

The Economics of Imperfect Labor Markets

Rudolf Winter-Ebmer

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Chapter 8. Education and training

What are we talking about?

- Human capital theory
- Schooling and training: investments by individuals and firms → costs are paid in exchange for expected future benefit
- Formal schooling usually before individual enters the labor market
- Training usually after entrance into the labor market:
 - General
 - Firm-specific
- Focus literature on schooling: how much?
- Focus literature on training: who pays?

Market failures education and training

- ① Incomplete capital markets
- ② Private rates of return \iff social rates of return
- ③ Long time lag between decision and outcome
- ④ Holdup problem: training agreements are non-contractible

Measures

- Organization formal education very country-specific
- Educational expenditures as % of GDP
- Training: difficult to measure
 - Participation rate
 - Annual volume
- PISA scores
 - Program for International Student Assessment
 - Survey of student knowledge and skills of 15-year-olds
 - Mathematics, science and reading

Educational expenditures & attainments

	Educational expenditures	Years of formal education		PISA Math score
		Men	Women	
Austria	5.4	12.3	11.7	496
Denmark	7.1	13.5	13.3	503
France	6.0	11.7	11.4	497
Germany	4.8	13.7	13.2	513
Italy	4.8	10.2	10.0	483
Netherlands	5.6	11.4	11.1	526
Spain	5.1	10.6	10.6	483
UK	5.7	12.7	12.4	492
US	7.2	13.2	13.4	487

Educational expenditures: % of GDP (2011)

Years of formal education: population 25-64 years (2011)

PISA: normalized to US score (2009)

Cross-country comparison schooling

- Substantial differences in spending level:
4.8% (Italy, Spain) \leftrightarrow 7.2% (US)
- Educational attainment wide variation:
10.2–10.0 (Italy) \leftrightarrow 13.2–13.4 (US)
- Positive but imperfect correlation between spending and educational attainment
- PISA math score (15 year olds):
Italy and Spain lowest score (483) \leftrightarrow Netherlands highest score (526)

Employment rates by education (2011)

	Men			Women		
	1	2	3	1	2	3
Austria	64.1	80.7	86.6	50.0	70.9	84.5
Denmark	70.7	82.7	87.1	58.8	76.9	82.6
France	73.8	83.4	89.5	57.7	69.0	81.8
Germany	67.9	80.7	88.3	51.5	70.1	82.2
Italy	75.0	82.5	81.1	40.9	60.2	65.2
Netherlands	81.3	82.7	85.9	55.8	71.9	76.1
Spain	72.0	76.3	83.1	49.3	65.3	72.2
UK	56.2	83.9	86.3	34.2	71.2	78.7
US	59.6	72.9	80.5	42.8	64.8	75.2

1 = Less than upper secondary education

2 = Upper secondary education

3 = Tertiary education

Relative earnings – income from employment (2011)

	Men			Women		
	1	2	3	1	2	3
Austria	48	100	106	54	100	134
Denmark	94	100	155	96	100	148
France	88	100	159	81	100	146
Germany	79	100	130	63	100	128
Italy	74	100	162	78	100	147
Netherlands	72	100	126	89	100	136
Spain	68	100	115	62	100	145
UK	73	100	151	70	100	180
US	67	100	189	70	100	177

Notes: Year 2005 for France, Italy, UK and US.

- 1 = Less than upper secondary education
- 2 = Upper secondary education
- 3 = Tertiary education

Comment to tables on education and labour market outcomes

- Strong relationship between educational attainment and labor market status and earnings
- Wide cross-country variation in employment rates of low-educated men
56.2 (UK) ↔ 81.3 (Netherlands)
- Less variation among higher-educated men
81.1 (Italy) ↔ 83.4 (UK)
- Wide range in relationship between earnings and education; men
67–189 (US) ↔ 94–155 (Denmark)

