Cross-Sectoral Differences in the Drivers of Innovation: Evidence from the Irish Community Innovation Survey

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Overview

- Introduction
- Sectoral Variation and Innovation
- The Irish Community Innovation Survey
- Method
- Results

Sectoral Approach to Innovation Determinants

- Malerba (2004:9) "Innovation takes place in quite different sectoral environments, in terms of sources, actors and institutions. These differences are striking"
- Montobbio (2004:66) "An empirical analysis provides stylised evidence that sectors display different economic and innovative trends".
- Paper explores whether sectors differ in the relative importance of sources of knowledge for innovation, using data from Irish Community Innovation Survey 2004-06.
- Moves beyond traditional approaches to treatment of sectoral differences

Sectoral Approach to Innovation Determinants

- Why should sectors matter?
  - Structure-Conduct-Performance (SCP) Paradigm and Strategic Behaviour (Porter, 1980)
  - Localisation Economies (Marshall, 1890)
  - Accessibility to knowledge and proximity (Boschma, 2005)
  - Pavitt's (1984) taxonomy of sectoral change
- Implications for a 'one-size fits all' policy perspective.
- Understanding how sectors source knowledge for innovation may facilitate more focused or nuanced policy making.

Data

- Community Innovation Survey (CIS) 2004-06
- 1,974 responses = 48% response rate
- Companies employing more than 10 employees
- Three forms of innovation output
  - Product innovation (new to firm or new to market)
  - Process innovation
  - Organisation innovation

Innovation Output

- Product Innovation
  - New or significantly improved good or service
- Process Innovation
  - Methods of manufacturing or producing goods and services
  - Logistics, delivery or distribution methods
  - Supporting activities e.g. maintenance, procurement, IT systems
- Organisational Innovation
  - Business practices for organising procedures
  - Methods of organising work responsibilities or decision-making
  - Organising external relations

Sectoral Classifications

- Substantial differences in sectoral classification required
- Logical, coherent selection of firms that operate in a similar manner
- Broad enough to provide statistically robust estimations for each sector
- Sectors identified (including NACE Rev 1 codes):
  - High-Tech Manufacturing (24,29,30-35)
  - All Other Manufacturing (10-14, 15-37 excl high-tech, 40-41)
  - Wholesale, Transport, Storage and Communications (51, 60-64)
  - Financial Intermediation (65-67)

Table 1 – Descriptive Statistics

Variable	
External Interaction	
Group (%)	9
Supplier (%)	11
Customer (%)	9
Competitor (%)	3
Consultant (%)	6
Public Interaction (%)	8
R&D (%)	25
Control Variables	
Employment (mean)	124
Irish Owned (%)	74
Innovation Output	
New to Firm (%)	22
New to Market (%)	25
Process (%)	31
Organisational (%)	44
Sector (% in each sector)	
High-Technology Manufacturing	15
All Other Manufacturing	35
Wholesale, Transport, Storage and Communication	40
Financial Intermediation	10

Method

- Initially an innovation production function, specified in equation (1) is estimated.

$$IO_i = \alpha_0 + \beta_k EI_{ki} + \chi R\&D_i + \delta_m Z_{mi} + \phi_n S_{ni} + \varepsilon_i$$

