The Effects of the Internationalisation of Firms on Innovation and Productivity in Ireland

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Outline

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Motivation

- Innovation is of crucial importance for economic growth and competitiveness in the context of increased international competition

- Understanding the determinants of innovation and how it affects productivity is important for designing effective innovation policies

- Firm-level analysis of the links between innovation investment, innovation output and productivity accounts for heterogeneity within countries and industries

Theoretical and Empirical Background

- Multinational firms are more productive than domestic firms
  (Doms and Jensen, 1998; Griffith and Simpson, 2001; Ruane and Ugur, 2004; Girma and Goerg, 2007)

- Exporters are more productive than domestic non-exporters
  (Bernard and Jensen, 1995; Melitz, 2003; Helpman, Melitz and Yeaple, 2004)

- Empirical evidence on the sources of the productivity advantage of firms with international linkages is scarce

- Positive links between innovation investment, innovation output and productivity at firm level (Crépon et al, 1998; Griffith et al, 2006) without accounting for international linkages

Research Questions

- Are firms with international linkages more productive?

- Are firms with international linkages more likely to invest in innovation and do they have a higher innovation expenditure intensity?

- Do firms with international linkages innovate more than firms serving only the domestic market?

Research Contribution

- Estimate an augmented structural model to account for the role of international linkages in the relationships between innovation investment, innovation output and productivity of firms in Ireland

   We build on and extend: Crépon, Duguet, Mairesse (1998)
   Griffith, Huergo, Mairesse and Peters (2006)
   Related research: Criscuolo, Haskel and Slaughter (2010)
   Doran, Jordan and O'Leary (2010)

- We estimate the model for all firms (not only innovative firms), all types of innovation (product, process, organisational)

- Use panel data from CIS 2006 and CIS 2008 and account for three econometric issues:
   - Selection bias: non-random set of firms which report innovation investment
   - Innovation input, innovation output and productivity are endogenously determined
   - Omitted variable bias

Empirical Model
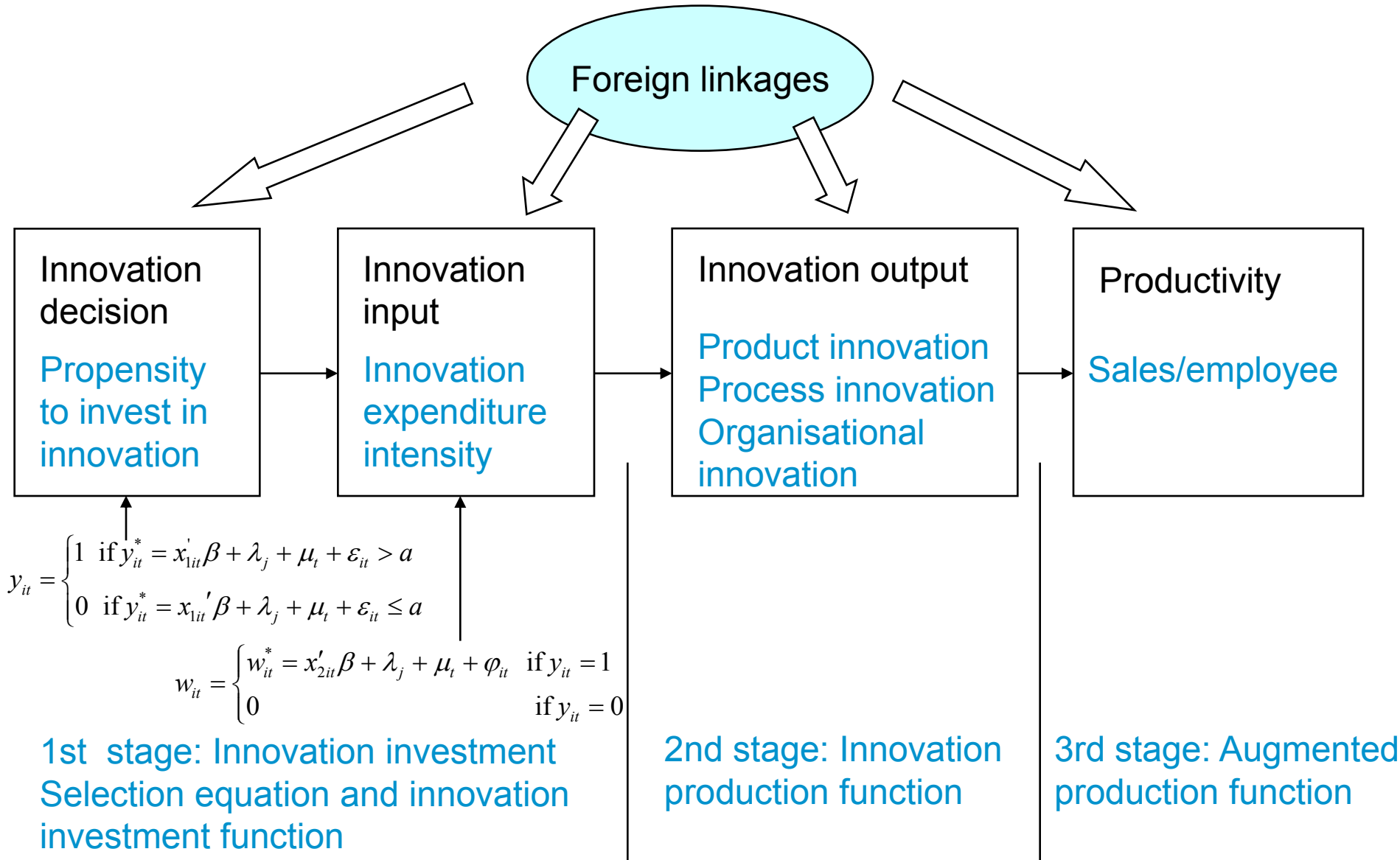
Based on the Crépon-Duguet-Mairesse (CDM) model

