Topic 1 - Human Capital

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Economics 471

Human Capital

- Under labour supply we emphasized the quantity of labour supplied but there is also a quality dimension
- In the section on compensating wages we talked about how negative job attributes like risk involved compensating wages to entice workers to those jobs
- This theory can also be applied to jobs that require workers to go through the costly process of acquiring human capital
- Thus, human capital can influence the quality of labour supplied to the economy as well as the wage that workers are paid
- We will look at two types of human capital

(1) Formal education

(2) Training

Human Capital Theory

- Investments are made in human resources to improve their productivity and their earnings

Why "investment"?

- Costs are incurred in the expectation of future benefits
- Like all investments we need to ask if it is economically worthwhile (i.e. benefits>costs)

Costs (2 components):

(i) Direct Costs

e.g. books, tuition fees etc.

(ii) Opportunity Costs

- Income foregone while acquiring human capital

- Difficult to measure what someone could have earned

Human Capital Theory

- We must also distinguish between the consumption and investment components of human capital

Consumption: acquire education because you enjoy learning

Investment: learn to get a high paying job

- Distinguish between private and social costs and benefits

Private: costs and benefits that accrue to the parties making the investment

Social: costs and benefits that accrue to society i.e. private and 3rd party external cost/benefits

Human Capital Theory

- Distinguish between real and pecuniary costs and benefits

Pecuniary: do not involve the use of real resources but a transfer from one group to another

e.g. savings in EI that result from a retraining program

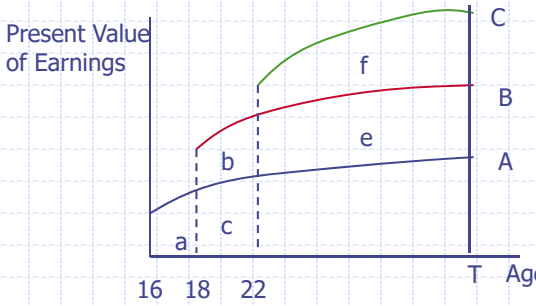
- These represent a reduction in transfer payments (winners=losers) not a newly created benefit
- should not be included in social costs/benefits

Real: involve the use of real resources

- Should be included in social costs/benefits

Formal Education

We can represent the education decision as follows:



- Earnings are measured in present value (comparable)
- T=terminal age (death)
- Graph gives income streams for different levels of education (age-earnings profiles)

A: did not complete high school (10 yrs ed. At age 16)

B: Completed high school (start at age 18)

C: University/College degree (start at age 22)

Notes

(1) Earnings increase with age but at a decreasing rate

- Reflects the fact that workers continue to make investments through on-the-job training/experience
- Adding more to productivity and earnings early in their careers and then diminishing returns set in late in their career

(2) Earnings of those with more years of education generally lie above those with fewer years of education

i.e. education provides skills which increase productivity

- Individuals with more education can still earn less than those in their age cohort with less education
- because of productivity enhancing effect of experience

Optimal Lifetime Income Stream?

First we need some simplifying assumptions

1. Individual receives no direct utility or disutility from education

- education is an investment

2. Hours of work are fixed (includes hours in acquiring education)

- comparing income only

3. Income streams are known with certainty

- gets rid of uncertainty/risk

4. Can borrow/lend at real interest rate (r)

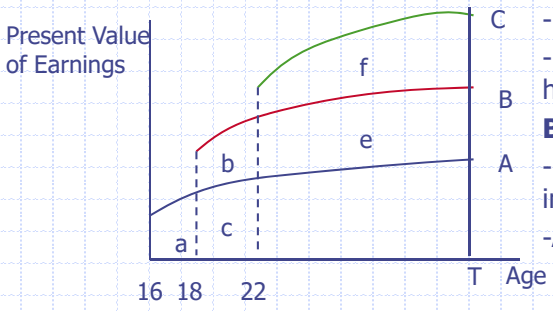
- perfect capital markets - "lifetime" earnings matter

Optimal Lifetime Income Stream?

