, private-sector workers aged 25–59. Formal training is measured in 2011. The empirical correlation equals 0.61.

Evidence from European Data (1994-2001) (Engbom, 2022)

TABLE 5. TRAINING AND LABOR MARKET FLUIDITY

Panel A. Cross-country correlation

	Days on training (fraction of year)			Hours on training (fraction of year)			Model
	Raw	Controls	Direct	Raw	Controls	Direct	
Fluidity	0.448***	0.386***	0.388***	0.360***	0.305***	0.312***	0.277***
	(0.091)	(0.083)	(0.066)	(0.050)	(0.038)	(0.031)	(0.009)
JJ			0.000			0.001	
			(0.002)			(0.001)	
Age		-0.000***	-0.000***		-0.000***	-0.000***	
		(0.000)	(0.000)		(0.000)	(0.000)	
College		0.006***	0.007***		0.003***	0.004***	
		(0.002)	(0.002)		(0.001)	(0.001)	
N	135,563	115,897	63,634	135,318	115,676	63,494	3,990,963

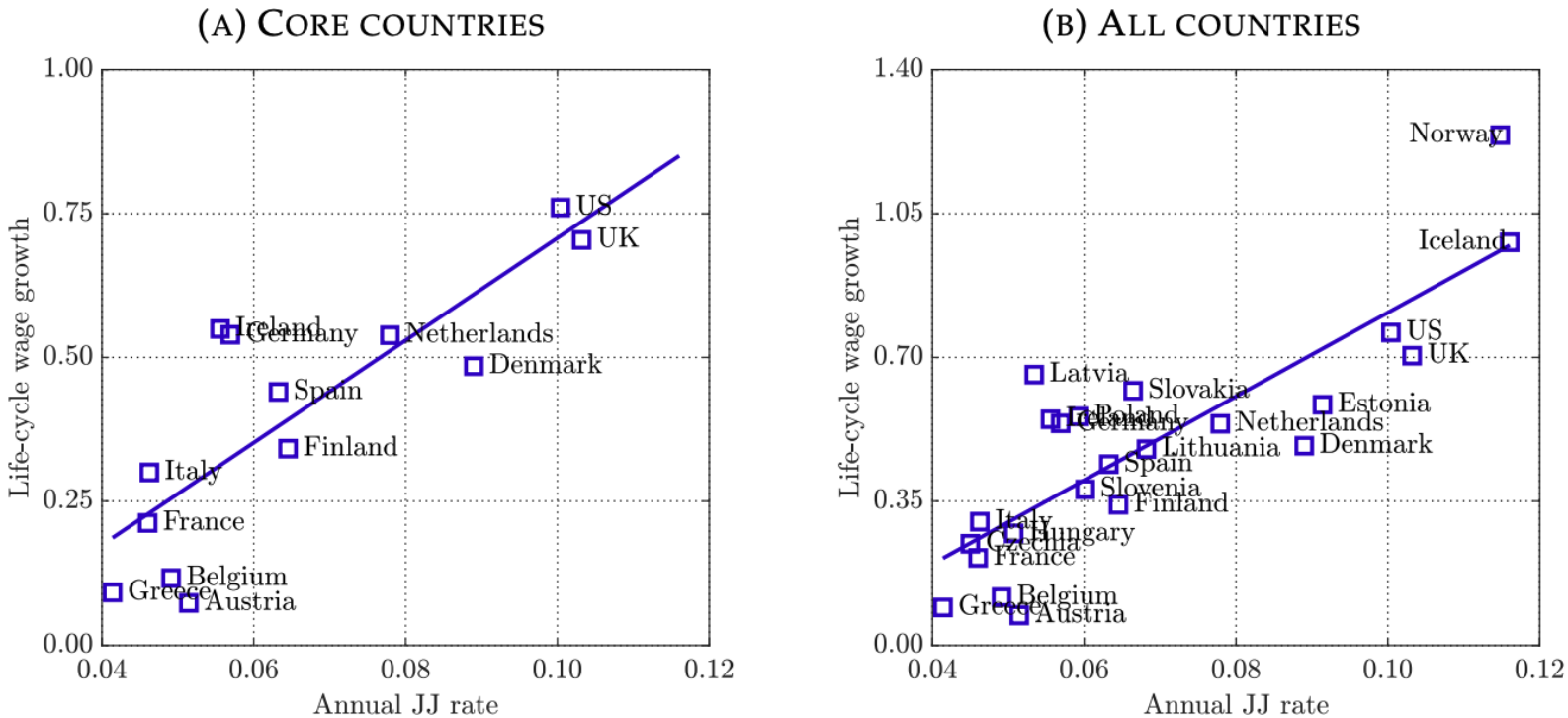
Panel B. Within-country correlation (hours as fraction of year)