Cross-country comparison employer sponsored training

	IALS data		ECVTS data	
	Participation rate (%)	Annual volume	Participation rate (%)	Annual volume
Austria	–	–	31	9
Denmark	45	36	53	22
France	–	–	46	17
Germany	–	–	31	9
Italy	14	8	26	8
Netherlands	24	21	41	15
Spain	–	–	25	11
UK	44	22	49	13
US	33	18	–	–

IALS = International Adult Literacy Survey – 1994–96

ECVTS = European Continuing Vocational Training Survey – 1999

Annual volume = hours per employed worker

Theory: Perfect Labor Market – schooling

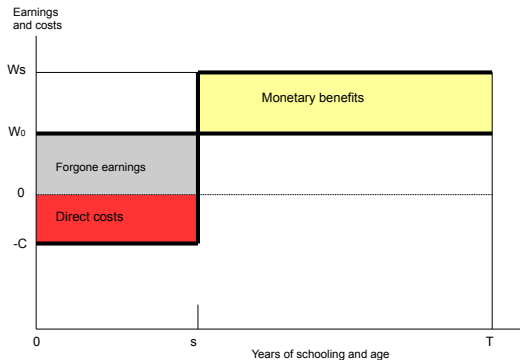
Basic assumption human capital model (Gary Becker, 1958):

- 1 More education \longrightarrow higher productivity
- 2 Higher productivity \longrightarrow higher wage
- 3 Individuals' choice is based on financial considerations

Investment decision:

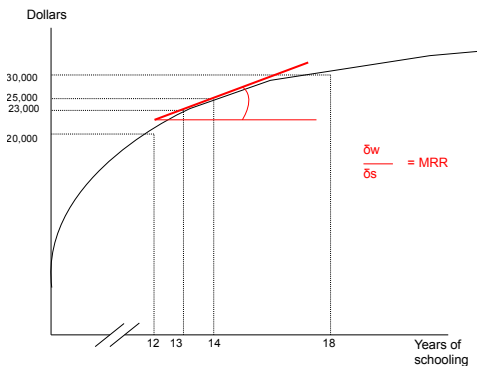
- Costs: direct expenses & forgone earnings
- Benefits: higher wage (and employment rate)

Graphical representation of schooling choice

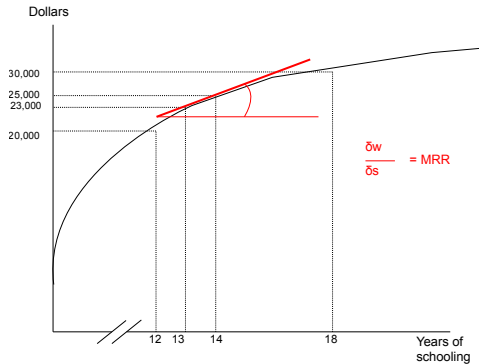


The Wage–Schooling Locus

The wage-schooling locus gives the salary that a particular worker would earn if he completed a particular level of schooling.

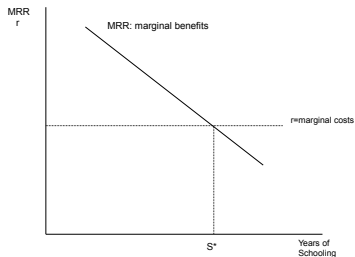


The Wage–Schooling Locus II



from 12 to 13 years of schooling: \$ 3000 extra – MRR = \$ 3000 = 15% / year
 from 14 to 18 years of schooling: \$ 5000 extra – MRR = \$ 1250 / year = 5% / year

Optimal level of schooling



- marginal revenues falling
- marginal cost: constant or rising (interest rate)
- marginal cost could be different for rich or poor households

Imperfect Labor Market: Schooling as a signal (Spence, 1970)

- Education reveals a level of attainment which signals a worker's qualifications to potential employers. Employer does not know productivity.
- Education → wage (but not via productivity)
- Information that is used to allocate workers in the labor market is called a signal
- Pooling Equilibrium: Firm can't distinguish good from bad workers: all get average wage
- There could be a separating equilibrium
 - Low-productivity workers choose not to obtain \bar{s} years of education, voluntarily signaling their low productivity
 - High-productivity workers choose to get at least \bar{s} years of schooling and separate themselves from the others

Signaling theory: numerical example

Cost of education differs:

- Less able: euro 25 s
- More able: euro 20 s

Lifetime Productivity - wage differs:

- Less able: euro 100
- More able: euro 240

What to do?

