The impact of R&D subsidy on innovation:

a study of New Zealand firms

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Background

- Innovation strongly affected by problems of non-appropriability, non-divisibility and uncertainty
  - → private investment in R&D suboptimal
  - → subsidies can improve resource allocation for innovation
- Many industrial countries subsidise R&D
- Evaluation studies:
  - Many on impact of subsidies on level of private investment (input)
  - Few on impact on innovation (output)
- This study examines the impact of R&D subsidy on innovation in NZ
- The Longitudinal Business Data (LBD) of Statistics NZ has rich data from administrative and survey records on a large number of NZ firms

Issues

- Basic Question: What is the effect of receiving a government R&D grant on the receiving firms' innovative performance?
- Main Challenge: What is the baseline against which we compare funded firms' performance?
- Possibilities:
  - Before/After: but funded firms might be on upward trajectory no matter what
  - Other firms: but funded firms may be *selected* on the basis of their expected innovative success, so observing such success may not demonstrate cause/effect from funding

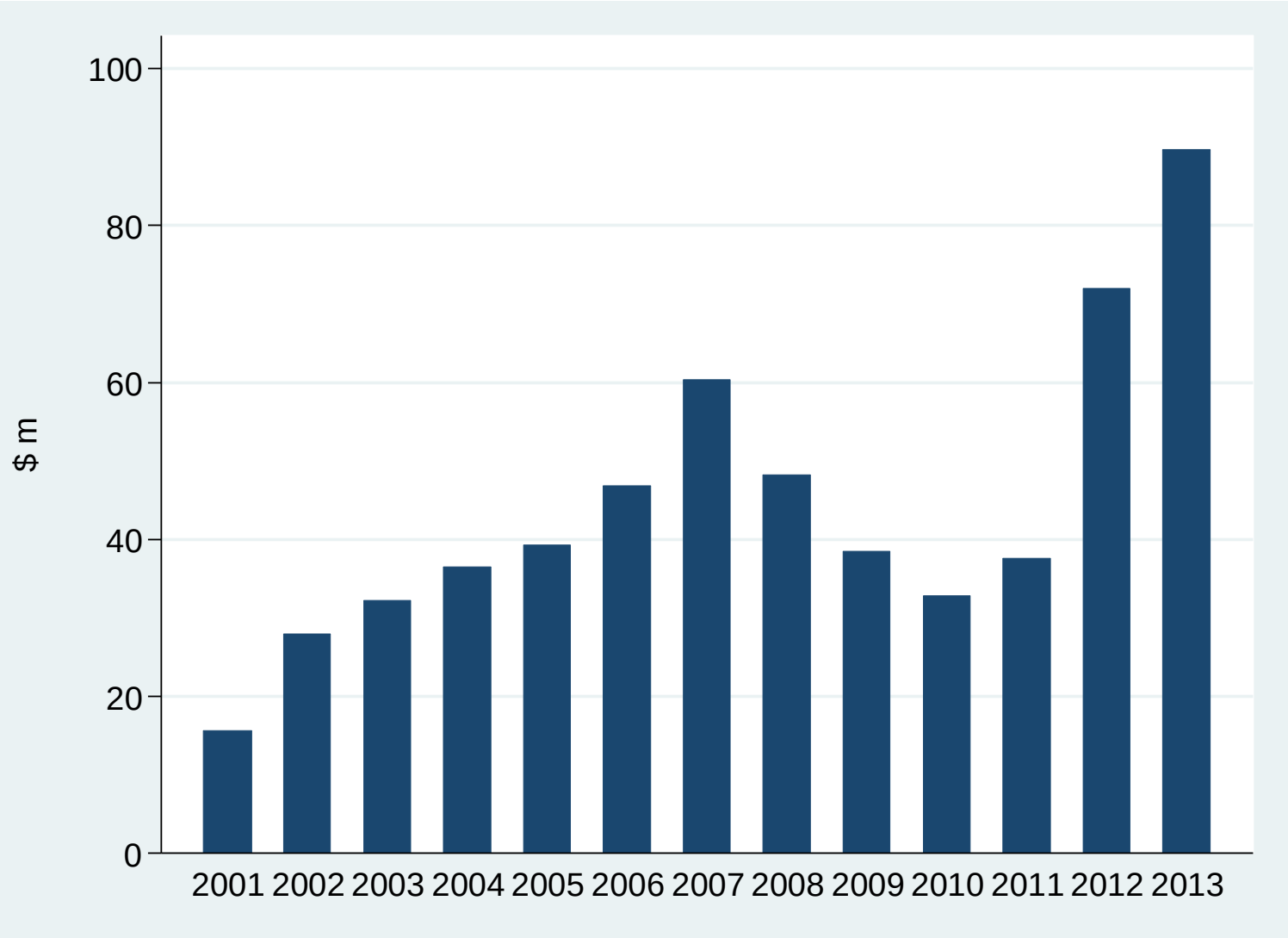
Our approach

- Control sample of matching firms:
  - We identify a set of firms that are matched to the funded firms as closely as possible based on observable characteristics (size, performance, history)
  - We compare the innovativeness of funded firms to that of the control sample of firms
- How to measure innovation
  - Statistics NZ Business Operations Survey ("BOS") every two years asks a series of questions about firms' innovation—we use all of these measures
  - Also have data from IPONZ on patent and trademark applications from NZ firms—alternative measures of innovation

Statistics New Zealand disclaimer

- The results in this paper are not official statistics, they have been created for research purposes from the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand. The opinions, findings, recommendations and conclusions expressed in this paper are those of the authors not Statistics NZ, the NZ Productivity Commission, or Motu Economy & Public Policy Research.