	Education		Occupation		Sector		Model
	Baseline	FE	Baseline	FE	Baseline	FE	
Fluidity	0.305	0.380	0.317	0.458**	0.328***	0.419***	0.277***
	(0.836)	(0.822)	(0.226)	(0.222)	(0.079)	(0.096)	(0.009)
N	204,207	204,207	148,155	148,155	148,782	148,782	3,990,963

Note: Panel A: Men aged 25–54. Regression of training outcome on labor market fluidity at the country-level, with or without controls. Raw: Controls for year. Controls: Controls for age, education, occupation, sector and year. Direct: Controls for age, education, occupation, sector, year and JJ mobility in previous year. Data: Days or hours on vocational training in the past 12 months, expressed as a fraction of potential work days/hours (5*52 or 40*52, respectively). Hours and days on training are top-coded at 13 weeks of full time training per year. Model: Fraction of time devoted to training, $i(a,h,z)$. Regressions are weighted using the provided survey weights, renormalized to give each country the same aggregate weight. Standard errors are clustered at the country level. *Panel B*. Men aged 18–64. Regression of training outcome on labor market fluidity at the country-education group/occupation/sector level. Baseline includes country and year fixed effects; FE includes country, year and education group/occupation/sector fixed effects. Data: Hours on vocational training in the past 12 months, expressed as a fraction of potential work hours (40*52). Model: Fraction of time devoted to training, $i(a,h,z)$. Regressions are weighted using the provided survey

Evidence from EU & US Data (1991-2015) (Engbom, 2022)

FIGURE 1. LIFE-CYCLE WAGE GROWTH AND LABOR MARKET FLUIDITY



Note: Male employees aged 25–54. Labor market fluidity: Share of employees who started working for their current employer at some point in the past 11 months while having been employed in all of the past 12 months. Employment in the past 12 months includes self-employment due to data limitations. Constructed by first collapsing the data to the country-age-year level using the provided survey weights, then to the country-level. Life-cycle wage growth: Log hourly real wage profile based on regression (1) with worker fixed effects, time effects and age effects restricted to zero growth after age 50. *Source:* BHPS, ECHP, EUSILC, GSOEP and PSID 1991–2015.

Evidence from EU & US Data (1991-2015) (Engbom, 2022)

TABLE 2. ENTRY WAGES AND LABOR MARKET FLUIDITY

	Year	Educ	Occup	GDP
α	-0.891	-0.358	-0.637	-3.105*
	(2.795)	(2.921)	(2.722)	(1.721)
N	21,266	20,342	20,200	21,266

Note: Male employees 21–24. Log hourly real wage in 2004 PPP-adjusted USD. Year: Year controls. Educ: Year and education controls. Occup: Year and occupation controls. GDP: Year and GDP per hour controls (in 2004 PPP-adjusted USD). Labor market fluidity: Share of employees who started working for their current employer at some point in the past 11 months while having been employed in all of the past 12 months. Employment in the past 12 months includes self-employment due to data limitations. Constructed by first collapsing the data to the country-age-year level using the provided survey weights, then to the country-level. Standard errors are clustered at the country-level. * significant at 10%. *Source:* BHPS, ECHP, EUSILC, GSOEP and PSID 1991–2015.

(Not very significant results on training or learning reduce entry wages here and also not sufficient evidence in the literature)

Reference

Acemoglu, D. (1997). Training and innovation in an imperfect labour market. *The Review of Economic Studies 64*(3), 445–464.

Acemoglu, D. and J.-S. Pischke (1998). Why do firms train? theory and evidence. *The Quarterly journal of economics 113*(1), 79–119.

Acemoglu, D. and J.-S. Pischke (1999a). Beyond becker: Training in imperfect labour markets. *The economic journal 109*(453), 112–142.

Acemoglu, D. and J.-S. Pischke (1999b). The structure of wages and investment in general training. *Journal of political economy 107*(3), 539–572.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of political economy 70*(5, Part 2), 9–49.

Black, D. A., L. Skipper, and J. A. Smith (2023). Firm training. *Handbook of the Economics of Education 7*, 287–468.

Engbom, N. (2022). Labor market fluidity and human capital accumulation. Technical report, National Bureau of Economic Research.