6. Human Capital

KAT.TAL.322 Advanced Course in Labour Economics

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Human capital

Labour heterogeneity is important for labour supply and demand.

Human capital includes **education**, training, health investments.

First references as early as Adam Smith; formalised by Becker in 1960s.

Today

- Stylised facts
- Productive human capital investments
- Signalling theory
- Returns to education

Stylised facts

Overview

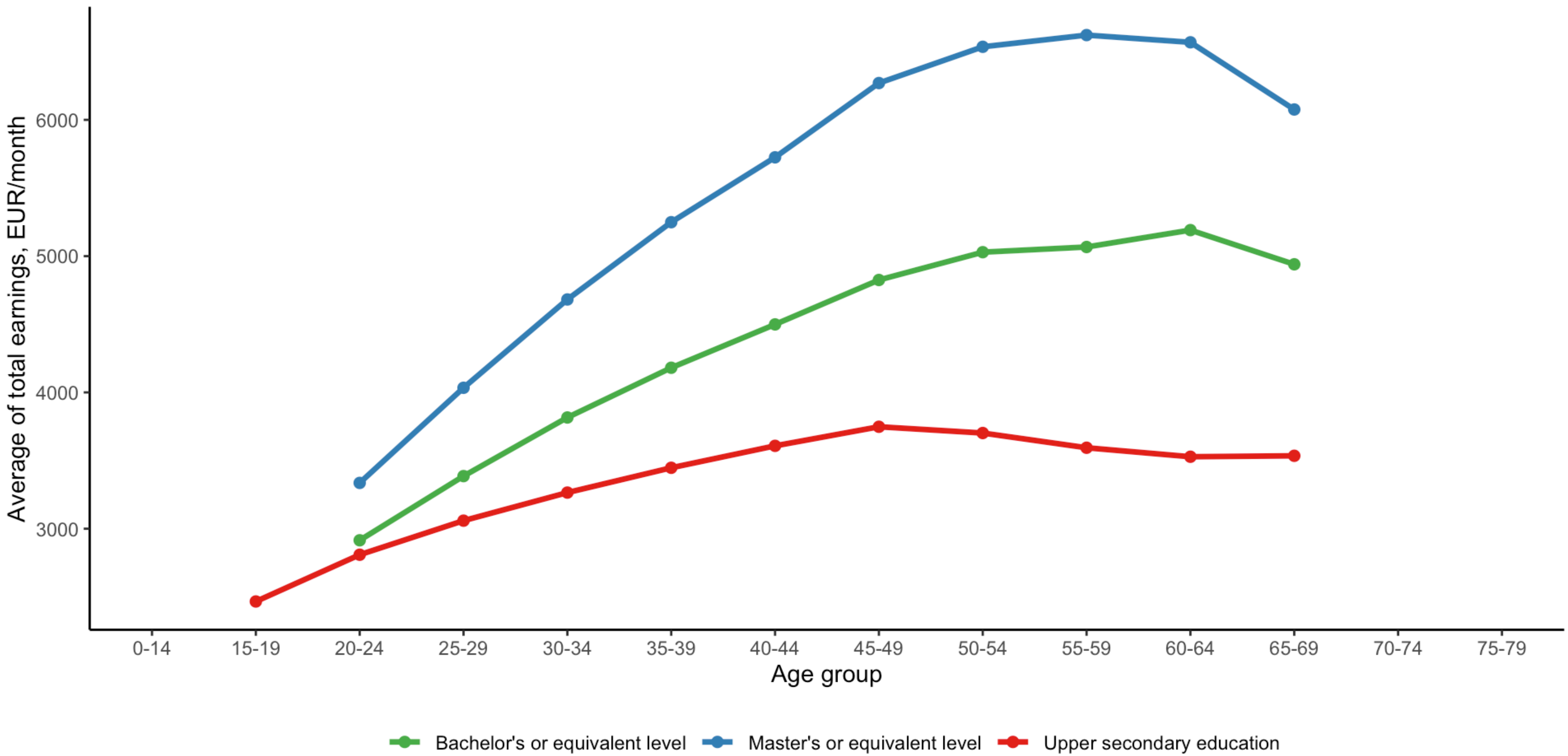
Human capital is an investment

- **benefit:** gain in earnings
- **cost:** tuition, foregone earnings, psychological costs

