MACROECONOMIC CONDITIONS AND THE DETERMINANTS OF COMMERCIALISATION

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(based on paper with Paul H. Jensen)

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Context

- Relationship between innovative activity and macroeconomic conditions studied several times (Geroski & Walters 1995; Saint-Paul 1997)
- Previous studies use proxies for innovation such as R&D expenditure or counts of innovations/patents
- This study uses a more downstream measure of commercialisation activities
- This is an empirical study – not just a deductive analysis

Research question

- Are commercialisation activities pro-cyclical or counter-cyclical?
- Given invention has taken place: what determines decisions to commercialise

WHY (ON EARTH) DO ECONOMISTS DO THESE SORT OF STUDIES?

- Empirical studies needed because:
    - Deductive theory can be ambiguous
    - To know the magnitude of effects
- Anecdotes cannot determine policy (but can guide empirical investigation)
- Series of empirical studies needed for 'stylised facts'
- Empirical studies rely on statistical regularities – data does not have to be 100% accurate to give useful information
- Random samples of people or events are good approximations for whole population
- Empirical studies give us confidence in a particular view, convince skeptics

FOR THIS TALK

- Analytic context
- What others have said
- Describe how we collected the data
- Model and estimation
- Find:
    - clear evidence that macroeconomic conditions matter for commercialisation and that they are pro-cyclical
    - supply-side factors (overdraft rates, the tax price of R&D, and changes in government R&D expenditure) **>** demand-side factors (growth of demand).

ANALYTIC CONTEXT

- Commercialisation is an (intangible) investment
- Almost all theories of firm investment behaviour are pro-cyclical.
    - aggregate theories of (tangible) investment. Keynes (1936), Lundberg (1937), Samuelson (1939), Harrod (1939), Schumpeter (1934, 1943), Kalecki (1939, 1968).
    - macro-economy has both a push and pull effect, both pro-cyclical
    - current sales are basis of future expectations of sales & source of investment funds
- Research & invention -------development ---------commercialisation---
- This study takes invention as given
- Not consider effect of macro-economy to the decision to invent
- NOT look at micro factors such as organisational capabilities, managerial style and the firm's marketing strategy on innovation

WHAT THE OTHERS HAVE SAID ABOUT MACROECONOMY & COMMERCIALISATON OF INVENTIONS

- Francois and Lloyd-Ellis (2003) argue that R&D is pro-cyclical but downstream commercialisation is counter-cyclical (Saint-Paul, 1997; Walde and Woitek 2004 have related arguments)
- Pro-cyclical camp (Ioannidis 1997; Fatas 2000; Piva and Vivarelli 2007; Geroski and Walters, 1995; Himmelberg and Petersen, 1994).
    - Increased confidence
    - Increased profits and means to invest
- Aside from these studies, little hard evidence (much loose conjecturing)

OUR DATA

- Our survey:
  - 2007 survey of Australian inventors
  - 3,736 patent applications with the Australian Patent Office 1986-2005.
  - 5,446 inventions with currently-valid addresses (= 68% response rate)
  - Respondents:
    - small–medium sized enterprise (36.4%)
    - large companies (10.5%)
    - public research organisations (6.6%)
    - individuals (46.6%).

- Date of the patent application
- Whether ‘Commercialisation event’ occurred. Defined as an attempt to:
    - develop (proof of concept, testing and validation, prototype)
    - license
    - transfer to a spin-off company
    - ‘make and sell’ (gathering market intelligence, validating the commercial opportunity, trialing the manufacturing process, and market launch)
    - mass produce
    - export

…the invention.

A FEW DESCRIPTIVES

Commercialisation event

Commercialisation event	Number	%
Apply for a patent	3,736	100.0
Attempt at least one development stage	3,399	91.0
Attempt to license	1,525	40.8
Attempt to spinout	531	14.2
Attempt at least one make and sell stage	2,700	72.3
Attempt mass production	1,383	37.0
Export	798	21.4
Total	3,736	100.0

MODEL AND ESTIMATION

- Link the events with the state of the macroeconomy in each year
- model the decision to attempt commercialisation event using duration analysis (Cox Hazard function)
- multiple event model and define the 'event' as an attempt made at one of the commercialisation stages
- Main issue: limited information on the timing of events – we know the date of lodgment of a patent application only
- We test a number of assumed timetables of the commercialisation stages

- Assume following lags between the year the patent application was filed (which we observe) and attempts (if made)
    - development (1 year)
    - licensing (3 years)
    - spin-off a company (4 years)
    - make and sell (5 years)
    - mass production (7 years)
    - export (9 years)
- Undertook a comprehensive sensitivity analysis of lags
    - seven other lag structures which involved 21 other estimated models
    - treated development & make and sell as 8 separate events rather than 2
    - put in larger lags for chemicals/pharma

- Following Guellec and Ioannidis (1997) use a parsimonious model
- firm's 'demand' for commercialisation is a function of exogenous prices and events
    - **Demand-side variables**
        - *Demand Growth*
            - annual rate of growth in real wages OR
            - annual rate of growth in industry value
        - *Business Confidence*
            - quarterly index of confidence in the Australian investment and business community

- **Supply-side variables**
  - *Cost of Commercial Borrowing*
    - official small business overdraft rate
  - *Business R&D Subsidies*
    - B-index= general incentives available to all firms via accelerated depreciation and allowable tax credits
    - =Present value of pre-tax income required to cover the cost of R&D investment and corporate income tax.
    - Lower B-index indicates more favorable tax regime for firms
  - *Public R&D*
    - annual change in intramural R&D designed for economic development in government organisations (GovRD)
    - excludes universities

Results from the estimated hazard of (multiple) 'success'

	MODEL 1	MODEL 2	MODEL 3	MODEL 4* (extra lags chemicals)
Demand-side variables				
Growth real wages	0.097***			
Growth industry value-added		0.777***	0.715**	1.372***
Business confidence	-0.003	-0.005**		
Supply-side variables				
Small business overdraft rate	-0.059***	-0.097***	-0.080***	-0.068***
B-index	-1.127***	-1.788***	-1.373***	-0.985**
Change in the real level of GovRD	1.373***	1.777***	1.903***	2.581***

*Extra lags on 2-digit industry -Petroleum, Coal, Chemical and Associated Product Manufacturing - since can have longer commercialisation lags than other fields.

Frequency of events since patent filed.

Effect of a change in independent variable from (mean less one standard deviation) to (mean plus one standard deviation) on the linear prediction Xβ

	Change in the linear prediction Xβ
Growth in industry value-added	0.067
Small business overdraft rate	-0.306
B-index	-0.170
Change in GovRD	0.164

- Overdraft rate was found to have the largest effect
- Followed by the level of tax incentives for R&D and changes to the level of public sector R&D.
- Supports findings of Guellec and Ioannidis (1997), 18 country dataset from 1972 to 1995

CONCLUSIONS

- While supply side factors appear to have the largest effect…
- Demand versus supply dichotomy can be misleading
- Both factors are necessary but not sufficient. A new product or process would not be commercialised if it clearly had no market. Nor would it be commercialised if funding was unavailable
- The real question for policy makers is: what constitutes the short side of the market? That is, which factor is the bottleneck?
- Is the rate of interest the major bottleneck?

THANK-YOU

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