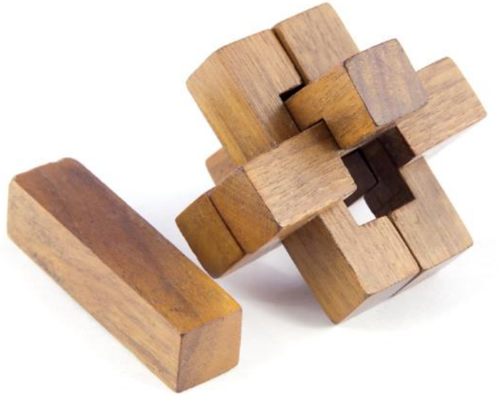

The International School
on Research Impact Assessment

Economic Rates

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Agenda

- What's the issue?
- Spillovers – conceptual framework
- Methodology
- Example
- Concluding remarks

Purpose of (Any) Economic Analysis

- Assess costs vs. benefits
- In our case: Assess costs *of doing research* vs. benefits *arising from the research*
- Further level of disaggregation:
  - Direct and Indirect

Estimating economic value of research – Medical Research

- Four possible approaches (Buxton et al., 2004):

1. Direct cost savings arising from research
   - e.g. new, less-costly treatments or to developments such as vaccines that reduce the number of patients needing treatment
2. Benefits to the economy from a healthy workforce
   - Human capital approach – indirect cost savings from healthier workforce
3. Benefits to the economy from commercial development
   - Employment, sales
   - Links between public and private sectors – ‘spillovers’
4. Intrinsic value to society of health gain
   - Monetary value on a life

NB To discuss: other examples beyond medical research?

What's the Issue for Governments?

- Any government policy: realising the health, scientific and economic value of research ***in the country***
- Maximising that value includes taking into account both **direct and indirect returns to** funding when devising research policies
- **Spillovers**: Research undertaken by one organisation, public or private, may benefit not only that organisation but also other organisations in the medical sector, other sectors, and other countries

Returns from Medical Research – Our focus

- **Direct returns** from investments in public/ charitable health sector research include:
  - Improved health (living longer and healthier lives) and quality of health care and/or
  - Cost savings in the provision of health care

– **Indirect returns:** benefits to third parties – “spillovers”, especially economic benefits. The achievement of spillovers is not a by-product, but a major, intended, benefit of research

Public-private sector complementarity – ‘spillovers’

- Three broad approaches to think about complementarity:

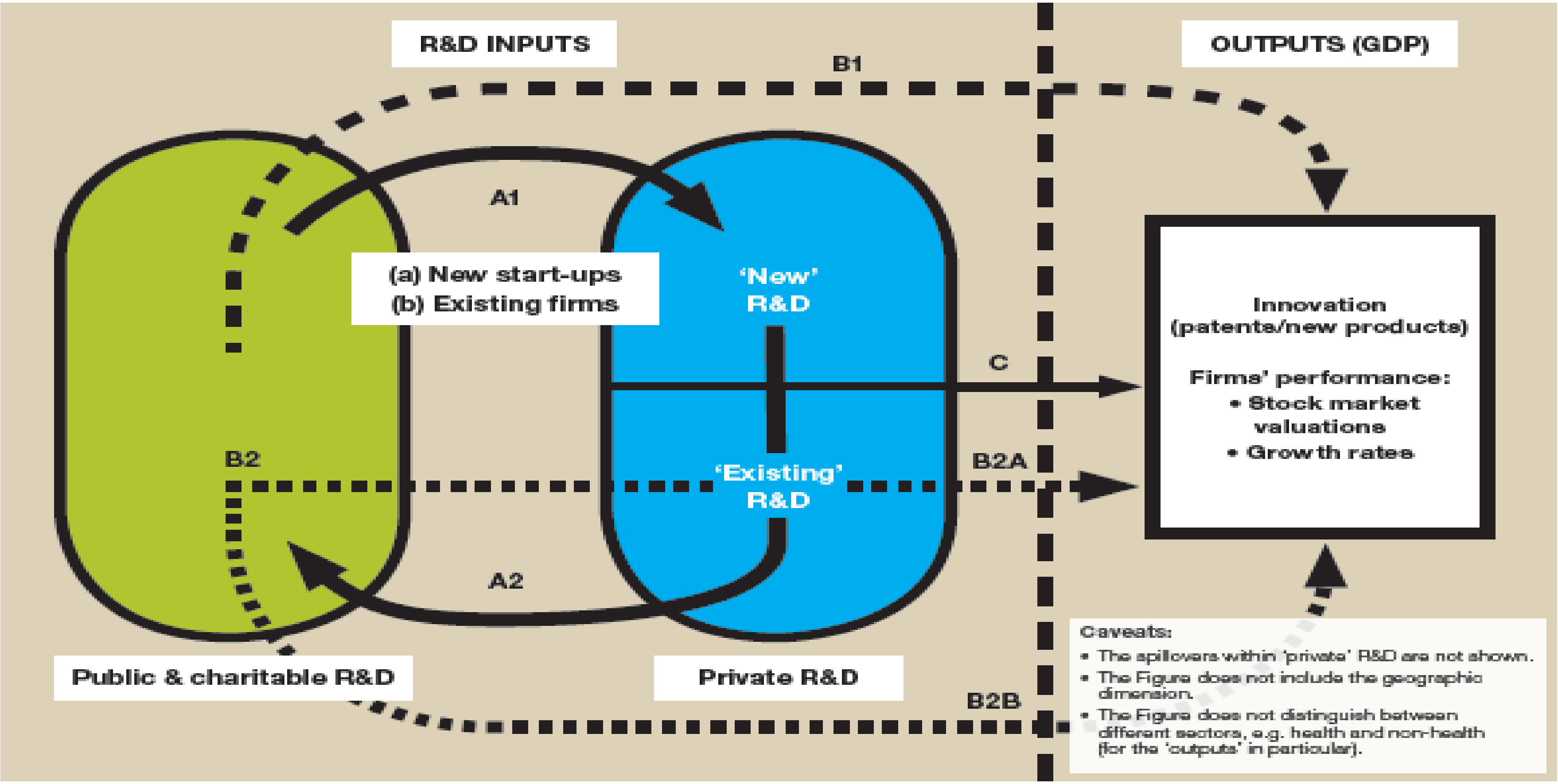
1. Biomedical sector
   - Public research plays an important role in the discovery of new health care technologies
   - Interaction between public and private sectors
2. New firm start-ups
   - Decision where to locate new start-ups influenced by opportunity to access knowledge generated by universities
3. Innovative activity
   - Positive correlation between location of R&D-performing firms and presence of high quality relevant university research departments