Two main camps for source of gain in earnings:

- gain in productivity
- signalling

Earnings by education

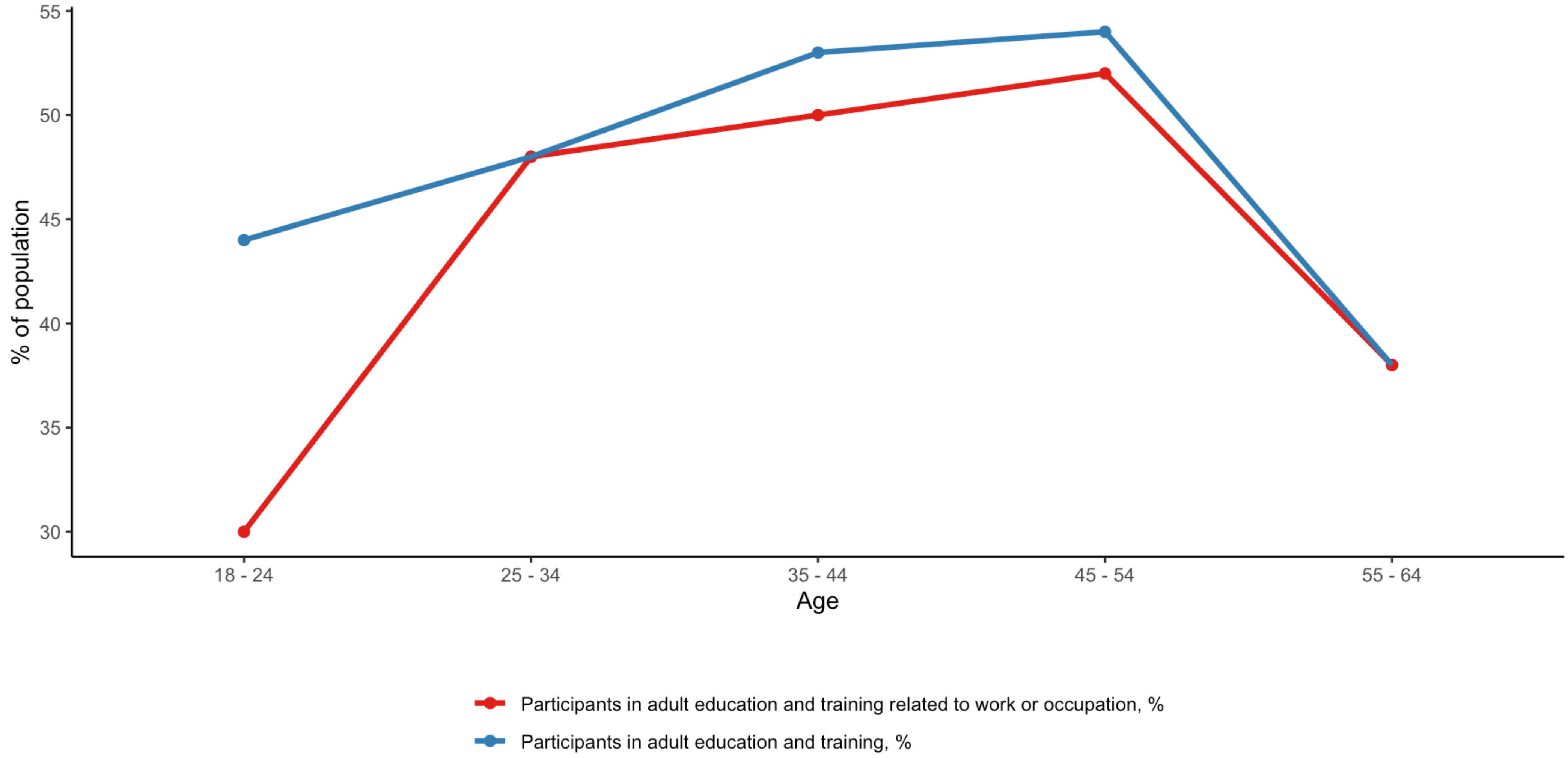


Human capital production function

Typically, univariate (years of education), it can be complex function of

- Innate skills (e.g., genetics)
- Parental investments (e.g., day care, time spent with children, tutors)
- Schooling/formal education
  - → Quantity (e.g., high school vs university)
  - → School quality (e.g., teacher quality, expenditure per student)
  - → Differences in curricula/fields (e.g., STEM vs arts)
- Peers (e.g., at school, at work)
- On-the-job training (e.g., general vs specific skills)

Adult education



Productive human capital investments

Basic model

Assume education choice $S \in \{HS, C\}$

Worker with S produces Y_S goods when employed by a firm

Perfect competition ensures that $W_{HS} = Y_{HS}$ and $W_C = Y_C$

Assume cost of education given by function $\eta(S)$

Then choose college if **marginal benefit** outweighs **marginal cost**

$$S = C \iff W_C - W_{HS} \geq \eta(C) - \eta(HS)$$

Lifecycle model: simplified Ben-Porath (1967)

- Divide time between schooling/training $\sigma(t)$ and working $1 - \sigma(t)$
