Human Capital, technology and growth
(Adnett ch.4; Employment in Europe ch.4)

- *"To became the most competitive and dynamic knowledge based economy"* is one of of the main goals of the EU since year 2000.
- At the basis the hypothesis that *human capital is a key determinant of economic growth* and that European countries should invest more in education and training (currently EU investment in tertiary education is only 1,2% of GDP compared to 2,9% in the USA) and in research and development (currently the EU GDP allocated to R&D is 1,9% relative to 2,6% in the USA).
- *How do economic models explain investment in Human capital?*
- *Is there a causal relation going from investmnet in HC to economic growth*?
- *What are the policy implications?*

Human capital theory/1
Main assumptions

Basic assumptions coming from the necolassical theory:

- The *individual acts rationally* in his/her choice of how much to invest in education/training: he/she maximises lifetime income.

- *Education/training increase the individual's labour productivity* and, given the neoclassical theory of labour demand, *increase future earnings*. Thus each level of education/training is uniquely related to an earnings stream.

- The *marginal rate of return to human capital investment declines as the quantity of HC acquired increases*, due to diminishing marginal returns to ability (ability is fixed).

Human capital theory/2:The individual choice

As with other investment choices, the individual compares the *present value of expected benefits (returns) and expected costs* of the investment.

- The **benefits (R)** are future earnings. Their present value is:

$$\mathbf{R = \Sigma \ k_t \ (1+i)^{-t}}$$

    where   t = years from 1 to N

                i = market rate of returns of comparable investments

                N = length of remaining working life

            k_t = expected additional annual earnings in the tth year

- The **costs (C)** are direct and opportunity costs (forgone earnings while studying)

- The individual will invest up to that level of education and training where the marginal benefits just exceed the marginal costs: **R≥C**

- This equilibrium level is the one where *the <u>rate of return</u> to investment in human capital (r) equates the rate of return on capital investments of comparable risk and uncertainty (i): **r = i.***

Human capital theory/3: demand and supply of investment in HC

- The *demand of human capital investment* depends on its expected rate of return. Since the marginal rate of return to human capital investment is assumed to decline as the human capital acquired by the individual increases, the *individual demand for HC will decline as investment increases (negatively sloped demand for HC investments)*

- The *supply* of funds for investments in human capital, on the other hand, *is related to the rate of interest to be paid on such funds (*funds are obtained by borrowing or selling assets). Since the interest rate increases as extra funds are neeeded for additional investments, the *supply curve of funds for investment in HC will be positively sloped.*

See figure 4.1 pg. 97 Adnett

Human capital theory/4: implications

- According to the basic HC model, if there is *perfect information and perfect capital markets,* each individual will invest the optimal amount of HC and wage differentials will only reflect differences in labour productivity coming from different investments in HC. There may be skill shortage in the short run, due to changes in technology and labour demand, but in the long run, due to changes in the relative wages, these shortages will be absorbed.

- *Factors which reduce the costs of financing* the HC investments (such as student loans) shift the supply curve to the right, increase the equilibrium level of investment (I*) and reduce the the equilibrium rate of return (r*).

- *Factors which rise the returns to investments* (such as increasing wage differentials for educated workers) will shift the demand curve to the right and increase both I* and r*.

Human capital theory/4: implications (cont.)

- However: *if capital markets are imperfect* and internal financial sources are cheaper than market sources, individuals from rich families will tend to invest more in education than the poor (because they have lower interest rates to pay over funds and are less risk averse than poor individuals)

- if *individuals have different abilities*, the more able individuals will invest more in education. However if the more able are poor and there are capital markets imperfections the more able may not be able to invest in education and there will be an underinvestment in education. On the other hand, if the less able are rich they may invest more than desiderable on efficiency grounds.

- If *information is asymmetric*, the firm may use education as a signal of the individuals' ability, which may be the only factor determining the individuals' productivity (screening models). In this case there is no need to support investment in HC, which is very costly, but only to increase information on individuals abilities.

Human capital theory/6: on the job training

- Investment in HC does not end with schooling, but continues with work experience and training on the job. This explains why wages increase with work experience up to a certain age, to level off afterwards.
- While investments in education are usually borne by individuals/ households, investment in training on the job may be borne either by workers, or firms or both. On the job training is:
- ➤ Financed by the worker (by accepting lower wages during training) when it is *general* : i.e. it increases transferable skills enhancing workers' productivity both within the present firms and other firms (it increases the wage the worker may get in all firms)
- ➤ Financed by the firms when it is *firm specific* : i.e. it is not transferable and only increases the worker productivity in the present firm and not in others.
- ➤ It is *financed by both* when it is firm specific, but there is high labour turnover. In this case the costs and benefits of training are shared by workers and firms: the wage profile is lower than productivity during training and higher afterwards.