Given these, choose the quantity of education to maximize the net present value of lifetime earnings

Costs and benefits:

(i) Attaining high-school education



Opportunity Costs:

-Forego shaded region (a)

-Earnings you would have had if quit school

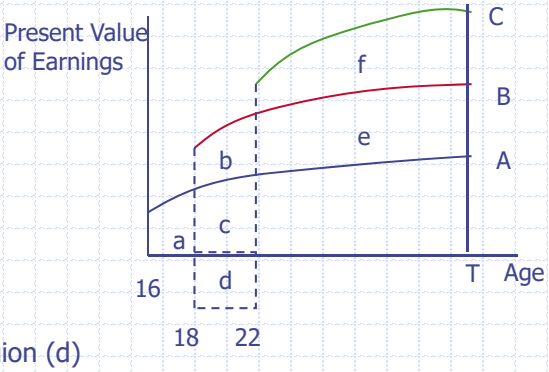
Benefits:

-Difference between income streams A and B

-Areas (b) and (e)

Costs and Benefits

(ii) High School grad contemplating university



Costs:

Direct: region (d)

Opportunity: (b)+(c) = foregone earnings

Benefits:

Area (f) - difference between earnings profiles B and C

Example, Present Value Calculation

18 year old high school graduate considering university:

- Work until age T (retirement)
- Income at each age if she chooses high school is Y^H(age)
- Assuming she works now at age 18

$$PV(H) = \frac{Y_{18}^H}{(1+r)^0} + \frac{Y_{19}^H}{(1+r)^1} + \frac{Y_{20}^H}{(1+r)^2} + \ldots + \frac{Y_T^H}{(1+r)^{T-18}}$$

- If she goes to university income at each age is Y^U(age)>Y^H(age)
- However, she will earn nothing for four years and will incur direct costs of $D per year

$$PV(U) = \frac{-D_{18}}{(1+r)^0} + \frac{-D_{19}}{(1+r)^1} + \ldots + \frac{Y_{22}^U}{(1+r)^4} + \ldots + \frac{Y_T^H}{(1+r)^{T-18}}$$

- We could compare PV(H) to PV(U) to determine whether or not it is rational to obtain a university degree

Example, Present Value Calculation

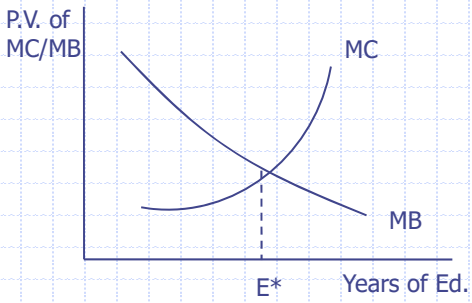
- These calculations can be tedious
- Instead, we might simply compare the PV of benefits to the PV of costs

$$PV(B) = \sum_{t=4}^{T} \frac{Y_{18+t}^U - Y_{18+t}^H}{(1+r)^t}$$

$$PV(C) = \sum_{t=0}^{3} \frac{Y_{18+t}^H + D_{t+18}}{(1+r)^t}$$

- This is precisely the same as comparing PV(H) to PV(U)

Alternative Portrayal



MB declines with years of education because:
1. Diminishing returns to ed.
2. Shorter period to receive higher income

MC rises with years of education because foregone earnings increase with increased education

- The individual should increase years of education until the present value of benefits (year of ed.) equals the present value of the additional cost
- Where MB=MC yields the maximum net present value of lifetime earnings

Problems

1. May not have this kind of detailed information

Models still might predict well

- Most people take into account at least some of the costs and benefits
- In groups, deviations from the optimum tend to offset each other

2. Simplifying assumptions may not be realistic

(i) Individuals may enjoy school

(ii) Capital markets may not be perfect - difficult to borrow against future earnings (no collateral)

- We could relax these assumptions

Education and Market Equilibrium

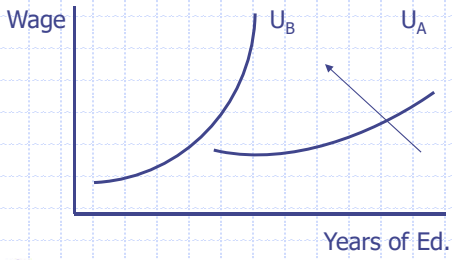
- The wages and education levels we observe are a result of the interaction between individuals and employers
- To understand this relationship we must look at the interaction between individuals and firms
- Different workers have different preferences for education
- Different firms will value skilled workers differently

Workers' Preferences for Education

- Suppose there are 2 types of workers

Type A: Strong preferences for education (could be because of ability or disutility derived)