- Law of motion of HC: $\dot{h}(t) = \theta\sigma(t)h(t)$
- Production function per worker: $y(t) = Ah(t) \equiv w(t)$
- Assume linear utility and no utility cost of $\sigma(t)$

$$\Omega = \int_0^T (1 - \sigma(t))\, Ah(t)e^{-rt}\,\mathrm{d}t \qquad \text{s.t. HC law of motion}$$

Marginal return to HC effort $\sigma(t)$ is

$$\frac{\partial\Omega}{\partial\sigma(t)} = -Ah(t)e^{-rt} + \int_0^T (1 - \sigma(z))\, A\frac{\partial h(z)}{\partial\sigma(t)}e^{-rz}\,\mathrm{d}z$$

$$\frac{\partial \Omega}{\partial \sigma(t)} = \underbrace{-Ah(t)e^{-rt}}_{\text{foregone earnings}} + \underbrace{A\theta \int_t^T (1 - \sigma(z))\, h(z)e^{-rz}\, \mathrm{d}z}_{\text{discounted future payoff}}$$

Lifecycle model: simplified Ben-Porath (1967)

Optimal effort is zero at low efficiency θ and high discount rate r

The change in marginal return over time is given by

$$\frac{d}{dt}\left(\frac{\partial \Omega}{\partial \sigma(t)}\right) = Ah(t)e^{-rt}(r - \theta)$$

If $r > \theta$, then marginal return ↑ over time, but is negative at T:

$$\frac{\partial \Omega}{\partial \sigma(T)} = -Ah(T)e^{-rT} < 0$$

Hence, marginal return at every period is negative ⇒ $\sigma^*(t) = 0 \quad \forall t$.

Lifecycle model: simplified Ben-Porath (1967)