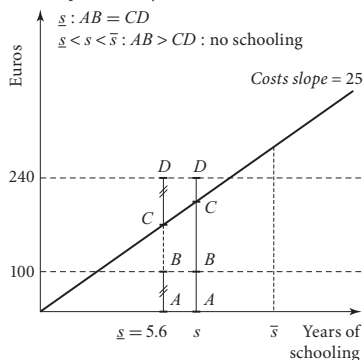
Search for threshold level of education such that less able chose lower educational attainment:

- less able: $100 > 240 - (25 * \bar{s})$ – so $\bar{s} > 5.6$
- more able: $100 < 240 - (20 * \bar{s})$ – so $\bar{s} < 7$

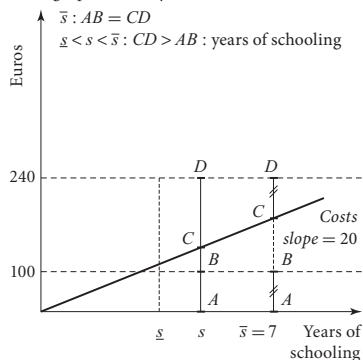
Conclusion $\bar{s} = 6$

Geometric illustration

(a) Low-productivity workers



(b) High-productivity workers

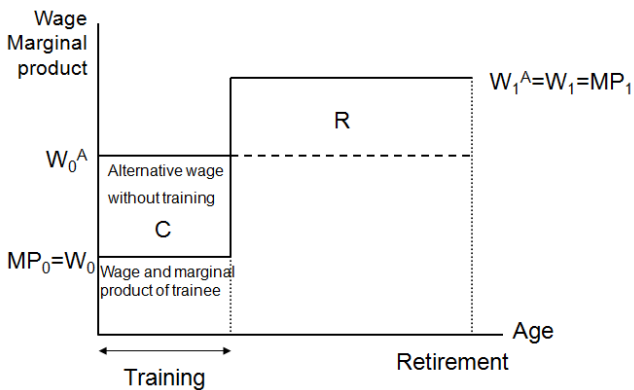


- 1 $AB > CD \longrightarrow 0$ years of schooling
- 2 $AB < CD \longrightarrow \bar{s}$ years of schooling

Training in Perfect Labor Markets

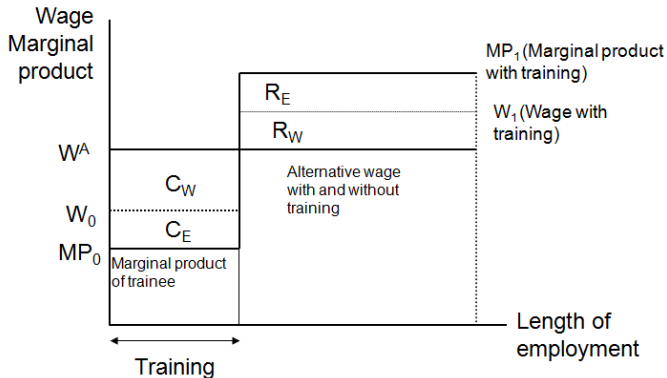
- Becker: Analysis under perfect labor markets
- General human capital theory:
 - training raises productivity of workers in current and other firms → increases alternative wage
 - Who invests in human capital?
 - Firms do not pay for general training, as firms will have to pay alternative wage or workers will leave firm
- Specific human capital theory
 - training only raises productivity in own firm, has no effect on productivity elsewhere
 - returns for worker and for firm
 - firm and worker split costs and benefits
 - incentives to stay together after investment
- in both cases: optimal training decision