Data: CIS 2006 and CIS 2008

- 723 firms in manufacturing and services (NACE 15-37; 50-74)
  - Foreign owned: 34%; Domestic exporters: 39%; Domestic non-exporters: 27%

- Innovation expenditure
  - R&D expenditure, spending on acquisition of machinery, equipment and software, of patents, licences, product design

- Innovation output
  - Product, process, organisational innovation (the *Oslo Manual,* OECD*)*

- Sources of external knowledge
  - Other enterprises within the same group; suppliers; clients or customers; competitors or other enterprises in the same sector; consultants, commercial labs or private R&D institutes; universities or other higher education institutions; government or public research institutions

- Perceived obstacles to innovation
  - Cost factors; Knowledge factors; Market factors

Data

- Foreign ownership - CIS
- Exporting - CIS
- Employment - CSO
- Sales - CSO
- Industry - CSO
- Price indices - CSO
- Global technology frontier - OECD

Innovation Measures

The Oslo Manual (OECD/EUROSTAT, 2005):

- **Product innovation**: "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses: significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics".

- **Process innovation**: "the implementation of a new or a significantly improved production or delivery method: significant changes in techniques, equipment and/or software".

- **Organisational innovation**: "the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations".

Propensity to Invest in Innovation

(Manufacturing and Services)

Dependent variable	Propensity to invest in innovation		Propensity to invest in innovation	
Estimator			Heckman first stage	
Foreign-owned firm	0.128***	(0.044)	Lack of internal funds	0.101* (0.061)
Domestic exporter	0.230***	(0.033)	Lack of external funds	0.041 (0.065)
Employment [20, 49]	0.089**	(0.045)	Costs too high	-0.138*** (0.045)
Employment [50, 249]	0.212***	(0.043)	Lack of qualified personnel	0.059 (0.059)
Employment [250, 499]	0.294***	(0.066)	Lack of technology information	0.079 (0.103)
Employment [>=500]	0.470***	(0.054)	Lack of market information	0.073 (0.068)
Distance to the GTF	-0.006**	(0.003)	Hard to find co-op partners	0.122* (0.068)
Time specific effect	-0.026	(0.024)	Market dominated	0.017 (0.033)
Industry specific effects	Yes		Uncertain demand	0.053 (0.037)
Constant	Yes		Government regulation	0.158*** (0.051)
N	1,446		Excessive risk	-0.023 (0.054)

Intensity of Innovation Investment
(Manufacturing and Services)

Dependent variables	Intensity of innovation expenditure (log of innovation expenditure per employee)
Estimator	Heckman second stage
Foreign-owned firm	0.790*** (0.268)
Domestic exporter	0.299 (0.244)
Employment [20, 49]	-0.545** (0.227)
Employment [50, 249]	-0.321 (0.260)
Employment [250, 499]	-0.486* (0.284)
Employment [>=500]	-0.523 (0.344)
Distance to the GTF	-0.075*** (0.017)
Time specific effect	-0.173 (0.136)
Industry specific effects	yes
Constant	yes
N	1,446

Innovation Output

(Manufacturing and Services)