Costs and returns of training on the job
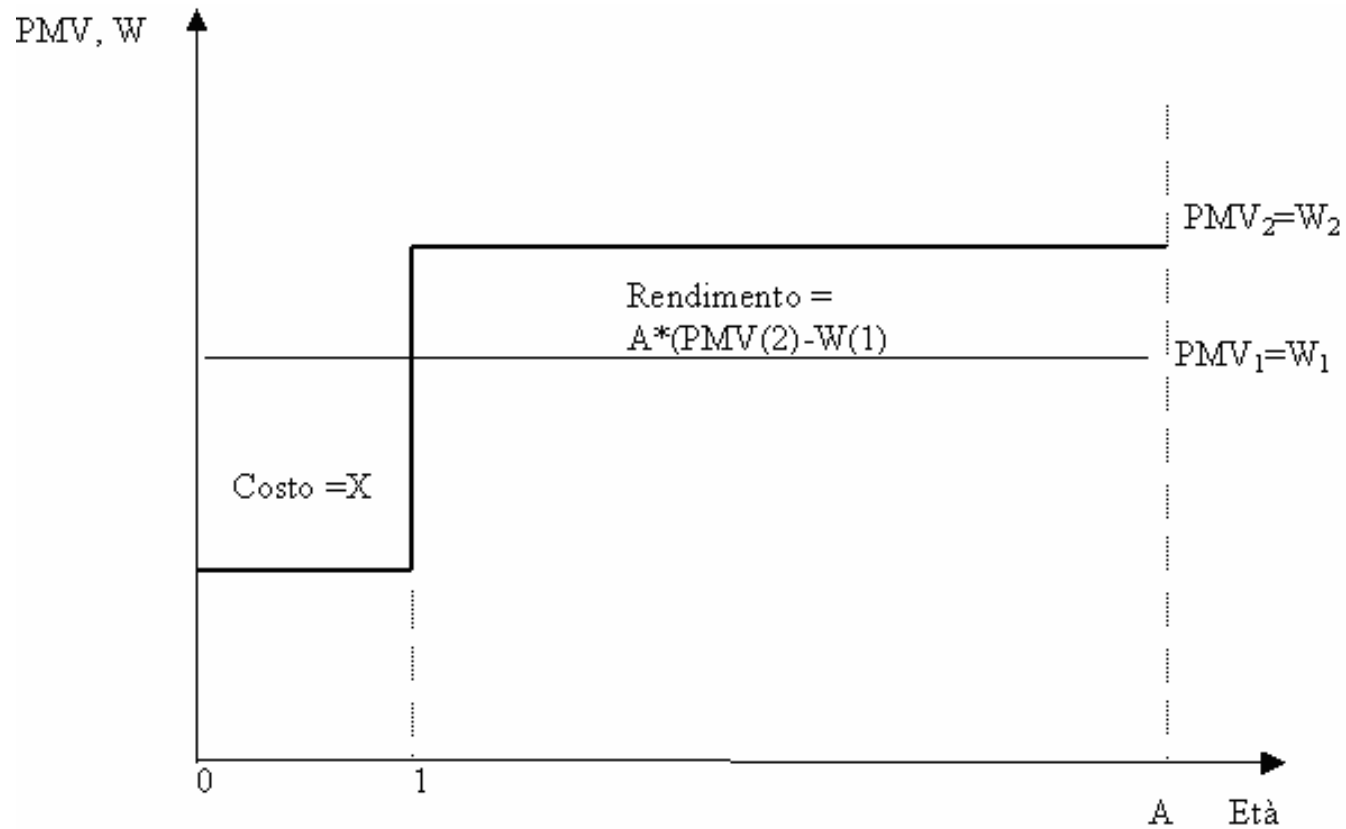
Policy implications/1

- If markets of capital, product and labour are perfectly competitive and individuals behave rationally , their investments choices should be at the optimal level and there should not be any intervention. A rationale for public intervention comes from **market failures, externalities and equity** considerations.

1. **Market failures:**

➢ **in capital markets** make it more difficult and costly to obtain funds for HC investments than for physical capital, because HC is illiquid and non transferable. Moreover these difficulties may be higher for poor individuals (equity motivations) thus reducing their possibility to invest in education and training and reinforcing, rather than reducing, social and income inequalities.

➢ **incomplete information** may also be an obstacle to informed decisions and lead to suboptimal results. Again the risk is that the lack of adequate information is greater for individuals coming from poor households.

2. **Externalities**.

➢ **Human capital is a merit good**: the social benefits (monetary and non monetary) of HC are higher then the private ones, while the social costs are lower than private costs, due to scale economies. Thus there is the risk of underinvestment if investment is only left to individuals' decisions.

➢ At the macro-economic level, **investment in HC can generate positive growth externalities**, as a more educated and trained workforce increases the probabilities of successfull innovation and this generates higher expenditure in R&D and faster productivity growth (*theories of endogenous growth*)

Policy implications/2

If social returns are higher than private ones and there are market failures is efficient to have public financing of investment in HC.