Optimal effort when efficiency θ is high or discount rate r is low

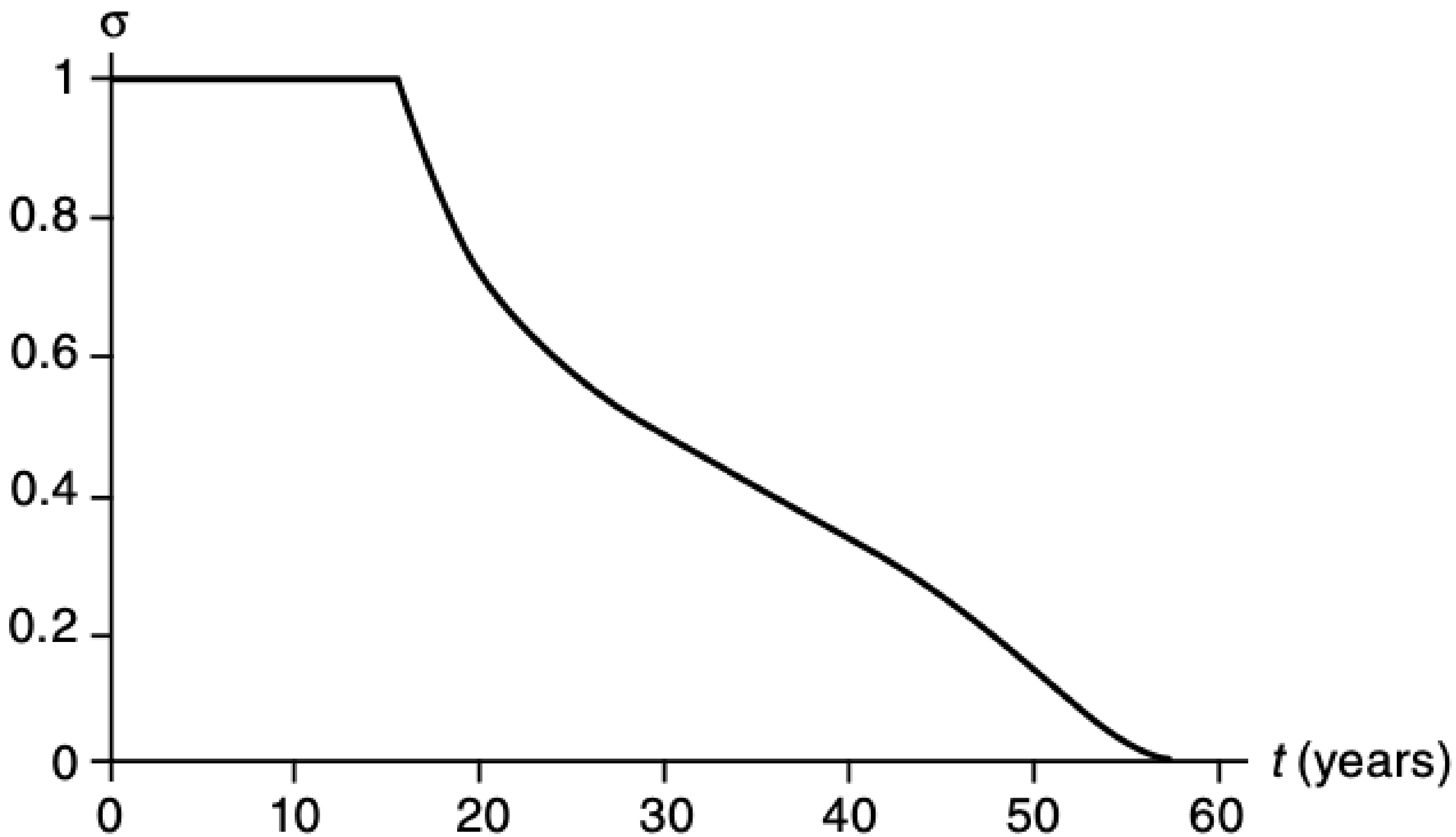
Marginal return ↓ over time ⇒ may exist $t = s$ such that $\frac{\partial \Omega}{\sigma(s)} = 0$

- initial investment into education $\sigma^*(t) = 1, \quad \forall t \leq s$
- work rest of the time $\sigma^*(t) = 0, \quad \forall t > s$
- study longer if θ higher

$$s = \begin{cases} T + \frac{1}{r}\ln\left(\frac{\theta - r}{\theta}\right) & \text{if } \theta \geq \frac{r}{1-e^{-rT}} \\ 0 & \text{otherwise} \end{cases}$$

Lifecycle model: Ben-Porath (1967)

Allows for human-capital depreciation and on-the-job training



Source: Figure 4.9 from Cahuc (2004)

Signalling theory

Basic model

- Two types of productivity θ_H and θ_L
- Education e costs $c_i = \frac{e}{\theta_i}$
- Linear utility $w - c_i, \forall i \in \{H, L\}$