Dependent variable	Any type of inno.	Product inno.	Process inno.	Organizational inno.
Estimator	Random eff.	Random eff.	Random eff.	Random eff.
Foreign-owned firm	0.284*** (0.046)	0.176*** (0.050)	0.105** (0.044)	0.138*** (0.040)
Domestic exporter	0.241*** (0.032)	0.167*** (0.034)	0.178*** (0.032)	0.243*** (0.031)
Predicted inno. expend. per employee	0.004 (0.052)	0.009 (0.028)	-0.000 (0.042)	0.057* (0.033)
Employment [20, 49]	0.095* (0.052)	0.076** (0.038)	0.075* (0.045)	0.088** (0.039)
Employment [50, 249]	0.211*** (0.059)	0.153*** (0.051)	0.107** (0.051)	0.143*** (0.047)
Employment [250, 499]	0.238** (0.100)	0.090 (0.070)	0.195** (0.092)	0.224*** (0.085)
Employment [>=500]	0.443*** (0.107)	0.359*** (0.131)	0.476*** (0.106)	0.414*** (0.107)
Co-operation with other enterprises	0.318*** (0.094)	0.083* (0.044)	0.306*** (0.061)	0.045 (0.042)
Co-operation with suppliers	0.478*** (0.063)	0.155*** (0.051)	0.191*** (0.052)	0.222*** (0.052)
Co-operation with customers	0.057 (0.081)	0.208*** (0.064)	0.080 (0.051)	-0.023 (0.033)
Co-operation with competitors	-0.169** (0.068)	-0.007 (0.033)	-0.023 (0.051)	0.093 (0.062)
Co-operation with consultants	0.678*** (0.051)	0.152** (0.061)	0.408*** (0.067)	0.323*** (0.067)
Co-operation with universities	0.235** (0.119)	0.173** (0.067)	0.242*** (0.071)	0.260*** (0.071)
Co-operation with government	0.678*** (0.051)	-0.007 (0.041)	-0.066 (0.054)	0.143 (0.091)
Time specific effect	-0.082*** (0.019)	-0.053*** (0.014)	0.043*** (0.017)	-0.082*** (0.016)
Industry specific effect	yes	yes	yes	yes

Productivity
(Manufacturing and Services)

Dependent variable	Log of sales per employee			
Predicted innovation output	Any type of inno.	Product inno.	Process inno.	Organizational inno.
Estimator	Random eff.	Random eff.	Random eff.	Random eff.
Foreign-owned firm	0.473*** (0.063)	0.504*** (0.060)	0.557*** (0.058)	0.470*** (0.060)
Domestic exporter	0.112** (0.046)	0.150*** (0.042)	0.169*** (0.041)	0.082* (0.044)
Predicted innovation output	0.479*** (0.100)	0.452*** (0.083)	0.334*** (0.077)	0.613*** (0.089)
Employment [20, 49]	0.038 (0.053)	0.053 (0.052)	0.066 (0.052)	0.057 (0.052)
Employment [50, 249]	-0.067 (0.061)	-0.050 (0.059)	-0.014 (0.058)	-0.040 (0.058)
Employment [250, 499]	-0.118 (0.108)	-0.080 (0.106)	-0.090 (0.107)	-0.117 (0.106)
Employment [>=500]	-0.095 (0.130)	-0.115 (0.130)	-0.099 (0.131)	-0.143 (0.129)
Time specific effect	0.093*** (0.019)	0.093*** (0.019)	0.046** (0.018)	0.120*** (0.020)
Industry specific effects	yes	yes	yes	yes

Robustness Checks

- Broadly similar results obtained with

  - In-house R&D expenditure
  - Sales as a proxy for size
  - No outliers

Manufacturing versus Services: Similarities

- Domestic exporters were more likely to invest in innovation in comparison to firms which served only the Irish market

- Propensity to invest in innovation increased with firms size

- Innovation expenditure intensity was not significantly associated with innovation output over and above other determinants

- Positive link between innovation output and labour productivity- all types of innovations

- Foreign owned firms and domestic exporters were more productive than firms serving only the Irish market

Manufacturing versus Services: Differences

- Foreign owned firms in manufacturing were more likely to invest in innovation; no significant link in the case of services

- More productive firms in services were more likely to invest in innovation; no significant link in the case of manufacturing

- Perceived obstacles to invest in innovation for manufacturing firms were high innovation costs and excessive risks; no significant link in the case of services firms

- Knowledge flows from universities were positively associated with all types of innovation output in manufacturing firms; no significant effect in services firms

- Product innovation in manufacturing was positively associated with knowledge flows from customers and universities; in services with knowledge flows from other enterprises within the same group; from suppliers; from customers; from consultants, commercial labs and private R&D;

- Organisational innovation in manufacturing was positively associated with knowledge flows from suppliers, from consultants and from universities; no significant effect of knowledge flows in the case of services

Key Findings

- Foreign owned firms and domestic exporters were more likely to invest in innovation and furthermore, they were more likely to have successful innovation output and a higher productivity in comparison to firms that served only the Irish market

- Innovation output was positively linked to productivity over and above other determinants such as foreign linkages, as well as unobserved industry, firm and time specific effects

- Innovation expenditure intensity was not significantly associated with innovation output over and above other determinants such as foreign linkages, firm size, and external knowledge flows (in particular co-operation with suppliers, with consultants, commercial labs or private R&D institutes, with universities and with enterprises from the same group)

- Similarities and differences in the relationships between innovation investment, innovation output and productivity for manufacturing and services, as well as technological (product and process innovation) and non-technological innovation (organisational innovation)

Policy Implications

- Enabling internationalisation of firms could foster innovation and productivity

- Fostering co-operation with other enterprises and institutions is an important way to source knowledge in order to generate innovation output

- Innovation expenditure *per se* does not translate into innovation output. Possible explanations:
    - Other factors more important to generate innovation
    - Lagged effects – not captured due to data limitations
    - Innovation failures, lack of absorptive capacity