Type B: Dislikes education



- Both require a higher wage to increase education
- Education is costly
- Workers like higher wages but dislike ed. because of cost
- Thus, utility increases up and to the left

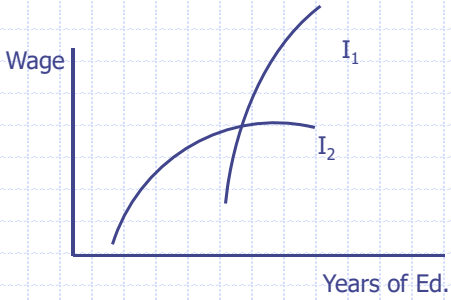
- Requires less of a wage increase to get A to increase education than B while holding utility fixed
- A's indifference curve is "flatter"

Firms' Iso-Profit Curves

- Suppose there are 2 types of firms

Type 1: Values skilled workers highly
e.g. computer software firm

Type 2: Values skilled workers less
e.g. textiles firm



- Positively sloped Iso-Profits
- Higher wage can be paid to higher educated workers (greater productivity)

Firms' Iso-Profit Curves

Firm 1: Iso-profit is steeper

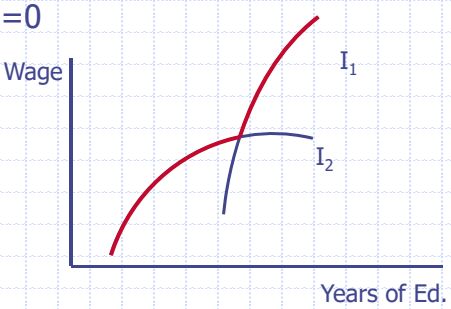
- Able to pay a larger wage increase to workers with more education - holding profits fixed

Firm 2: Iso-profit is flatter

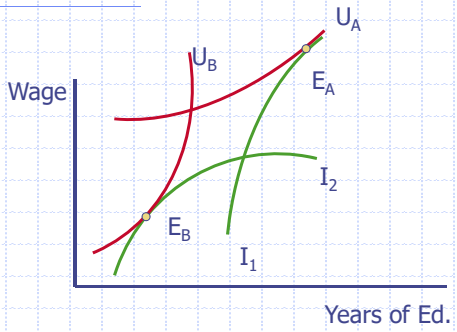
- Can't pay a higher wage for education
- Perfect competition $I_1=I_2=0$

Employers Offer Curve:

- Maximum wage for each level of education
- Boundary of two curves



Equilibrium



Pareto Optimal:

Both workers are better off than if they were to switch firms

- The worker with more education receives a higher wage (compensating differential)
- The magnitude of the differential depends on preferences of workers and technology of production
- Employees with strongest preferences for education are matched with employers who value education the most

Empirical Evidence

- Most early studies include men only because of intermittent labour force participation of women
- Basic idea is to run regressions with lots of things that should affect wages (occupation, industry, experience etc.) and see what effect education has

Results:

1. Strong relationship between education and earnings
   - Income streams of the educated are above the less educated
2. Earnings increase with age (experience) until about age 40-50 and then decline
3. Earnings increase most rapidly for those with the most amount of education