How much investment should be supported with public funds?

- Compare the social costs and benefits of public investment in HC, considering the trade off between equity and efficiency goals:

➢ **Equity**: offer education and training opportunities especially to those with lower possibilities to access education and training in order to reduce social inequalities.

➢ **Efficiency**: given the scarsity of resources it is more efficient to concentrate public resources on the most able and support market competition in the provision of education and training.

The choice depends on the distribution of ability and income among the population and on the social preferences in the trade off between equity and efficiency.

Note that equity reasons ask that only compulsory education be completely financed by public resources, while tertiary education should be paid by users to avoid the non users (usually low income families) paying for the education of users (usually coming from high income families).

In order to reduce inequalities in the access to tertiary education it is better to adopt scholarships and student loans for able students coming from low income households.

Estimating the rate of return to human capital

The most common way to estimate the rate of return to schooling and training is to estimate a so called *Mincerian wage equation:*

$$\text{Log W} = \alpha + \beta\,\text{S} + \delta\,\text{E} + \gamma\,\text{E}^2 + \varphi\,\text{D} + \varepsilon$$

where S = years of schooling

E and E^2 = years of experience/ on the job training

D = vector of dummy variables of personal characteristics

ε = error term

There are some *specification problems* in estimating this equation:

1. The main one is due to the fact that both wages and schooling may depend from other (un)observable variables (such as **ability** and/or **family background**) and if this occurs, the estimated return are biased.

2. Another is that on the job training may be affected by education (the most educated are more likely to receive training on the job) and the two variables schooling and experience and interrelated

3. Quality of schooling and of jobs are not considered

Use of alternative econometric methods and adequate data   (for example considering twins to correct for ability) to correct for these problems

Estimations of private returns to education in European countries

Tab. 2.3. *Stime dei rendimenti dell'istruzione per diversi paesi europei*

	Uomini	Donne
Austria (1995)	0,069	0,067
Danimarca (1995)	0,064	0,049
Germania (Ovest) (1995)	0,079	0,098
Olanda (1996)	0,063	0,051
Portogallo (1994-95)	0,097	0,097
Svezia (1991)	0,041	0,038
Francia (1995)	0,075	0,081
Gran Bretagna (1994-96)	0,094	0,115
Irlanda (1994)	0,077	0,105
Italia (1995)	0,062	0,077
Norvegia (1995)	0,046	0,050
Finlandia (1993)	0,086	0,088
Spagna (1994)	0,072	0,084
Svizzera (1995)	0,089	0,092
Grecia (1994)	0,063	0,086
Media	0,072	0,079

Nota: Tra parentesi l'anno a cui si riferiscono i campioni di popolazione su cui sono state svolte le stime. I valori sono stimati calcolando l'esperienza potenziale come (età – anni di studio – 6).

Fonte: Brunello *et al.* [1999, tab. 4].

Table A13.4.

Social rates of return to education (1999-2000)

Rates of return to upper secondary and tertiary education, by gender (in percentage points)

	Social return in upper secondary education[1]		Social return in tertiary education[2]	
	Males	Females	Males	Females
Canada[3]	m	m	6.8	7.9
Denmark	9.3	8.7	6.3	4.2
France	9.6	10.6	13.2	13.1
Germany	10.2	6.0	6.5	6.9
Italy[4]	8.4	m	7.0	m
Japan	5.0	6.4	6.7	5.7
Netherlands	6.2	7.8	10.0	6.3
Sweden	5.2	m	7.5	5.7
United Kingdom	12.9	m	15.2	13.6
United States	13.2	9.6	13.7	12.3

1. The rate of return to upper secondary education is calculated by comparing the benefits and costs with those of lower secondary education.

2. The rate of return to tertiary education is calculated by comparing the benefits and costs with those of upper secondary education.

3. In Canada, no data were available on expenditure per student in upper secondary education.

4. In Italy, the sample size of earnings for women was not large enough to allow for the calculation of rates of return.

Source: OECD.

Private and social returns to education in different areas for different levels

Tab 2.4

TAB. 2.4. *Rendimenti dell'istruzione per livello e per anno, medie regionali sui dati pubblicati*

| | Metodo integrale | | | | | | Funzione minceriana | |
| | Rendimento sociale | | | Rendimento privato | | | Anni medi di scuola | Rendimento privato |
	Primaria	Secondaria	Università	Primaria	Secondaria	Università		
Africa sub-sahariana	24,3	18,2	11,2	41,3	26,6	27,8	5,9	13,4
Asia	19,9	13,3	11,7	39,0	18,9	19,9	8,4	9,6
Europa/Medio Oriente/Africa del nord	15,5	11,2	10,6	17,4	15,9	21,7	8,5	8,2
America Latina e Caraibi	17,9	12,8	12,3	26,2	16,8	19,7	7,9	12,4
Paesi OCSE	14,4	10,2	8,7	21,7	12,4	12,3	10,9	6,8
Mondo	18,4	13,1	10,9	29,1	18,1	20,3	8,4	10,1

Fonte: Psacharopoulos [1994, tabb. 1 e 4].