- Access to the anonymised data used in this study was provided by Statistics NZ in accordance with security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business or organisation and the results in this paper have been confidentialised to protect these groups from identification. Careful consideration has been given to the privacy, security and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the privacy impact assessment for the IDI available from www.stats.govt.nz.
- The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit-record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.
- Statistics NZ confidentiality protocols were applied to the data sourced from the Ministry of Business, Innovation and Employment; New Zealand Trade and Enterprise; and Te Puni Kōkiri. Any discussion of data limitations is not related to the data's ability to support these government agencies' core operational requirements.

Govt R&D funding for businesses



Govt R&D funding for businesses in 2012

	Share in total funding	Avg. grant amt ($)
By grant type		
R&D Capability building	0.11	14,500
R&D Project	0.89	326,500
By firm size		
<20 employees	0.32	54,500
20-49 employees	0.08	65,800
50-99 employees	0.13	171,800
>=100 employees	0.47	339,200

Measures of innovation

- Intellectual Property (IP) data: patents, trademarks
  - Accurate on its own terms
  - But not all innovations patented and not all patents lead to innovation
  - Quite rare among NZ firms
- BOS Survey questions: variety of categories (good or service verus process); various levels of newness (new to firm, new to NZ, new to world)
  - Self-reported, definition varies by reporter
  - Capture aspects of innovation not captured by IP data
  - Some innovation reported by many firms, but not clear how meaningful
- Overall, over 100K firms, of which about 11K are covered by BOS, 2005-2013

BOS Descriptive statistics

	Grant Recipients*	Control
Any innovation	67%	44%
Process innovation	42%	23%
Product innovation	58%	25%
New Good/Service to the world	25%	3.5%
Sales due to new Good/Service	7.4%	2.9%
Number of observations	1,194	22,785

** Firms that received an R&D grant in prev. 3 years*

Estimation method: Propensity score matching (PSM)

- PSM estimates the treatment effect by comparing a ‘treated’ firm with an control firm that is as similar to the treated firm as possible
  - Estimate a propensity score
  - Match a treated with an control
  - Calculate the difference in outcome between treated and control
- Robustness confirmed using several technical variations on these methods.