Mechanisms transmitting spillovers

- Literature full of possible spillover mechanisms:
  - Universities – faculty, graduates, libraries, papers
  - Networking – informal and formal
  - Absorptive capacity – ability to exploit existing information
  - Spillovers create ‘entrepreneurial opportunities’
  - Trade – international spillovers

- *The pharmaceutical sector in particular has some distinctive characteristics that suggest that the public-private interactions are more important here than in other sectors*

Spillovers – Conceptual Framework



Source: *Medical Research: What's it Worth?*

Our focus – complementarity between public medical research and private R&D

- Key question: how many, if any, £s of private pharmaceutical R&D expenditure are stimulated by an extra £ of public or charity medical research spending, that would otherwise not have been stimulated?

Methodology (1)

- Data needs:
  - Time series for 20 years+ for public/charitable medical research *and* private R&D, by therapeutic area (8-10)
  - Additional drivers of private R&D – ‘control’ variables:
    - Global sales by therapeutic area, indicators of country’s NHS activity by therapeutic area, and any country’s policy dummy variables such as when there were major changes in R&D tax allowances

Data analysis

- Panel of data (R&D expenditure by year, by therapy area)
- Econometric analysis:

Change in Private R&D = f (public research, charitable research, control variables) + time lags of changes

Change in Public or/and charitable research = g (private R&D, control variables) + time lags of changes

Challenges

- Time series of private pharmaceutical R&D spending in any one country by therapeutic area are usually not available (probable exception: US – see later)
- Need proxies: UK example
  - Bibliometric analysis of the proportion of research papers with a UK-based pharmaceutical industry author or authors by disease/therapeutic area
  - Analysis of patents from UK-based pharmaceutical industry by therapeutic area
  - But need additional weighting to take into account that different pharmaceutical companies, and the same companies at different times, may have differing policies towards their employees publishing research papers
  - Also probably need some external validation checks for the splits of the total private R&D effort by therapy area estimated by the bibliometric and patent analyses – qualitative analysis

Alternative

- Less data intensive but also less comprehensive
- Collect data on *indicators* to understand the dynamics of collaborations between the public/charitable and the private medical sectors
- Examples include co-authoring of scientific papers and PhD students funded by industry

Example – Toole (2007)

- To estimate the impact of public basic and clinical research on industry investment in the US. The focus is on seven medical therapeutic classes: endocrine/neoplasm (cancer), central nervous system, cardiovascular, anti-infective, gastrointestinal/genitourinary, dermatologic and respiratory
- Data
- *Public investment in basic and clinical research*: data on grant and contract awards by the US Department of Health and Human Services, particularly the National Institutes of Health.
- *Private R&D*: pharmaceutical industry investment by therapeutic class, sourced from the Pharmaceutical Research and Manufacturers of America (PhRMA) trade association. Defined as US and worldwide spending by US companies and spending in the US by non-US companies.
- Time period: 1981-1997