Effects of HC on growth rates

- OECD estimations show that one more year of labour force education increases the growth rate of per capita GDP between 4% and 7%.

- Physical capital increases per capita GDP by only 1,3-1,5 %.

Chart A14.1.

Decomposition of changes in annual average growth rates of GDP per capita

Estimated effect of changes in explanatory variables to changes in output
per capita growth rates over the period 1980s to 1990s
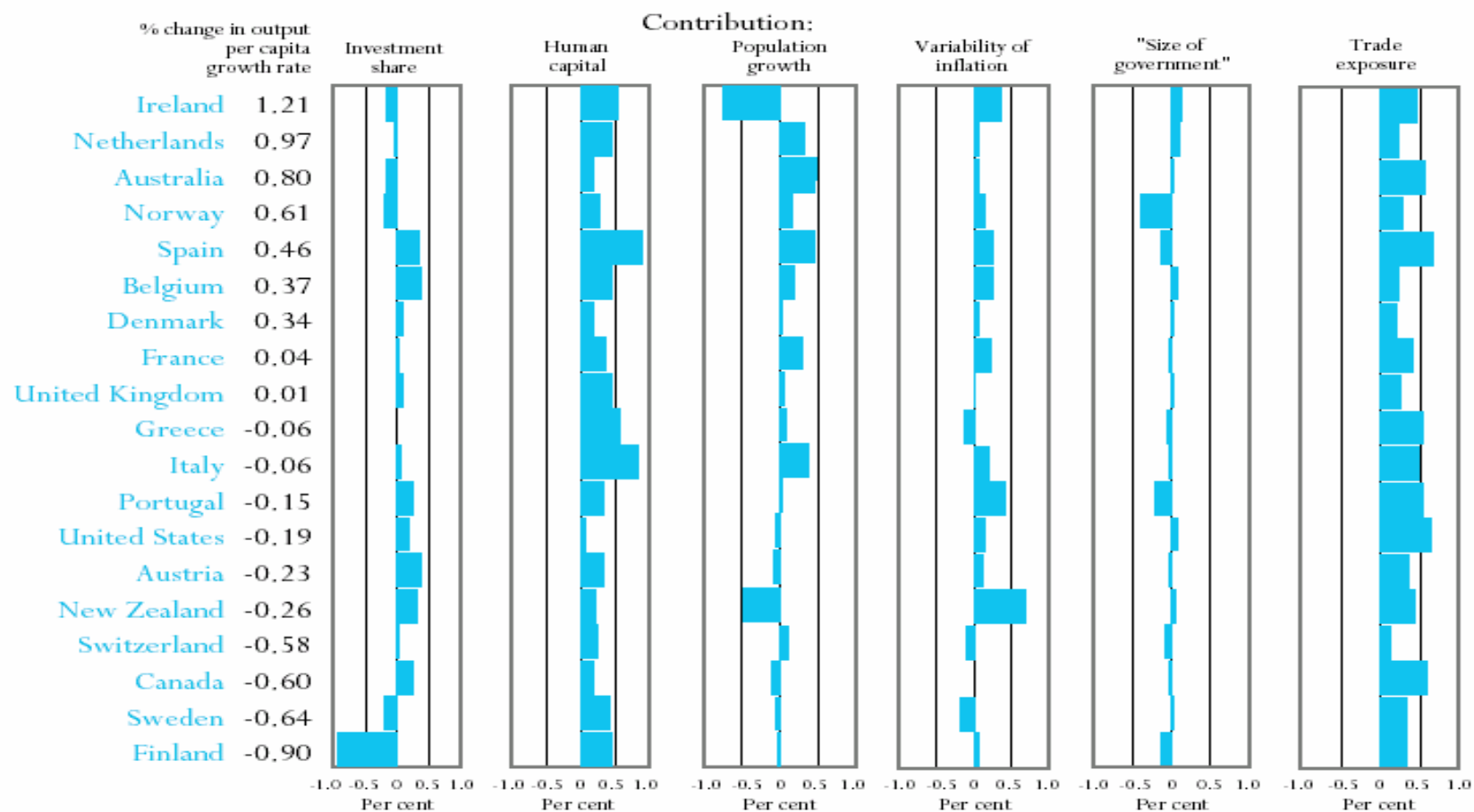
Countries are ranked in descending order of the percentage change in output per capita growth rate.
Source: OECD Economic Outlook, December 2000. Table A14.1.