General human capital



General training is paid by worker

Firm-specific human capital



Firm-specific training: paid by firm and worker

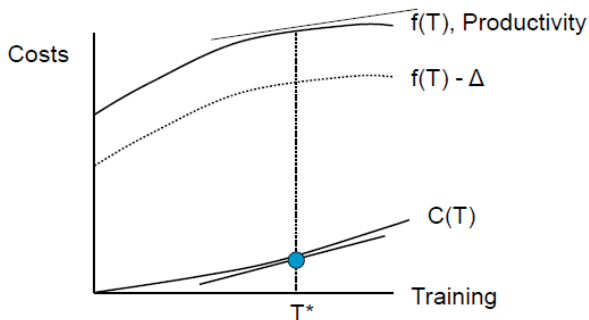
Training in Imperfect Labor Markets

Alternative theory general training: non-competitive markets

- Employers have **monopsony power**: worker is paid below productivity
- **Wage compression**: gap between wage and productivity increases with training
- Employers chooses the optimal level of training maximizing revenue
- Monopsony power: moving costs due to matching and search frictions, asymmetric information

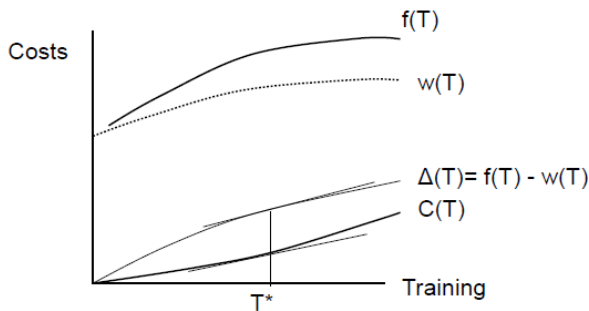
Acemoglu/Pischke Model:

A: No wage compression



- In how much training will be invested?: $f'(T) = C'(T)$
- Δ : profit of the firm
- Who pays for the training? Firms do not pay, but workers (as in model of Becker)

B: Wage compression

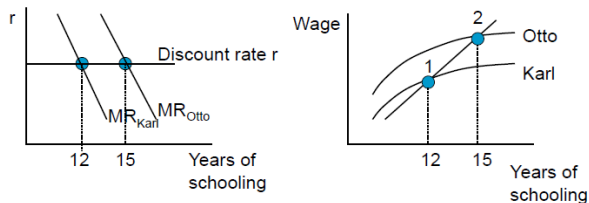


- Rising wage and productivity differentials
- Firm profits from training, because profit $\Delta(T)$ increases
 $\Delta(T)' = C'(T)$...offer of training by firm

The ability bias

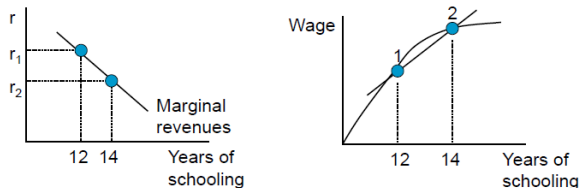
- $\ln(\text{wage}) = a + b * \text{schooling} + cX + \epsilon$
- Observed data on earnings and schooling do not allow us to estimate returns to schooling
- In theory, a more able person gets more from an additional year of education
- Ability bias - the extent to which unobserved ability differences exist affects estimates on returns to schooling (since the ability difference may be the true source of the wage differential)
- Ability may be correlated with years of schooling

Example 1: Two individuals with different skills



- Line from 1 to 2 does not measure returns on education (neither for Karl, nor for Otto)
- Ability bias: return to education overestimated: smarter people attend school for more years

Example 2: Two individuals with different discount rates



- Returns to education = line from 1 to 2
- According to the graphic, it might be possible to receive returns by an extension of duration of compulsory education
- Why are there different discount rates?

