



Innovation and Financial Markets

(preliminary and incomplete draft)

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What's the link?

- Individuals with ideas (potential innovators) are not necessarily the same as those with the money (or skills) to execute those ideas
- *Innovation* requires both to be successful
 - *Def:* the first (successful) introduction of a new and useful product and/or process to the market

National environment

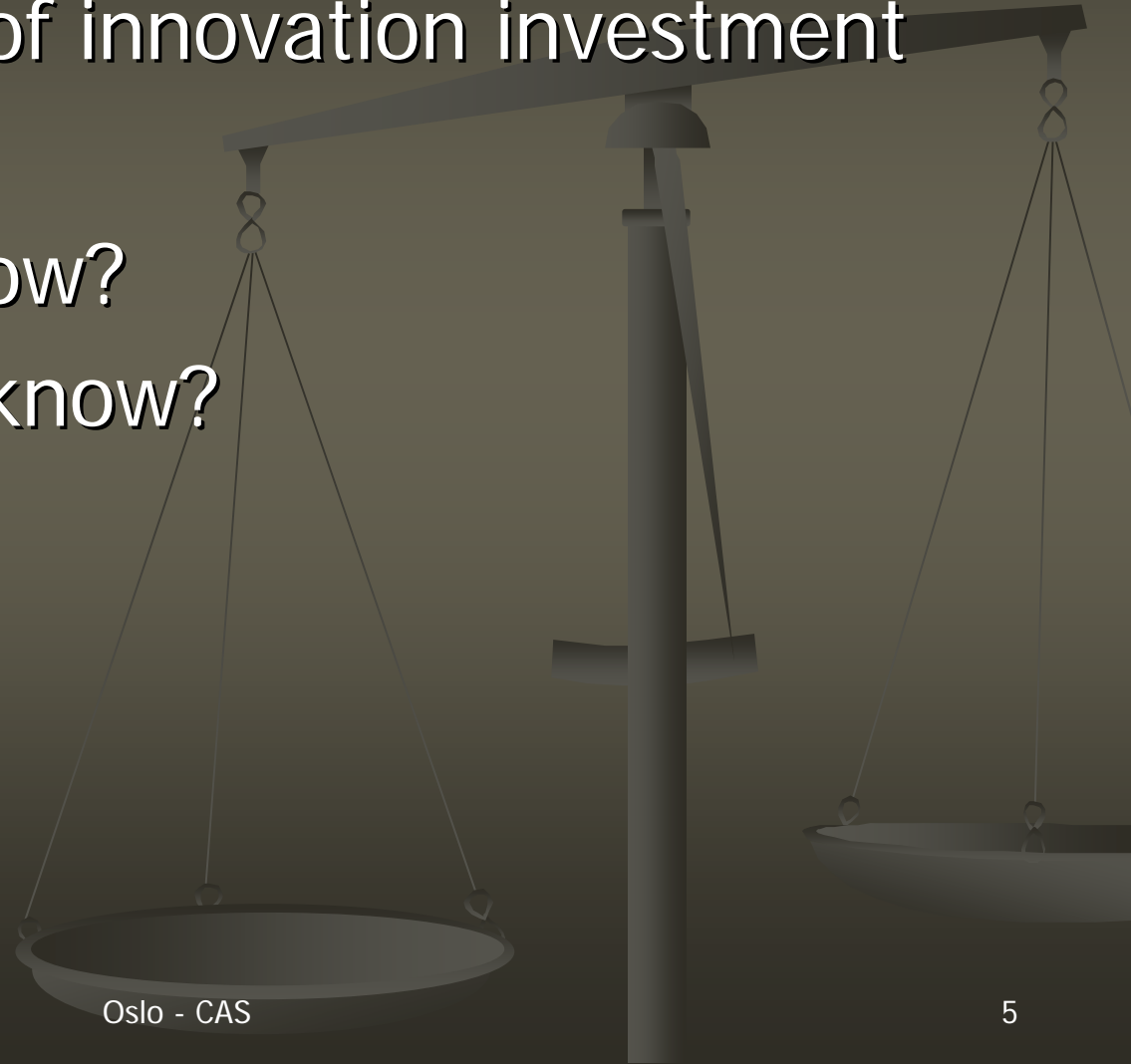
- Institutions (legal and other), markets, and the national “innovation system” are an important influence on the innovative performance of firms
- This paper: the role of financial markets in supplying the funds required for investment in innovation
 - banks
 - equity markets
 - investment firms
 - venture capital
 - Governments
- But can we study this factor in isolation?

Literature

- Voluminous literature with several main strands, e. g.,
 - Micro-economic studies of R&D responsiveness to financing or policy changes
 - Cross country studies of financial development and growth, some targeted at innovation measures
 - New wave following Rajan-Zingales 1998
 - Policy studies related to the venture capital system and how to jumpstart it

Outline

- Characteristics of innovation investment
- Consequences
- What do we know?
- What don't we know?