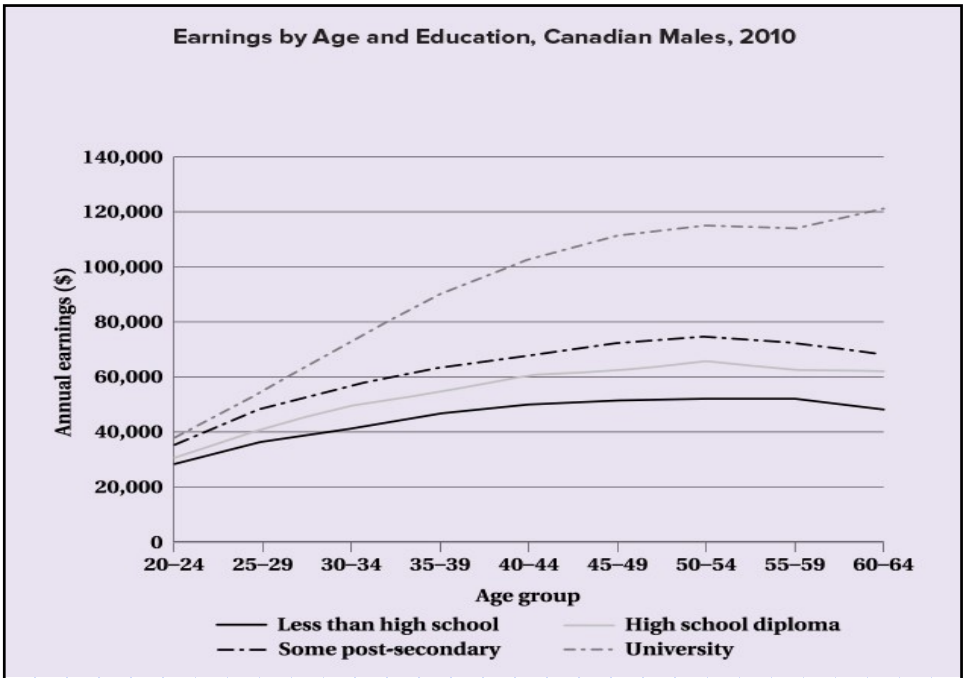


TABLE 9.1 Estimates of the Private Returns[1] to Schooling in Canada, 2000

Level of Schooling	Males	Females
Bachelor's degree[2]	12	14
Master's degree	3	5
Ph.D.	nc[2]	4
Medicine	21	22
Bachelor's Degree by Field of Study	**Males**	**Females**
Education	9	14
Humanities and fine arts	nc	10
Social sciences[3]	11	14
Commerce	9	19
Natural sciences	9	8
Engineering and applied science	9	14
Health sciences	18	18

NOTES:
1. Rates of return by level of schooling are calculated relative to the next-lowest level. For example, the return to a bachelor's degree is relative to completed secondary school, and the return to a master's degree is relative to a bachelor's degree.
2. "nc" indicates "not calculated" because that estimated returns were not significantly different from zero, statistically.
3. Social sciences includes law degrees.
SOURCE: Adapted from *Extra Earning Power: The Financial Returns to University Education in Canada*, p. 3. C. D. Howe Institute. Used with permission.

Problems

There are some problems with estimating the returns to education

1. Ability Bias
   - Difficult to control for ability
   - More able are inherently more productive and may also get more education
   - Thus, some of the returns to education may, in fact, be a return to innate ability
   - Some studies use test scores or, more ingeniously, twins to control for ability

Problems

2. Selectivity Bias
   - You may get the right education to prepare you for a job you simply have an aptitude for

e.g. 2 people and 2 occupations

Person A: mechanically inclined

Person B: bean counter

Can choose to be either a mechanic or an accountant

   - Need college degree to be accountant
   - Both A and B could become an accountant
   - B's wage would likely be higher (better at it)
   - Possible that college graduation is a signal, not actually adding productivity

Signalling/Screening Hypothesis

- Higher education acts as a filter (screening the more able) rather than enhancing productivity
- Workers signal unobserved ability and firms use education to screen workers
- Bachelor's diploma represents a "sheepskin"

Model Assumptions:

- Asymmetric information
  - The employee knows his/her productive capabilities but the employer does not observe them
  - Even after hiring it may take time to determine productivity
- Employers do observe some characteristics of workers

Signalling/Screening Hypothesis

Indices: observable, unalterable characteristics

- Sex
- Race

Signals: observable, subject to manipulation by the worker

- Education – one can invest in at some cost

- Employers may form "beliefs" about the relationship between education and productivity
- Perhaps based on past experience

Market Equilibrium:

- Beliefs about the relationship must be realized
- Employers will offer higher wages to more educated workers if they believe there is a positive relationship

Signalling - Model

- Suppose there are two types of workers
  - Low ability (L)
  - High ability (H)
- Type L have marginal productivity of 1
- Type H have marginal productivity of 2

Education (the signal) is acquired at a cost

- Education is measured in years (y)
- The costs are both financial and psychic
  - Cost to type L = $y
  - Cost to type H = $y/2
- Could be that it takes able workers less time or that they simply dislike school less