Different costs for education

- Imperfect capital markets
 - Human capital cannot be used as collateral at bank → higher interest rates
 - education is more expensive for poorer families
→ education credit, issued by the state to avoid liquidity constraints
 - However, it is difficult to prove liquidity constraints empirically, as family income is correlated with „attitude towards education “
 - Permanent income should be separated from temporary liquidity constraints (Cameron, Heckman, JPE 99), not easy.

Returns to schooling & identical twins

Ashenfelter and Rouse (1998)

- Correct for ability bias – sample of twins
- Annual Twinsburg Twins Festival (Ohio) → interviews 1991, 1992, 1993
- Sample: identical twins both of whom have held a job at some point in the previous 2 years
- Schooling difference: each twin reported own schooling and sibling's schooling

Returns to schooling & identical twins

Ashenfelter and Rouse (1998)

- Returns to schooling → percentage increase in wage due to 1 additional year of schooling
 - Account for differences in ability (more able → more education)
 - US sample of 340 twins
 - Direct estimate 10.2%
 - Twins: 8.8%
 - Ability bias: 1.4%-points

Causality: finding exogenous sources of variation in schooling

- Instrumental variables estimation
- Distance to school
- Season of birth → variation in compulsory schooling age
- Vietnam War lottery: each day of the year → random number; low numbers were drafted for the war; high number not. Through going to college one could avoid having to go to war. Low numbers had this incentive; high numbers not. Low numbers more schooling than high numbers (same ability)

Estimating Returns to Schooling in the UK

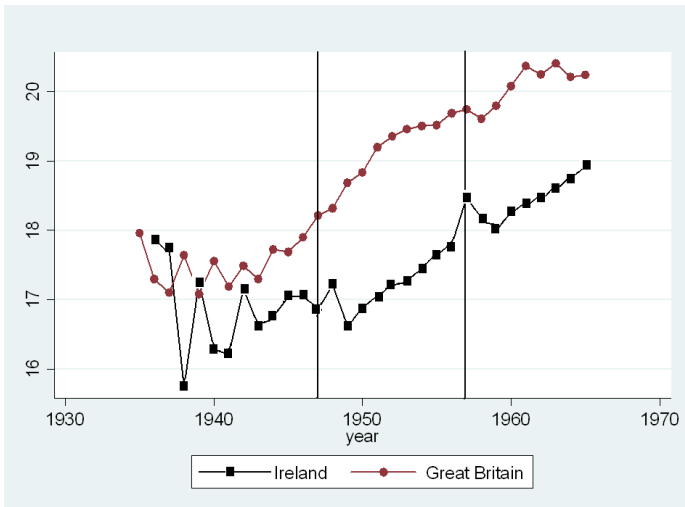
Oreopoulos (2006)

Correction of ability bias through variation of compulsory schooling age in UK.

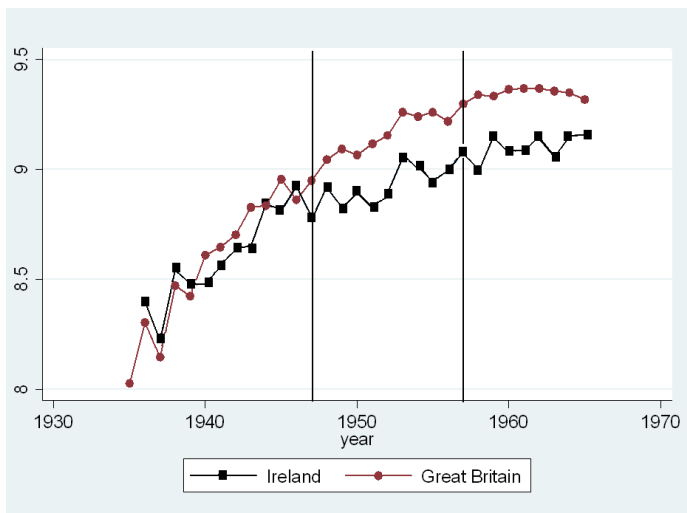
- Natural experiment:
- 1944: Education Act, minimum school-leaving age raised from 14 to 15 years old in England, Scotland, and Wales from 1947
- Control group: Northern Ireland (no change in compulsory school until 1957)