Innovation expenditure as investment

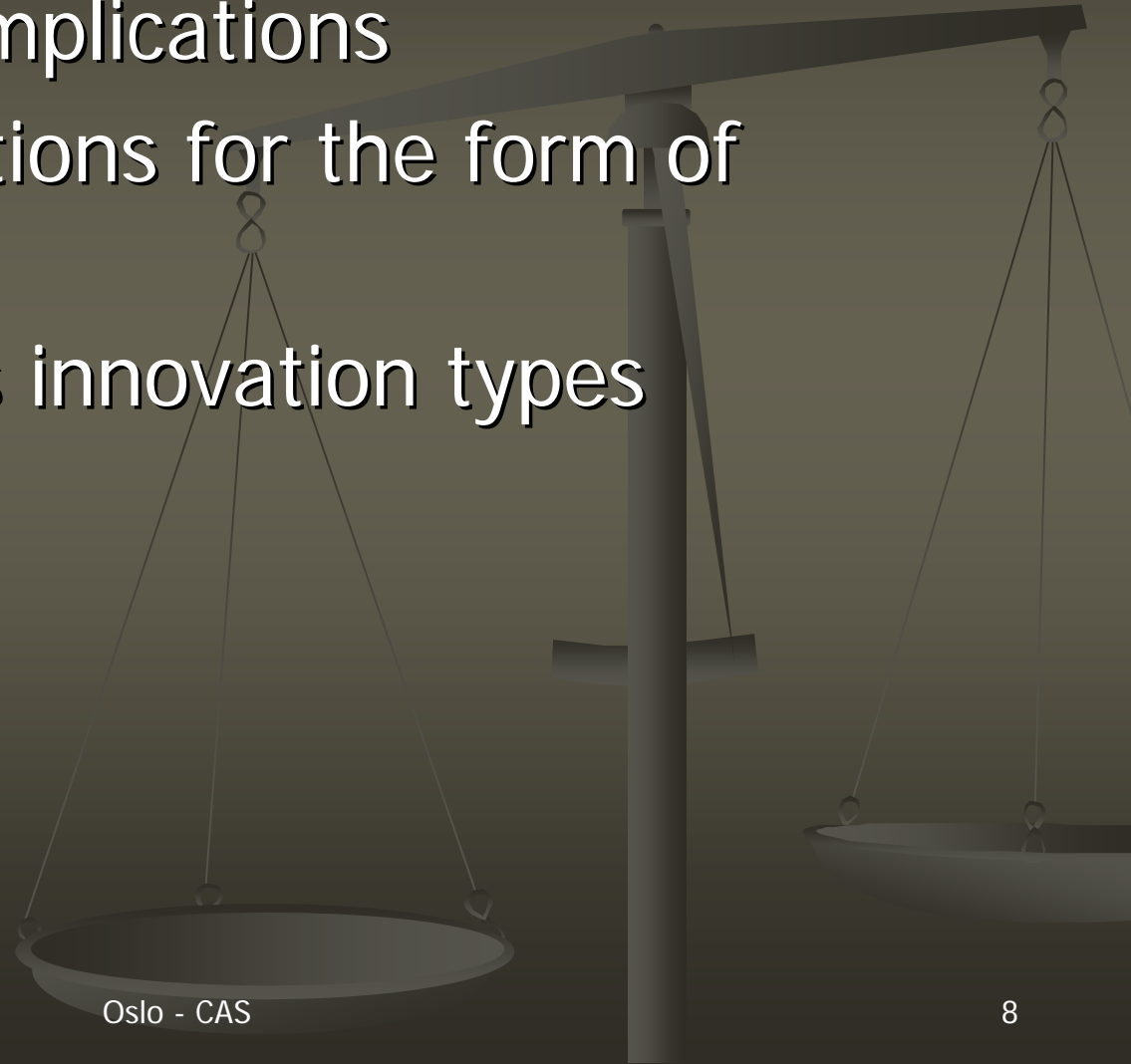
- Similarity:
 - Expenditure undertaken today to secure (uncertain) returns in the future
- Differences:
 - Composition – wages of scientists and engineers are more than half of spending, unlike tangible capital
 - Asset created is intangible
 - Unknown share is human capital (partly owned by employees)
 - Not easily tradeable (low salvage value)
 - Level of uncertainty much more extreme

Varieties of innovation

- Innovation comes in more than one “flavor”
 - Radical - creating whole new industries or subsectors of existing industries
 - air flight, telephones, the personal computer, the iPod
 - Incremental - building on and improving products and processes within an existing paradigm
 - much of the welfare improvement that we have derived from networked microcomputers and the internet has in fact been due to incremental rather than radical innovation
- Obviously, yesterday's radical innovator often becomes today's incremental innovator

Consequences for financing

- Some general implications
- Specific implications for the form of financing
- Variation across innovation types