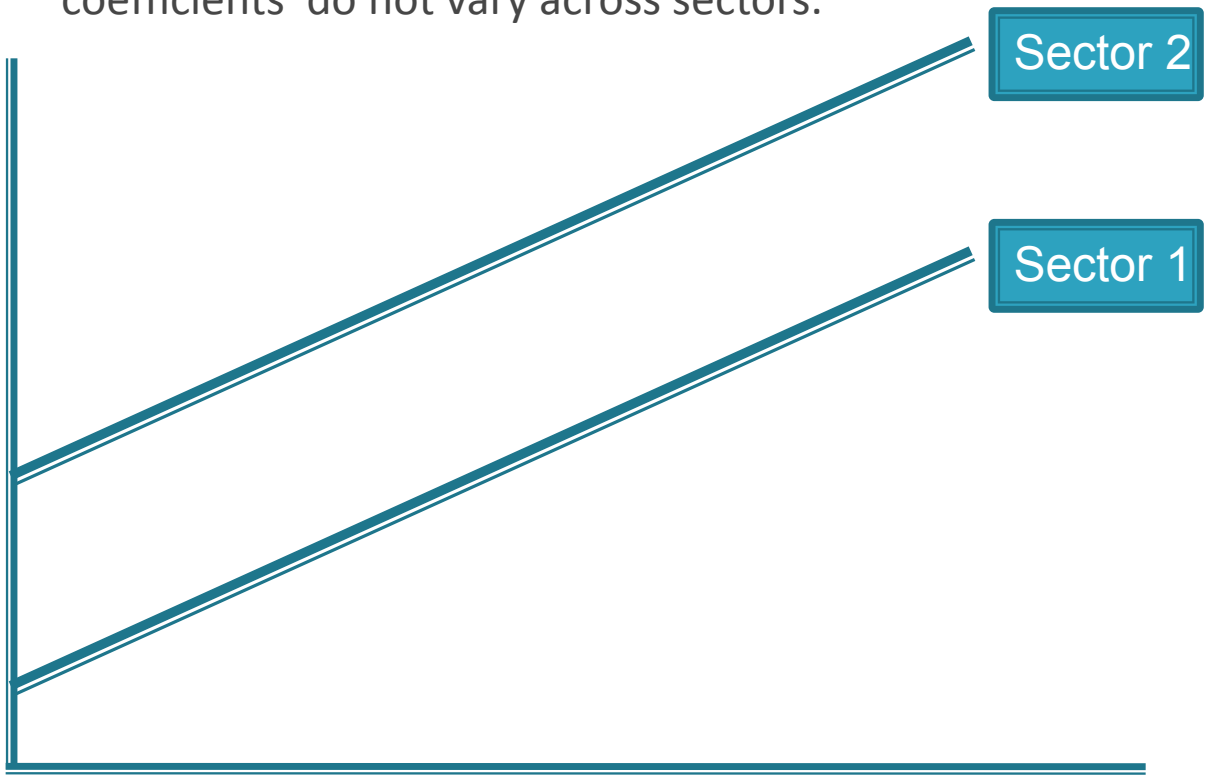
- Where:
  - IO is a binary indicator of innovation output
  - EI is series of k binary indicators of whether a firm engaged in external interaction with a range of agents
  - R&D is a binary indicator of whether a firm engaged in research and development.
  - Z is a range of business specific factors.
  - S is a series of binary variables indicating the sector in which the firm operates.

Method

- Equation 1 is estimated using a probit model for each type of innovator.
- The key contribution of this paper is to assess whether innovation activity varies across sectors.
- Traditionally, a series of dummy variables are included in innovation production functions to control for different propensities to innovate across sectors.
- However, this traditional approach assumes that the slopes of the coefficients and their relative magnitude and importance do not vary.
- This paper therefore tests the estimates from equation (1) for parameter stability across sectoral classifications using the likelihood ratio test.

