R&D, Human Capital and Growth

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Primary Sources of Growth in Labour Productivity

- **Accumulation of physical capital**
  - ultimately subject to diminishing returns
  - hence it affects level of growth path, not its slope

- **Accumulation of embodied human capital**
  - through education / training / learning-by-doing
  - limited perhaps by finite human capabilities

- **Accumulation of ideas (technological progress)**
  - through R&D
  - through national spillovers
  - through international spillovers

Evidence on Human Capital

Microeconomic studies of education and earning

1. Estimated impact of an additional year of school on wages

Ashenfelter and Krueger	USA	9% to 16%
Miller, Mulvey and Martin	Australia	4.5% to 8.3%
Lee and Miller	Australia	9.2%

2. Estimated impact of attained schooling on wages

	Borland, Hirschberg and Lye	Preston
Completed high school	7.1%	13.4%
Certificate	28.5%	26.9%
Diploma		55.9%
Degree	46.2%	89.3%

Macroeconomic Evidence on Schooling and Growth in OECD countries

Predicted increase in the level of output for an additional year of national average schooling

STUDY	
Bassanini and Scarpetta (2002)	6 %
Mankiw *et al.* (1992)	6% - 15%

Evidence on Increase in Productivity Growth Due to an Additional Year of Schooling

(through international technological spillovers for a country at 2/3 of US productivity level)

Benhabib and Spiegel (1994)	0.3 *% p.a.*
Frantzen (2000)	0.8 *% p.a.*
Dowrick & Rogers (2002)	0.2 – 0.5 *% p.a.*

Research and Development
Industry-Level Evidence

Private and Social Marginal Rates of Return on Investment in US Manufacturing Industries, 1985

(before tax, net of depreciation)

	Investment in Physical Capital	**Investment in R&D**	
	Private Returns	*Private Returns*	*Social Returns*[1]
Chemical Products	20%	22%	46%
Fabricated Metal	21%	21%	21%
Non-electrical Machinery	24%	25%	40%
Electrical Products	18%	27%	31%
Transport Equipment	26%	23%	35%
Scientific Instruments	28%	28%	86%

Source: Bernstein and Nadiri (1991) Table 6

1. 'Social' returns are defined as private returns plus spillovers to the other industries covered in the study.

International Evidence

		Private Rate of Return	*Social Rate of Return*	*Cross-country Spillover Elasticity*
Lichtenberg and Siegel (1991)	**i) survey of 15 previous studies of US firms and industries**	**25%**		
	ii) 2000 US firms	**30%**		
Nadiri (1993)	**survey of 50 US studies of firms and industries**	**20% to 30%**	**50%**	
Lichtenberg and van Pottelsberghe (1996)	**GDP growth across OECD countries**		**51-63%**	
Coe & Helpman (1995)	**OECD countries, pooled time-series 1971-90**		**85%** [1]	**6%** [2]
Frantzen (2000)	**Business sector TFP growth across OECD countries**		**59%**	
Lichtenberg and van Pottelsberghe (1998)	**TFP across OECD**			**5% – 11%**

Concluding Comments

- **Investment in both education and R&D promote productivity growth**
- **There is evidence of significant spillover effects from education in its role as an enabler of technological diffusion**
- **There is also evidence of substantial national and international spillovers of R&D**
- **These spillover effects are not captured by standard growth accounting methods**