Some general implications

- Production of knowledge is not intertemporally separable → adjustment costs high
 - Policy changes take time to have an impact
 - Measurement difficulties
 - Finding indicators for input and output
 - R&D does not exhibit much variation over time within a firm
 - Responds slowly to changes in capital cost (LHS)
 - Little variation to identify its productivity (RHS)
- Uncertainty
 - distribution of returns can be near Pareto (and without a second moment)

Innovation finance



- Need for long term investments
- Need for monitoring
- Debt versus equity finance
 - debt prefers physical assets as collateral *but ..*
 - R&D and related investment create an intangible asset
 - Equity can lead to owner-manager conflict
- Tax treatment
 - Tax subsidies to R&D in some countries *but ..*
 - Can be costly; project ranking problems

Required rate of return

- Probably higher than that for ordinary investment:
 - **Uncertainty and risk**
 - **Depreciation** (private obsolescence) highly variable and endogenous to the behavior of other firms
 - **Asymmetric information** between financier and firm implies there is a lemons premium
 - Mitigating **asym info** by revealing idea to potential investor is costly and can lead to imitation
 - Akerlof (1970): if lemons premium large enough, market disappears
 - One solution: hands-on venture capital investment
 - **Agency costs** – can arise in any setting where the goals of a principal and his/her agent conflict

Agency costs for innovative firms

Principal	Agent	Agency cost
owner	manager	risk aversion; preference for “easy life”
minority shareholder	majority shareholder	private benefits preferred to share value maximization
VC firm	entrepreneur	diversion of funds; overconfidence

Asymmetric information

- Some examples
 - Large firms – owner/manager
 - Large labs – manager/researcher
 - VC setting
 - Entrepreneurs and startups - over-optimism on the part of the innovator may be more severe
- Increases cost of external vs internal finance

Asymmetric information - micro evidence

- Survey of asymmetric information and R&D investment (Hall 2002):
 - Micro evidence from a number of countries - in all firm sizes, R&D investment is sensitive to cash flow surprises
 - May be due to an asymmetric information or lemons problem, but not necessarily
 - In general, smaller firms and firms in Anglo-Saxon (common law) economies exhibit higher sensitivity to cash flow

Asymmetric info – cross country growth evidence

- Rajan and Zingales (1998)
 - Industrial sectors in more need of external finance (from US data) develop faster in countries with higher financial sector development
- Bena and Jurajda (2007)
 - Financial development fosters growth of young firms in EU 15; no variation over firm size

Testing for agency costs

- Minority/majority shareholder conflict
 - Compare valuation of shares across countries – if private benefits are being extracted, value will be lower
 - Relate differences in valuation to the innovation activities of the firm
- Hall and Oriani 2006
 - Market value of R&D approximately the same across North American and Western European countries, with the exception of majority-controlled firms of the type common in continental Europe, where it is lower

Market value and agency costs

- The literature on pyramids and tunnelling (**Johnson et al 2000; La Porta et al 2002**) suggests Hall-Oriani finding may be due to lower minority shareholder protection available in countries like France and Italy
- Investments in innovation may be particularly vulnerable to “tunnelling” because of their intangible nature, but full exploration of this possibility has yet to be done
 - **Munari, Oriani, and Sobrero 2005**: family-held firms in EU have lower R&D investment; also true of widely-held firms in UK
- **Belenzon and Berkovitz (2007)** show that group membership can facilitate innovation in EU firms (an old hypothesis newly tested)

New evidence

- Planned work on market value of R&D in European firms with more detail on ownership (type and control), joint with Stefano Mengoli and Raffaele Oriani.
 - Preliminary evidence that the Hall-Oriani result is due to family-owned firms, rather than govt-controlled firms

Variations in cost profiles

- Innovation requires varying levels of resources and time
 - Patient shareholders or investors are needed for some investments in the biotechnology area
 - Fast-moving ICT markets require firms to mobilize resources and respond quickly to good or bad news, implying that the speed of response in the capital markets becomes important for the firm
- Financing needs for different types of innovation can be quite different
 - radical innovations generally arise in startup firms
 - incremental innovation is largely (but not always) the province of established firms

Cautionary note

- As time passes, the distinctions among economies highlighted by this kind of study are blurring due to the globalization of financial markets. Even in the venture capital area, there is now a tendency to look worldwide rather than locally, for suitable investments. If capital can move freely across national boundaries, financial markets become less important in generating variations in innovative performance across countries, while corporate governance rules and conventions may remain just as important. Thus it will be important and useful to consider the time periods analyzed carefully in order to avoid comparing apples and oranges.

Modeling investment

- Marginal profit condition: marginal product of capital equals tax-adjusted user cost of capital:

$$MPK = \rho \equiv E_t \left[\frac{1 - A^d - A^c}{1 - \tau} (r + \delta + MAC) \right] \cong E_t [r + \delta + MAC]$$

r = investor's required rate of return

δ = (economic) depreciation rate

MAC = marginal adjustment cost

τ = corporate tax rate

A^d = PDV of depreciation allowances

A^t = PDV of tax credits

Last equality holds if R&D expensed and no special tax credit.