Signalling - Beliefs

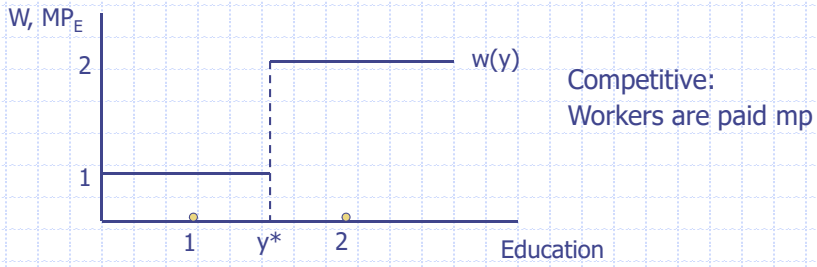
- Suppose that the employer's beliefs are as follows:

If $y<y^*$ then mp=1 (Type L)

If $y \geq y^*$ then mp=2 (Type H)

- There is some critical value of education above which individuals are believed to be type H below which they are believed to be type L

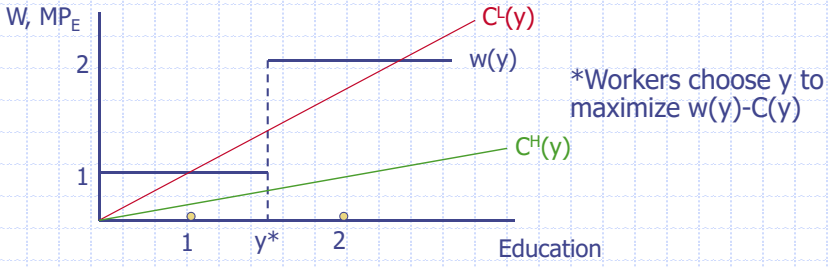
Thus, the employer's offered wage curve w(y) will be:



Competitive:
Workers are paid mp

Signalling - Equilibrium

- Persons who choose y<y* will set y=0
- Education is costly
- Persons who choose y≥y* will set y=y*
- If the employer's beliefs are confirmed type L workers choose y=0 and type H set y=y*
- We can add in the cost schedules to see if this is true (i.e. if this is an equilibrium)



*Workers choose y to maximize w(y)-C(y)

Signalling - Equilibrium

Type L will choose y=0

- Net wage = $1 (cost=0, receive w=1)
- If they choose y*
- Net wage = $2-$y* <$1

Type H will choose y=y*

- Net wage = $2-y*/2 >$1
- As opposed to w=$1 choosing y=0

Can show that the equilibrium requires y* to be between 1 and 2 years of education

- L chooses y=0 if 1>2-y*
- H chooses y=y* if 2-y*/2>1
- Together these imply 1<y*<2

If not, the employer would alter the offered wage curve

Notes on Signalling

1. There are an infinite number of equilibrium values for y*
   - The equilibria are not equivalent in terms of welfare
   - Increases in y* hurt type H workers while type L workers are unaffected
   - Type L workers are worse off than if there was no signal (get average marginal product)
2. The education level (y*) acts as an entrance requirement for the high-salary job
   - From the outside education might appear productive (wages increase with education)
   - However, education acts strictly as a signalling or sorting mechanism
   - Education is productive for the individual (wage)

Notes on Signalling

3. The private and social rates of return will differ

Private Returns – increase in earnings

Social Returns – increase in national income

- With the signalling model there are positive private returns but zero social returns
- Ignores the fact that signalling serves the useful role of sorting workers into the right jobs
  - Mismatch cost could be large if a type L worker winds up running a nuclear power plant!
- Within the confines of the model there are more or less efficient ways of getting sorting
  - e.g. increase in y* gives same result but higher costs

Empirical Evidence

- The few studies that test between human capital and signalling are based on the following notion
- Employers observe the level of education but not the "quality" of that education
- Increases in quality affect human capital but not the signal

Example, Kang & Bishop (86) look at high-school grads:

- Diplomas are generally homogeneous to employers, but can be obtained taking easy or hard courses
- They find that, holding other courses fixed, taking difficult courses is associated with lower wages

Overall, these tests have not been conclusive

- Education is not purely a signal it has some impact on productivity
  - i.e. medicine, law and engineering are more than elaborate screening devices!