Impact of R&D grant receipt on innovation outcomes

		Kernel bw=0.01
Process innovation	Mean of control	0.347
	Treatment effect	0.053**
Product innovation	Mean of control	0.445
	Treatment effect	0.100***
New GS to the world	Mean of control	0.124
	Treatment effect	0.094***
Sales due to new GS (%)	Mean of control	5.012
	Treatment effect	1.964***
N. control		20,121
N. treated		1,017

Capability building vs. Project

		Capability building	Project
Process innovation	Mean of control	0.328	0.339
	Treatment effect	0.046*	0.086**
Product innovation	Mean of control	0.42	0.442
	Treatment effect	0.050**	0.174***
New GS to the world	Mean of control	0.105	0.118
	Treatment effect	0.033*	0.158***
Sales due to new GS (%)	Mean of control	4.447	5.322
	Treatment effect	0.206	4.324***
N. control		19,425	17,064
N. treated		537	300

SME vs. larger firms

		SME (rme<=20)	Larger
Process innovation	Mean of control	0.311	0.354
	Treatment effect	0.051*	0.086**
Product innovation	Mean of control	0.427	0.443
	Treatment effect	0.104***	0.092***
New GS to the world	Mean of control	0.126	0.104
	Treatment effect	0.090***	0.086***
Sales due to new GS (%)	Mean of control	5.577	4.147
	Treatment effect	2.762***	1.251**
N. control		13,041	4,818
N. treated		420	501

2005-2007 vs. 2009-2013

		2005-07	2009-13
Process innovation	Mean of control	0.346	0.334
	Treatment effect	0.007	0.122***
Product innovation	Mean of control	0.437	0.428
	Treatment effect	0.083***	0.143***
New GS to the world	Mean of control	0.113	0.125
	Treatment effect	0.098***	0.120***
Sales due to new GS (%)	Mean of control	5.196	4.692
	Treatment effect	1.901***	2.691***
N. control		9,213	10,764
N. treated		555	453

Effects on patents and trademarks

		Kernel bw=0.01
New patent	Mean of control	0.014
	Treatment effect	0.011***
New trademark	Mean of control	0.091
	Treatment effect	-0.001
N. control		292,455
N. treated		4,137

Robustness checks

- Ultimately hard to know if PSM has succeeded in controlling for selection bias.
- Could be “good firms” get funded and “good firms” have more innovation, in ways that are not captured by observable firm characteristics on which we match.
- Test: do firms getting grants show “effect” on unrelated “good” outcome?
  - No effect of grant on reported “employee satisfaction”
- Test: does a non-R&D-related programme show apparent increase in innovation?
  - Recipients of Enterprise Training Programme (ETP) grants do show some weak innovation effects, particularly for “easiest” forms of innovation
  - Could be evidence of some residual selection bias
  - Could be evidence that ETP indirectly/weakly helps firms become more innovative

Other Robustness checks

- Results are very similar with the following variations:
  - Match on pre-treatment characteristics rather than post-treatment
  - “Window” for R&D/Innovation effect of 2 or 5 years rather than 3
  - Lag time between grant and innovation effect increased (2-4 years or 3-5 years previous, rather than 1-3)

Relationship to previous work

- A 2011 study by MED looked at the impact of R&D grants on firms' sales, employment and productivity
- Finds impact for capability-building grants, but not project grants
- Impact limited to small firms (<=6 workers)
- In contrast, we find effect of project grants but not capability grants, and effects similar for firms of different sizes.

➢ Ministry of Economic Development (2011). Evaluation of cross-vote government assistance on firm performance: Stage 2, Impact of direct financial support for R&D.

Possible explanations

- Link between innovation and performance is variable in magnitude and timing, making it hard to pick up in limited data
- R&D grants have impact on innovation outcomes as considered in the current study, but those innovation outcomes have no links to performance outcomes
  - Survey respondents remember about grants, so report innovation (which did not take place) to justify
  - True innovation does improve performance, but the innovation outcomes considered here are poor proxies
- Even true innovation has no links to performance
- More research needed to understand significance of BOS innovation reports:
  - Don’t seem to be pure “noise,” but meaningfulness still unclear.

Summary

- R&D grant receipt doubles the probability of reported introduction of goods or services new to the world, but much weaker effect on process innovation
- R&D project grants show stronger effects than R&D capability-building grants
- Little evidence of differential impacts by firm size
- R&D grant receipt doubles probability of filing a patent, but no significant effect on trademark activity
- Part of observed effects probably due to selection, but a large part still seems to indicate a causal relationship
- Ultimate interpretation requires more study of relationship of BOS-reported innovation to economic outcomes
- Important: we are looking for “direct” effect—if spillovers create benefits for other firms that are comparable to the direct benefit to the funded firm, we wouldn’t find effect.