Estimating Returns to Schooling in the UK

- Clear difference in educational attainments before and after the 1947 policy change.
- The difference is reduced after the same policy change was introduced in Northern Ireland in 1957.
- Estimates: 5.5-7.0 percent increase in earnings, in average, associated with raising compulsory schooling to age 15.
- Advantages of the study: very large fraction of the population reacted to the reform
- *"The benefits from compulsory schooling are very large whether these laws have an impact on a majority or minority of those exposed"*

Average age left full-time education by year aged 14 (*Great Britain and Northern Ireland*)

Note: The upper dark line shows the average age a person left full-time education by year aged 14 for British-born adults aged 32 to 64 from the 1983 to 1998 General Household Surveys. The lower line shows the same, but for adults in Northern Ireland.

Average log annual earnings by year aged 14 (*Great Britain and Northern Ireland*)

Note: The upper dark line shows the average log annual earnings by year aged 14 for British-born adults aged 32 to 64 from the 1983 to 1998 General Household Surveys. The lower line shows the same, but for adults in Northern Ireland.

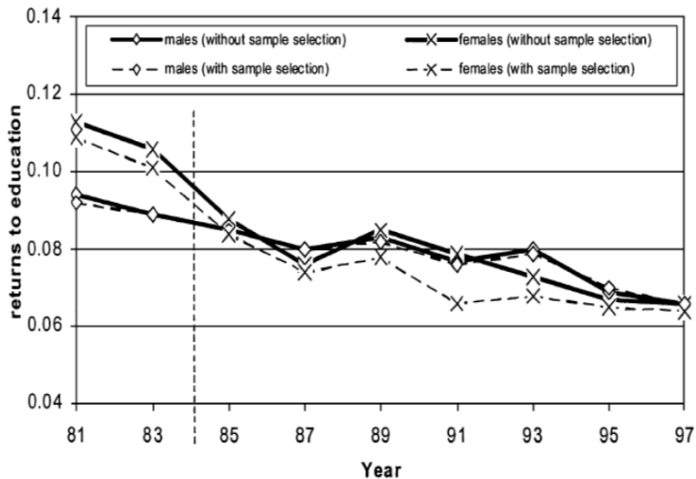


Fig. 1. The impact of sample selection: returns to education 1981–1997.

Returns to schooling and non-cognitive abilities

Non-cognitive abilities (perseverance, motivation, risk aversion, self-control...) are as important as cognitive abilities (intelligence) in determining future earnings

- Heckman et al., 2001: evidence from GED program (second-chance schooling option given to people who previously dropped out)
- GED guys are as smart as all the others, but they earn **less!**

Implications:

- Both cognitive and non-cognitive abilities can be precisely measured
- They are not only genetically determined: they can be enhanced by investments made by family and society
- Life-cycle very important for their development

Box 8.4 On-the-job training in Germany/Austria

- Training in imperfect labor markets
- Firms voluntarily offer apprenticeships to workers entering the labor market
- Firms that train have to follow prescribed curriculum
- Apprentices take rigorous outside exam at the end of their apprenticeship
- Training is monitored by worker councils
- Most of the skills acquired = general training

Box 8.4 On-the-job training in Germany/Austria

Acemoglu and Pischke (1998)

- Why do German firms do this → do they have monopsony power?
- Mobility of workers is restricted
- No direct investigation of training – instead: focus on presence of adverse selection – **informational monopsony power: firms have better knowledge of quality of apprentices**
- 3 cross-sections (1979, 1985-86, 1991-92) German “Qualification and Career Survey”
- Gross monthly wages

Box 8.4 On-the-job training in Germany/Austria

Acemoglu and Pischke (1998)

- Quits or layoffs signal low quality – exogenous separations can break informational monopsony power
- Military quitter: left apprenticeship firm immediately & mention military service as reason – unrelated to ability
- Relative to voluntary quitters' wage increase
 - Stayers: 1.2%
 - Military quitters: 4.5%
- Military quitters earn more because they are separated for an exogenous reasons and therefore are perceived by market as of higher quality

Policy issue 1 – Should there be a compulsory schooling age?