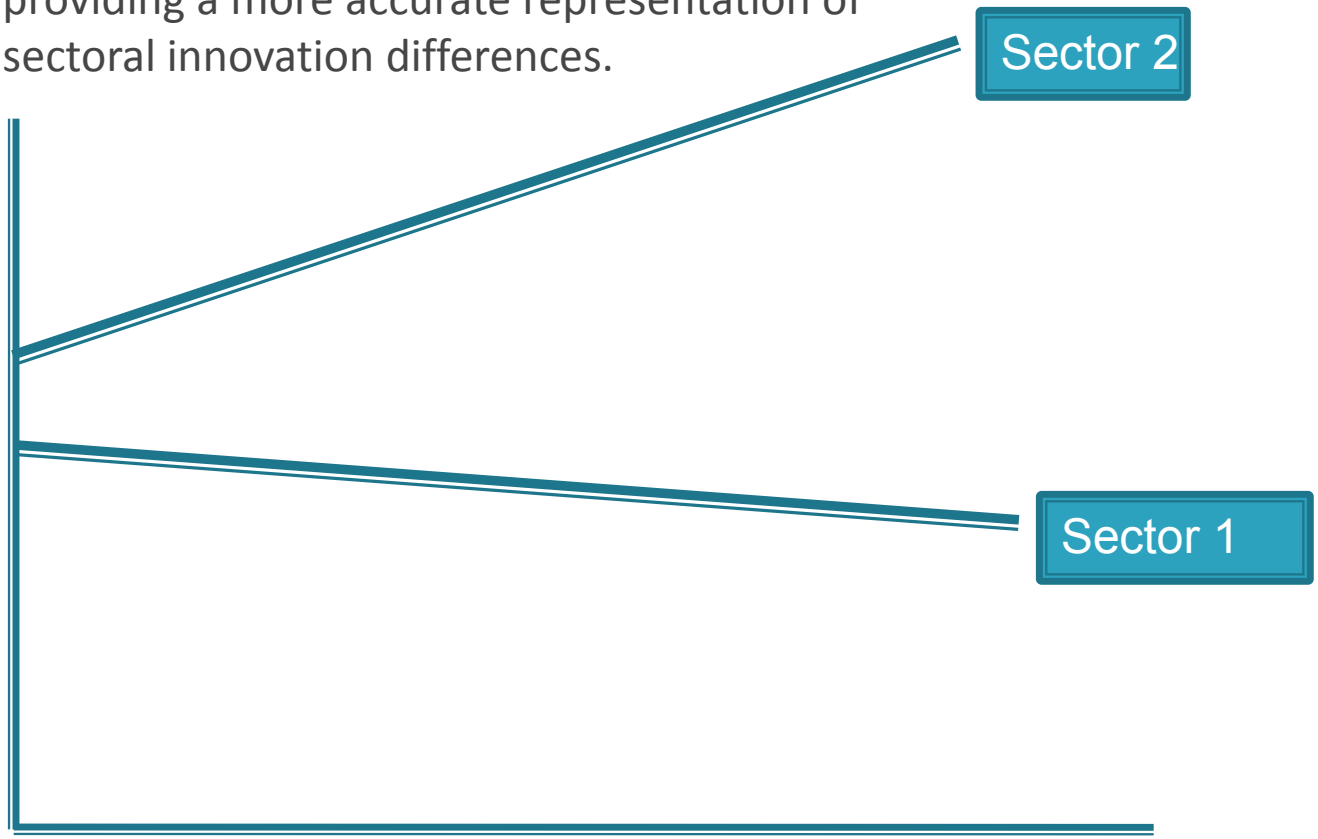
Controlling for Sectors

Sectoral dummy variables allow for varying propensities to innovate.
Implicitly, assuming that the slope of the coefficients do not vary across sectors.



Controlling for Sectors

By testing for parameter stability across sectors, this paper allows, where necessary, slope, as well as intercept, coefficients to vary across sectors. Thus providing a more accurate representation of sectoral innovation differences.



Method

- The implementation of the likelihood-ratio test requires the estimation of the unrestricted equation (1).
  - Where all coefficients, regardless of the firms sector, are equal.
- This unrestricted model is then compared to an restricted model where the estimates are restricted across sectors.
- The restricted model can be specified as equation (2)

$$IO_{is} = \alpha_{0s} + \beta_{ks} EI_{kis} + \chi_s R\&D_{is} + \delta_{ms} Z_{mis} + \varepsilon_{is}$$

- Where all variables are defined as previously but a separate estimate is derived for each sector.

Method

- Once the estimates are derived for the restricted and unrestricted equations a likelihood-ratio test can be applied.
- The null hypothesis of the likelihood-ratio test is that the likelihood-ratio of unrestricted model is equal to the sum of the likelihood-ratios of all the sub-models.

$$L(\hat{\theta}) = \sum_{j=1}^{k} L_j(\hat{\theta}_j)$$

- If this is rejected we reject the hypothesis that the unrestricted probit model applies to each of the sectoral subsets.