Training

- Form of human capital

Becker - 2 types

1. General Training:

- Skills that can be used in various firms not just in the firms that provide the training
- e.g. operating a sewing machine

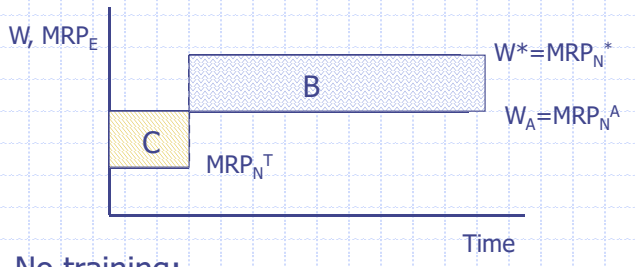
2. Specific Training:

- Skills that are useful only in the company that provides the training
- e.g. Working with software specific to the firm (airline industry)

General Training

- Firms can bid for general training by offering a wage that is higher by an amount equal to the value of the training
- Therefore, the trainee would be willing to pay for the training as long as the benefits (higher earnings) exceed the costs
- If the company paid for training they would still have to bid against other companies for the services of the trainee

General Training



The costs of training = C

The benefits of training = B

No training:

- Worker receives $W_A = MRP_N^A$

Training:

- During training, the value of the worker's output is MRP_N^T (could be zero)
- After training, the worker's value in production to any firm rises to MRP_N^*

Who Pays for General Training?

Employee:

- Could finance training if C<B and earn w* after training

Firm:

- Could pay for training and reap the benefits
- i.e. pay the worker w_A before and after training

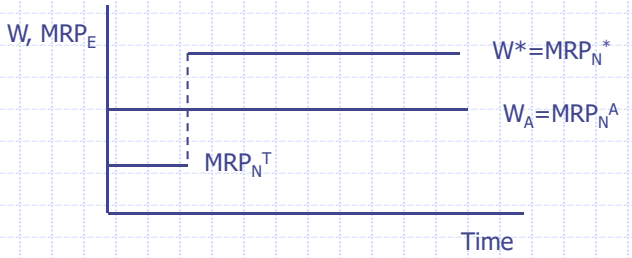
Problem?

- Worker is likely to leave after training to collect w* somewhere else

* Thus, general training is likely to be financed by employees

Specific Training

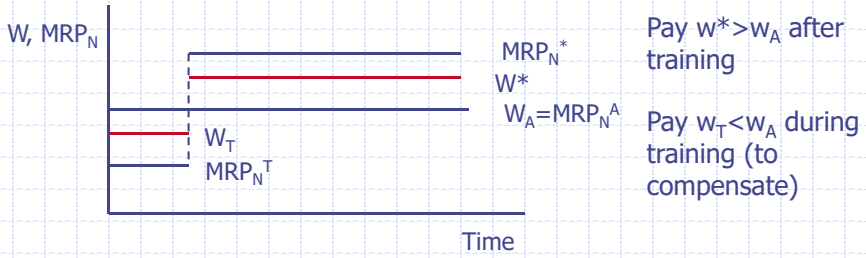
- Other firms have no incentive to pay higher wages
- The trainee would not bear the costs because he/she won't get the benefits of a higher wage
- The firm would bear the costs if the benefits outweigh the costs (wouldn't have to pay a higher wage after training)



The firm would pay w_A before and after training

Shared Investment?

- The firm faces the risk that the worker will quit after the training (can get w_A elsewhere)
- Thus, the anticipated return (B) is eliminated
- Alternatively the firm could pay the worker a wage premium to reduce turnover and increase the probability of receiving B



Pay $w^* > w_A$ after training

Pay $w_T < w_A$ during training (to compensate)

- Thus, both the employer and employee incur costs and reap benefits of training

Shared Investment?

- This also minimizes the risk that either party will terminate the employment relationship

Both earn rents after training:

Employer: $MRP_N^* - w^*$ each period

- Only lay off if MRP_N falls below w^* due to demand shocks

Employee: $w^* - w_A$ each period

- Only quit if w_A increases above w^*

Note:

- May not be easy to distinguish between general and specific training
- Even if skills aren't transferable could act as a signal that the worker is capable of learning

Role of Government

- Are there situations when the private market does not provide a socially optimal amount of training?

1. Workers can't afford a lower wage during training

2. Workers can't borrow against future earnings

3. If there are positive external effects from training firms may under invest

4. Training could be a public good

- i.e. available to all workers and difficult to exclude those who don't pay