R&D and innovation expenditures in the crisis

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Outline

• R&D as an investment and implications for financing R&D
  – Further reading: Hall and Lerner (2010), in Hall and Rosenberg (eds.), Handbook of the Economics of Innovation, Elsevier.

• Empirical evidence on the cyclicality of R&D
R&D vs innovation

• R&D only part of innovation expenditure, in addition we have
  – Worker training, etc.
  – New capital equipment (process innov)
  – Marketing, etc for new and improved products

• However
  – Data available in these only recently
  – Much of the data is qualitative only
  – => most empirical literature uses R&D as an indicator of innovation
R&D as investment

• **Similarity:**
  – Expenditure undertaken today to secure (uncertain) returns in the future
  – => creates a capital asset for the firm

• **Differences:**
  – Composition – wages of scientists and engineers are more than half of spending
  – 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

Characterizes most other innovation-related expenses as well
Implications for policy and practice

• Production of knowledge is not intemporally separable → adjustment costs high
  – Policy changes take time to have an impact
  – Measurement difficulties - R&D does not exhibit much variation over time within a firm
    • Responds slowly to changes in capital cost
    • Little variation to identify its productivity

• Uncertainty – in some cases, distribution of returns is Pareto (and without a second moment)
  – Scherer, Harhoff, etc.
  – risk adjustment problematic
Choosing the level of R&D

Stylized model: profit-maximizing firm invests in R&D until the marginal product of the resulting capital asset is equal to the tax-adjusted user cost of capital.

Therefore, R&D will depend on

- Investor’s required rate of return
- (Economic) depreciation rate of the asset
- Marginal adjustment cost of R&D program
- Corporate tax rate
- Tax depreciation allowances
- Tax credits, if present

If R&D is expensed and no tax credit, tax effects will not matter
Implications for R&D finance

- **Depreciation** (private obsolescence) highly variable and endogenous to other firms’ behaviors
  - possibly higher than aggregate rate of 12 or 15%
- **Debt versus equity** finance
  - Debt sometimes cheaper than equity due to interest deductability
  - However, debtholders prefer physical assets as collateral and R&D creates an intangible asset that is not easily collaterizable
- Evidence that equity strongly preferred over debt for external financing in R&D firms, but that **financing by internal funds most preferred**
Recent evidence

  – Costly for firms to adjust R&D to transitory shocks
  – => firms facing constraints hold cash to smooth R&D, dampens
effect of financing constraints
  – Less true of large unconstrained firms with profit flows
• Brown, Martinsson & Petersen 2010 – European firms from
  16 countries 1995-2007
  – Cash flow alone does not matter much
  – Changes in cash holding are negatively related to R&D
    investment, especially for firms in active stock markets (UK and
    Sweden)
  – Financial factors more important for younger, smaller, and lower
    payout firms
Conclusions from empirical work

• Small and startup firms in innovative industries face a higher cost of capital than their larger competitors.
• Cash holdings are used by these firms to smooth R&D in the presence of financial frictions.
• Evidence for a financing gap for large established firms less clear, although they do seem to prefer internal funds for R&D.
• VC solution to asym info/moral hazard problems has some limitations and is not widely diffused successfully across countries.
• Even though they often focus on quarterly rather than long term performance, thick public financial markets seem to be better at financing innovative activity.
Implications for R&D in the crisis

• Current crisis:
  – Lower demand => lower expected rate of return, demand shifts down
  – Cost of funds rises due to tightened lending standards => supply shifts up

• Result: lower R&D expenditure – However---
  – Desire to smooth R&D and retain human capital suggests counter-cyclicality (a form of the more general opportunity cost theory)
  – Financial constraints and lower demand suggest pro-cyclicality
What do we know about this empirically?

  - Used demand shocks at industry level (weighted sum of downstream shipments)
  - Find R&D in largest firms shows evidence of counter-cyclicality - increased R&D in response to fall in industry demand

- **Cosh, Hughes, and co-authors at the Centre for Business Research, Cambridge University** – UK SMEs 1991-2008
  - 18% sought to grow in 2004; 9% in 2008
  - Constraints on growth:
    - <20% mention financial
    - Lack of demand more important
  - However, loans and mortgages more difficult to obtain, and cost has risen; less financing obtained.
  - High growth innovative firms appear to be more resilient, but worried about demand (consistent with Brown and Petersen evidence)

- In general, not as bad as early 1990s for SMEs in the UK
What do we know about this empirically?

  - Share of R&D over total investment *counter-cyclical* without credit constraints
  - Becomes more *pro-cyclical* as firms face tighter credit constraints
  - Larger result for firms in sectors that depend more heavily upon external finance
  - In more credit constrained firms, R&D investment share plummets during recessions but does not increase proportionally during upturns

  - Model similar to Aghion et al.
  - R&D *counter-cyclical* for firms whose internal resources increase more than 4%
  - Otherwise *pro-cyclical*
  - On-the-job training is *counter-cyclical*
  - Goodwill, purchases of patent rights *acyclical*
US firms 1990-2010

• Naïve model – log variable on own lag with annual dummies
  – Log R&D – R-squared = 0.90
  – Log Sales – R-squared = 0.92

• Examine year dummies to see average effects of business cycle – R&D tracks sales pretty closely.

• Stratify by firm size (<500 employees) – R&D is twice as volatile for small firms.

• Aghion et al. equation estimates (within firm):
  – Large firms R&D share ~ -0.20 (0.01) Δsales
  – SME firms R&D share ~ -0.14 (0.01) Δsales
  – Note: very coarse size cut; no info on credit constraints
Year dummies from regression of log R&D and sales on lagged log R&D and sales for US firms (publicly traded) 1990-2010
Year dummies from regression of log R&D on lagged log R&D
US firms (publicly traded), stratified by average size >=500 emp

s.d. = 0.076

s.d. = 0.038


-0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30

SMEs
Large
Conclusions

• R&D less pro-cyclical than investment
  – for large established firms, it may be counter-cyclical with respect to sales
  – for credit-constrained and smaller firms, more strongly pro-cyclical, in spite of their attempts to smooth via cash holdings
  – French, US, and Spanish firms shift towards R&D and away from tangible investment during downturns

• Less known about other innovation expenditures
  – OJT may be counter-cyclical, at least if employment is sticky

• Liquid stock markets facilitate financing for innovative small or new firms, but also create some volatility in financing, leading to cash hoarding

• Some hints that things may vary across countries – what about the role of employment flexibility?

• Effects on entry?