R&D and growth: Introduction

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R&D

- R&D commands sizeable resources
  - Expenditures on research and development over GDP; around 2%
  - Compare with the weight of government expenditures in education over GDP: around 5%
- How do we measure R&D and how do we relate it to economic growth ?

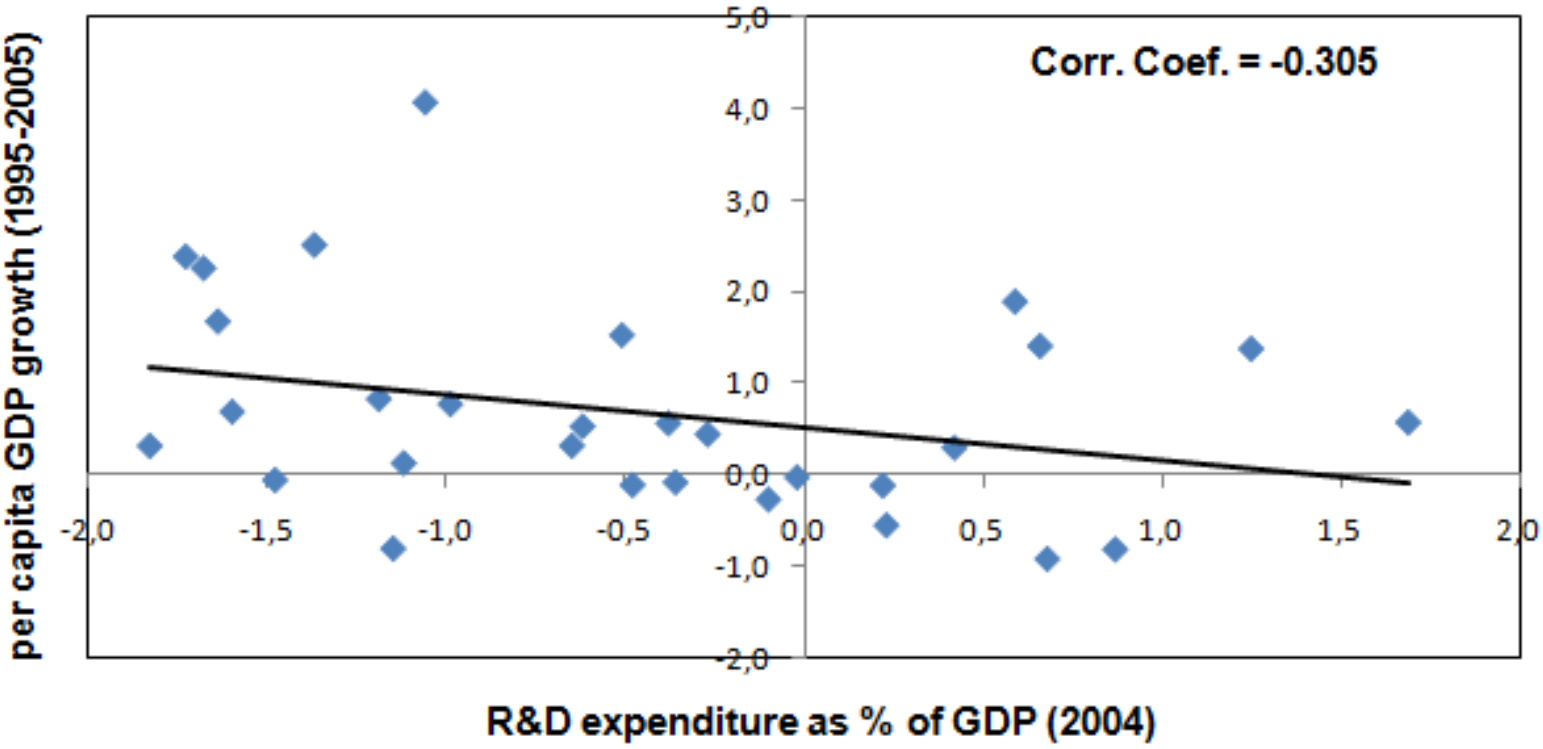
R&D

R&D measures

- patents
- scientific papers published

R&D and growth

- there are some puzzles



(see Gil et al. (2013))

R&D. ideas, competition and growth

- Technology and technical progress:
  technical progress = systematic increase in TFP
- Exogenous and endogenous technical progress:
  endogenous t.p = increase in TFP a purposeful activity
- Types of endogenous technical progress:
  learning-by-doing, and ideas
- Ideas:
  fundamental research = ideas for the purpose of knowledge, curiosity
  R&D = ideas for profit

R&D. ideas, competition and growth

The problem with ideas: non-**rivalry and excludability**

- can be used by several people simultaneously (non-rivalry)
- once an idea is found it can be used by others (non-excludability)

Because coming up with ideas takes costs (effort, time, resources) this generates a problem of **free-riding**

- this is particularly serious for R&D ideas that can have market value
- fundamental research has some characteristics of excludability and lack of market value

Production of R&D

- The **free-riding problem** entails a difference between private benefits and costs for the developers of R&D
- R&D "production": as R&D has costs, it can only exist under two environments:
  - market economy in which there is **imperfect competition** (patents or other type of rent generating mechanism)
  - in a **centralized economy**, where R&D costs can be internalized

R&D and growth

In a decentralize setting: there is a **trade-off**:

- the need imperfect competition generates a reduction in the growth of productivity
- but the existence of R&D generates growth

This creates a role for policy: internalizing the externalities

R&D models in the literature

Modelling options

Type of research (ideas)

- Fundamental or applied (R&D)
- Horizontal innovation (new industries) versus vertical innovation (in an existing industry)
- Quantity expansion and/or quality enhancement
- Product based or task-based
- Process innovation (intermediate products) versus product innovation (final goods)
- Neutral versus biased technical change (complementary or substitutable with other inputs)

R&D models in the literature

Other modelling options

- Who does R&D: in-house or imported or imitated
- Who introduces innovation: an incumbent or an entrant
- Technology of innovation: lab-equipment versus knowledge-driven models

Next lectures

R&D and growth models

- Expansion of varieties
- Schumpeterian models (creative destruction)
- Directed technical change
- Automation

References

- (Barro and Sala-i-Martin, 2004, ch. 6), (Acemoglu, 2009, ch. 13), (Aghion and Howitt, 2009, ch. 3)

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Robert J. Barro and Xavier Sala-i-Martin. *Economic Growth*. MIT Press, 2nd edition, 2004.

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