Example – Toole (2007)

$$\Delta I_{it} = \beta_1 \Delta S_{i(t-1)} + \sum^{T}_{j=1} \alpha_j \Delta B_{i(t-j)} + \sum^{T}_{j=1} \eta_j \Delta C_{i(t-j)} + \beta_2 \Delta R_{i(t-1)} + \Delta X'\delta + \Delta\lambda_t + \Delta\varepsilon_{it*}$$

- Objective: Explain drivers of industry R&D investment (dependent variable) in therapeutic class *i* in year *t* (I_{it})
- Explanatory variables
  - Lagged public basic and clinical research investment in therapeutic class i
  - Other control variables
- Certain degree of sophistication required

Results (1)

Ward and Dranove (1995)

↑ 1% public basic research in a particular therapeutic area (by US NIH)

↑ 0.76% in private R&D in **same** therapeutic category over 7 years

↑ 1.71% in private R&D in **other** therapeutic category over 7 years

In total, a 1% increase in public basic research across the board will generate up to a 2.5% increase in total private pharmaceutical R&D spend

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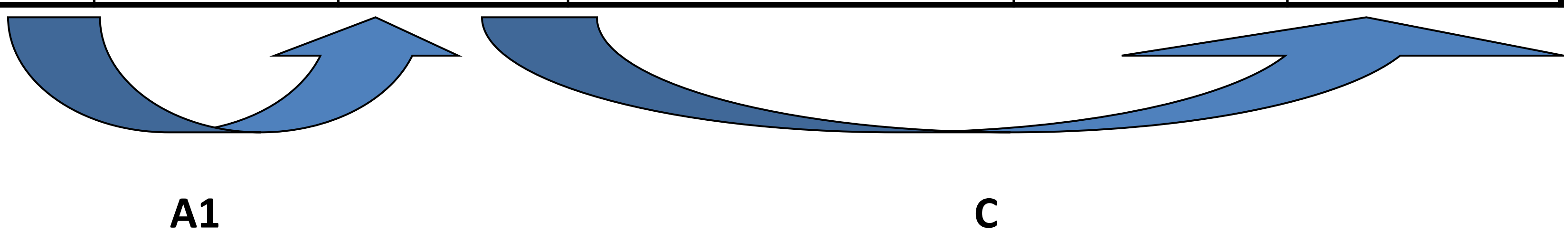
Toole (2007): Distinction between basic and clinical research

↑ $1 public research	Additional private R&D	After how many years?
Basic	$8.38	8
Clinical	$2.35	3

Results – Applying results to the UK

Extra spend in public R&D	Study	Additional private R&D induced	Study	Social rate of return of private R&D (£)	Overall social return due to a £1 increase in public R&D spending
£1	Toole (2007)	£2.2	Nadiri (1993), PICTF (2001), Garau & Sussex (2007), Griffith *et al* (2004)	50%	£1.1
£1	Ward & Dranove (1995)	£5.1	Nadiri (1993), PICTF (2001), Garau & Sussex (2007), Griffith *et al* (2004)	50%	£2.5



Further applications (1) – Other countries

- In *theory* replicable to other national settings
- Will the complementarity be higher or lower than in the US?
  - Some points to consider:
    - US biggest market
    - What are the relative shares of private and public research expenditure as a % of GDP?
    - How ‘open’ is any one country? Will benefits from public research leak out to a higher or lower extent?
- Empirical question!

Further applications (2) - ‘Cluster’ type policies

- Location and proximity matter in exploiting spillovers
  - Geographic concentrations of knowledge are likely to create higher levels of innovation than would otherwise be achieved
  - But also requires active participation in a network
- Role of knowledge spillovers is geographically bounded: innovative activity is more likely to occur within close geographic proximity to the source of that knowledge – ‘localised knowledge spillovers’

Skills sets required

- Not straight forward
- But do-able
- There is a need to collaborate with:
  - Economist/econometricians
- There is also a need to understand private R&D decision making processes i.e. what drives industry's decision on where to invest, and how much?

Possible Research and Policy Agendas

- More robust Return on Investment (ROI) numbers
- Identifying and quantifying transmission mechanisms – beyond case studies
- Medical research can be expected to yield the highest return where? – e.g. Cancer v Dementia:
  - Unmet need
  - Tractability of the science
- Hoping to replicate analysis to the UK (!)
- And, and, and …….

Key Messages

- In addition to health gains, publicly and charitably funded medical research generates additional national income.
- Published literature indicates that additional public medical research leads to additional private R&D spending. Both contribute to increasing a country's gross domestic product (GDP).
- In the UK, for example, it has been estimated that each £1 of extra public/charitable investment in UK medical research yields £2.20-5.10 of extra pharmaceutical company investment, which taken together earns an extra £1.10-2.50 GDP per year for the UK economy

To enquire about additional information and analyses, please contact Dr. Jorge Mestre-Ferrandiz at jmestre-ferrandiz@ohe.org

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