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Table 2 – Restricted Estimations

Variable	Process	Organis-ational	New to Firm	New to Market
Constant	-0.5528	-0.2929	-0.8262	-0.9492
External Interaction				
Group	0.2196	0.1961	-0.0369	0.2717*
Supplier	0.615***	0.672***	0.409***	0.411***
Customer	-0.0723	-0.2106	0.440***	0.2221
Competitor	0.667***	0.0207	0.1934	0.2306
Consultant	0.1245	0.2348	-0.424***	-0.349*
Public Interaction	0.0822	0.334***	-0.0648	0.0636
R&D	1.103***	0.798***	1.097***	1.199***
Control Variables				
Employment	0.0001**	0	0	0.0001
Irish Owned	-0.204***	-0.293***	-0.262***	-0.254***
Sector				
All Other Manufacturing	-0.0841	-0.0364	-0.175*	-0.128
W,T,S&C	-0.198*	0.0732	-0.1276	-0.245**
Financial Intermediation	-0.2172	0.1971	-0.253*	-0.579***
No. of obs.	1722	1722	1722	1722
Wald Chi2	447.66 0	284.18 0	329.4 0	423.58 0
Pseudo R2	0.2021	0.1208	0.176	0.2385
Log likelihood				

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Table 3 – Unrestricted Estimations

	New to Firm Innovation			
Variable	High-Tech Man.	All Other Man.	W,T,S & C	Financial Inter.
Constant	-0.6591	-1.4745	-0.6872	-0.9713
External Interaction				
Group	-0.0819	0.2723	-0.4756	0.5604
Supplier	0.1152	0.3524	0.6368***	0.0528
Customer	0.1943	0.2246	1.4240***	-0.3932
Competitor	0.0742	0.239	-0.1321	0.5338
Consultant	-0.1358	-0.325	-0.7812*	-0.4508
Public Interaction	0.211	0.0508	-0.8523	-0.5103
R&D	0.895***	1.206***	1.141***	1.157***
Control Variables				
Employment	-0.0001	0.0004	0.0001	0.0001
Irish Owned	-0.2558	0.2067	-0.6358***	-0.5490**
No. of obs.	277	591	688	166
Wald Chi2	42.78	128.36	101.27	37.26

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Table 4 – Unrestricted Estimations

	New to Market Innovation			
Variable	High-Tech Man.	All Other Man.	W,T,S & C	Financial Inter.
Constant	-0.8214	-1.3214	-0.9269	-1.7128
External Interaction				
Group	-0.0614	0.793***	0.4773	0.2326
Supplier	0.3204	0.1667	0.983***	-1.0912
Customer	-0.1376	0.2109	0.880***	-0.5886
Competitor	0.338	0.6842	-1.221***	1.1333*
Consultant	0.2195	-0.823***	-1.449***	2.064**
Public Interaction	0.2138	0.0421	-0.0236	-1.2029
R&D	0.950***	1.312***	1.236***	1.702***
Control Variables				
Employment	0.0001	0.0007	0.0001	0.0001
Irish Owned	-0.1297	-0.0684	-0.6673***	-0.1796
No. of obs.	277	591	688	166
Wald Chi2	55.2	158.2	119.39	54.76
	0	0	0	0
Pseudo R2	0.1471	0.2463	0.2303	0.38
Log-likelihood	-160.04	-242.09	-199.52	-44.67

Summary

- For process and organisational innovation no evidence of variation in sources across sectors.
- For both types of product innovation, sectors source knowledge differently.
- R&D is significantly positive across all sectors.
- For new to firm innovation the external interaction effects are driven by the largest (WTSC) sector. No other sector demonstrates a significant EI effect.

Summary

- No evidence of a variation between indigenous and foreign businesses in innovation propensity for manufacturing sectors.
- For new to market product innovation a more complex picture emerges.
- The EI effects vary across sectors.
- For new to market product innovation indigenous businesses have a lower innovation propensity for the WTSC sector only.

Conclusion

- Care required in drawing implications for all sectors from analysis at higher level of aggregation.
- One size does not fit all!
- Sectors with a larger proportion of the sample can dominate and mask what is happening at sectoral level.
- Innovation policy that seeks to support innovation across an economy must take account of specific sectoral issues.
- Differentiated policy supports and interventions may be worthwhile.