Observable types

Free entry ensure $w = \theta_i \Rightarrow e_i^* = 0, \forall i \in \{H, L\}$

Unobservable types

- Low type gets no education $e_L^* = 0$ and a payoff θ_L
- High type gets $e_H^* = \theta_L(\theta_H - \theta_L)$ and a payoff $\theta_H - \frac{\theta_L(\theta_H - \theta_L)}{\theta_H}$

Returns to education

J. Mincer (1958)

- $E(S)$ earnings with S years of schooling
- Assume no direct cost of education
- **Internal rate of return**: r that equates costs and benefits

Present value of earnings $P(S) = \int_S^T E(S)e^{-rt}\,dt = E(S)\frac{e^{-rS} - e^{-rT}}{r}$

$$P(S) = P(0) \Rightarrow \ln E(S) \approx \ln E(0) + rS$$

Source: J. A. Mincer (1974), Table 5.1

Regression	R^2
$\ln w = 7.58 + 0.070S$	0.067

J. A. Mincer (1974)

Accounting for experience

Building on Ben-Porath (1967)

- $t(x)$ share of time dedicated to training at x experience and s
- HC law of motion: $\dot{h}(s+x) = \rho_1 t(x) h(s+x), \ \forall x \in [0, T-s]$

$$\ln w(s+x) = \ln w(0) + \rho s + \rho_1 t(0) x - \rho_1 \frac{t(0)}{2T} x^2$$

SOURCE: J. A. MINCER (1974), TABLE 5.1

Regression	R^2
$\ln w = 6.20 + 0.107S + 0.081X - 0.0012X^2$	0.285

OLS estimates of returns to schooling

Potential issues

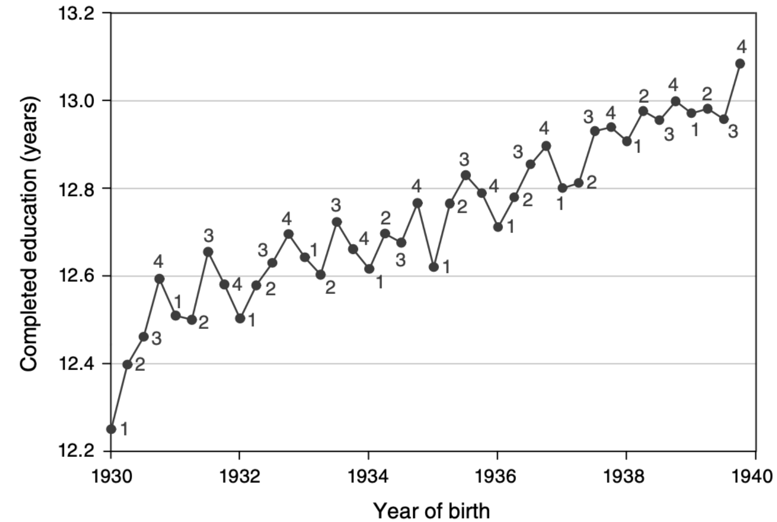
- Endogeneity of schooling and earnings
  - → Cognitive and noncognitive abilities (**Heckman, Stixrud, and Urzua 2006**)
- Return to education is same regardless of duration of study
- Does not take into account direct costs of education
- Heterogeneity of returns (e.g., family background, schooling system)
- Years of schooling vs qualifications
- Productivity vs signalling interpretation

Causal estimates of returns to schooling

*Angrist and Krueger (**1991**)*

Compulsory schooling laws: exogenous variation by quarter of birth

Instrumental variable approach



Local Average Treatment Effect (LATE)

$$\ln W_{icq} = \beta X_i + \rho E_i + \sum_c 1\{YOB_i = c\}\xi_c + \mu_i$$

$$E_{icq} = \pi X_i + \sum_c 1\{YOB_i = c\}\delta_c + \sum_c \sum_q 1\{YOB_i = c\}1\{QOB_i = q\}\theta_{qc} + \epsilon_i$$

Causal estimates of returns to schooling

*Angrist and Krueger (**1991**)*

IV estimates of returns to education ρ

	cohort30	**cohort40**
r	0.076	0.095
	(0.029)	(0.022)
Weak IV F-stat	1.6	3.2

Issues:

- Instrument is weak (IV estimates are inflated)
- Who are the compliers? Endogeneity? External validity?