- All OECD countries compulsory schooling age
- Is it welfare improving?
- Individuals may be shortsighted – too high discount rate – ignore future benefits (higher wages, lower unemployment)
- If social returns $>$ private returns: governments may step in and subsidize \rightarrow scholarships are welfare improving
- If only liquidity constraints, but no higher social returns, then student credits would do it.

Policy issue 2 – Should governments subsidize in-company training?

- Is it optimal from a welfare point of view?
- Deadweight loss?
- Answer depends on market power of firms
- Competitive market – employers reluctant to invest in training – if productivity goes up: social returns to training
- Social returns – based on gross wage; private returns – based on net wage
- If social returns $>$ private returns: governments may step in and subsidize
- In non-competitive markets: employers will do optimal training

Overlaps with other institutions

- Payroll taxes: incentives to extend schooling & to attend training
- Unions: training
- Employment protection:
 - if not – no training
 - if too much – no training
- Retirement programs:
 - a longer working life increases the lifelong returns from education by enabling individuals to enjoy education premia for a longer time span
 - on-the-job-training may reduce the productivity losses typically associated with ageing, increasing the demand of older workers

Why do governments provide education and training?

- Having a higher educated population and a well-trained workforce has positive externalities – competitive asset
- Capital market imperfections → impossible or difficult to borrow → sub-optimal investments in human capital
- Investment in schooling and training → national income goes up

Technical Annex: Schooling decision – theory s or $s + 1$ year?

$$NPV_s = \sum_{t=0}^T \left(\frac{1}{1+i}\right)^t w_s = w_s + \sum_{t=1}^T \left(\frac{1}{1+i}\right)^t w_s$$

$$NPV_{s+1} = -C_s + \sum_{t=1}^T \left(\frac{1}{1+i}\right)^t w_{s+1}$$

The individual will attend another year of schooling as long as

$$\sum_{t=1}^T \left(\frac{1}{1+i}\right)^t (w_{s+1} - w_s) > w_s + C_s$$

Technical Annex: Schooling decision – theory s or $s + 1$ year?

if $C_S \approx 0$,

$$w_{S+1} - w_S = w_S i$$

So the previous condition becomes

$$w_{S+1} > w_S(1 + i)$$

So

$$\ln(w_{S+1}) > \ln(w_S) + \ln(1 + i) \approx \ln(w_S) + i$$

and therefore

$$\ln(w_{S+1}) - \ln(w_S) > i$$

Review questions

- 1 Why do firms pay for general training even though trained workers are valuable for other firms as well?
- 2 Why is it difficult to measure returns to schooling?
- 3 Why should not all students try to achieve an academic degree?
- 4 Does it matter for the schooling decisions of the individual to what degree schooling is a signal of innate productivity?
- 5 Should the state subsidize on-the-job training?

Exercise

Paola is about to decide which career path to pursue. She has narrowed her options to two alternatives. She can become either an economist or a concert pianist. Paola lives for two periods. In the first one, she gets an education. In the second, she works in the labor market. If Paola becomes an economist, she will spend 15,000 on education in the first period and earn 472,000 in the second. If she becomes a concert pianist, she will spend 40,000 on education in the first period and then earn 500,000 in the second. Suppose Paola can lend and borrow money at a 5 per cent annual rate.

- 1 Which career will she pursue?
- 2 What if she can lend and borrow money at a 15 per cent interest rate? Will she choose a different option? Why?
- 3 Suppose musical conservatories raise their tuition so that it now costs Paola 60,000 to become a concert pianist. What career will Paola pursue if the discount rate is 5%?