Causal estimates of returns to schooling

Some other IV approaches

	Instrument	Estimated ρ
Card (1993)	Proximity to college	0.132 (0.055)
Cameron and Taber (2004)	Proximity to college	0.228 (0.109)
Cameron and Taber (2004)	Earnings in local labour market	0.057 (0.115)
Kane and Rouse (1995)	College tuition fees	0.116 (0.045)
Oreopoulos (2007)	Changes in compulsory schooling laws	0.133 (0.0118) US 0.084 (0.0267) Canada 0.158 (0.0491) UK

Causal estimates of returns to schooling

Twin studies

$$\ln w_{ij} = \alpha + \rho s_{ij} + A_j + \varepsilon_{ij}, \ \forall i \in \{1, 2\}$$
$$\Delta \ln w_j = \rho \Delta s_j + \Delta \varepsilon_j$$

	Estimated ρ
Ashenfelter and Rouse (1998)	0.088 (0.025)
Oreopoulos and Salvanes (2011)	0.0476 (0.0026)

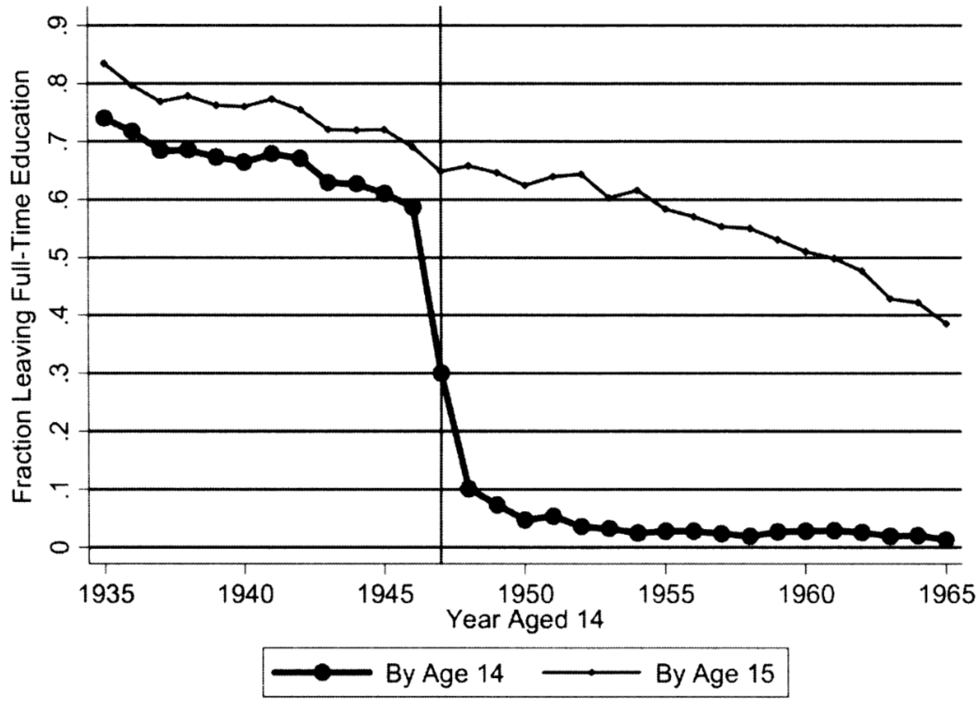
Causal estimates of returns to schooling

*Regression discontinuity design: Oreopoulos (**2006**)*

UK 1947: raised min school leaving age (ROSLA) from 14 to 15
Compare similar people just before and after policy change

Estimated ρ = 0.069 (0.040)

Second reform in 1972: min SLA ↑ from 15 to 16
Small (or zero) return (**Dickson and Smith 2011**)



Source: Figure 1 from Oreopoulos (2006)

Causal estimates of returns to schooling

*Carneiro, Heckman, and Vytlacil (**2011**)*

- Many papers estimate sizable returns to schooling
- Average dropout rate in OECD 17% in 2020
- Heterogeneity in returns to schooling

Role of individual characteristics?

E.g., patience (**Cadena and Keys 2015**)

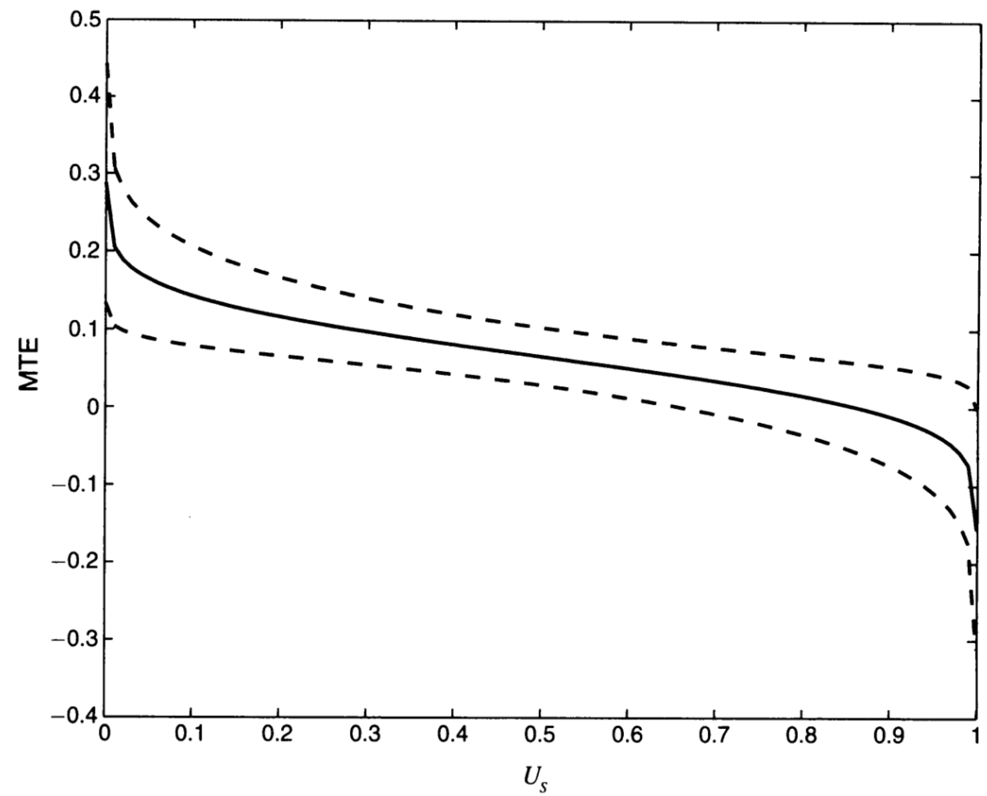


FIGURE 1. MTE ESTIMATED FROM A NORMAL SELECTION MODEL

Source: Carneiro, Heckman, and Vytlacil (2011)

Causal estimates of returns to schooling

Productivity or signalling?

Hard question to answer

Productivity

- [No] upstream effects of ROSLA on qualifications (Chevalier et al. 2004)
- Student riots, ↑ passes, ↑ higher edu, ↑ wages (Maurin and McNally 2008)
- RDD of just passing/failing high school exam: no effect (Clark and Martorell 2014)

Signalling

- Employer learning: 30% of returns due to signalling (Aryal, Bhuller, and Lange 2022)
- Positive effect of degree classes (Feng and Graetz 2017)

Summary

- Education is a human capital investment
- Models describing the investment decisions treat education as productivity enhancing and/or signalling device
- Empirical estimates suggest sizable wage returns to a year of schooling
- However, still a lot of debate about causality, heterogeneity and interpretation

Next: Education Quality

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