

# Productivity effects of innovation modes

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# Introduction

- OECD project ‘Innovation in firms: a microeconomic perspective’
  - topic 1 ‘Innovation and productivity’
  - international comparison using standard ‘CDM’ model
- Eurostat project ‘ICT impacts’
  - presentation Tony
- Current paper:
  - Extension of standard CDM model with
    - ICT as in Eurostat project
    - other types of innovation besides product innovation



# The CDM model

- Traditionally (e.g. Griliches, 1979)
  - R&D →
  - Productivity gains
- Crépon-Duguet-Mairesse (1998)
  - R&D →
  - Knowledge →
  - Productivity gains



# The CDM model

- Implementation:
  - How to measure 'knowledge' (innovation output)?
    - Sales of innovative products
    - Patents
- Community Innovation Survey (CIS) data



# Structure of the model



Standard CDM model



# This research

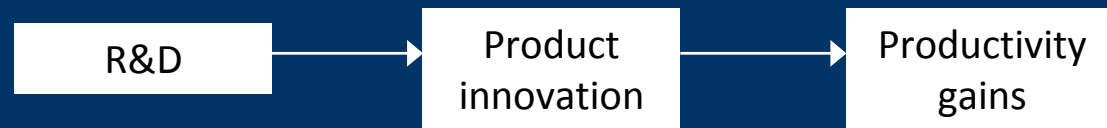
Extension of standard CDM framework in different dimensions:

- more types of innovation than product innovation
  - Process
  - Non-technological

These types are likely to influence productivity as well!
- Other inputs to innovation besides R&D
  - ICT is an important enabler of innovation
  - ICT investment complemented by organisational innovation (e.g. Brynjolfsson and Hitt, 2000)



# Structure of the model



Standard CDM model



# Structure of the model



Brynjolfsson et al.



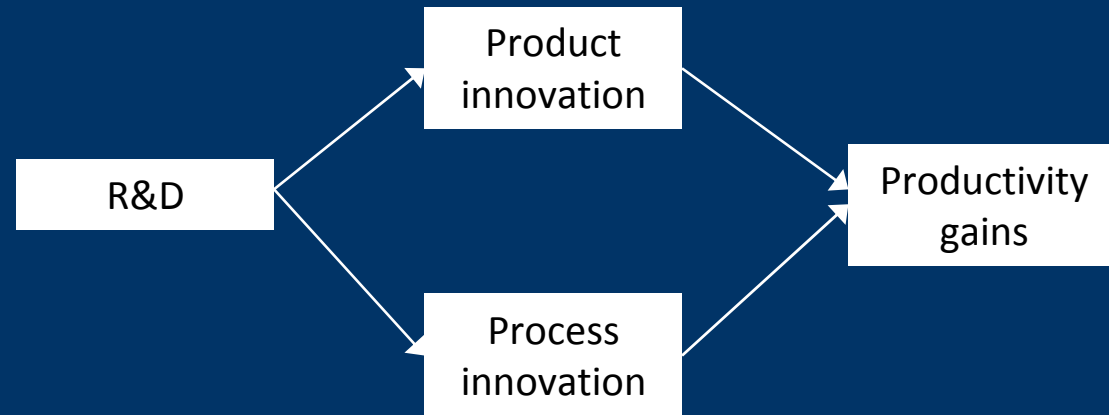


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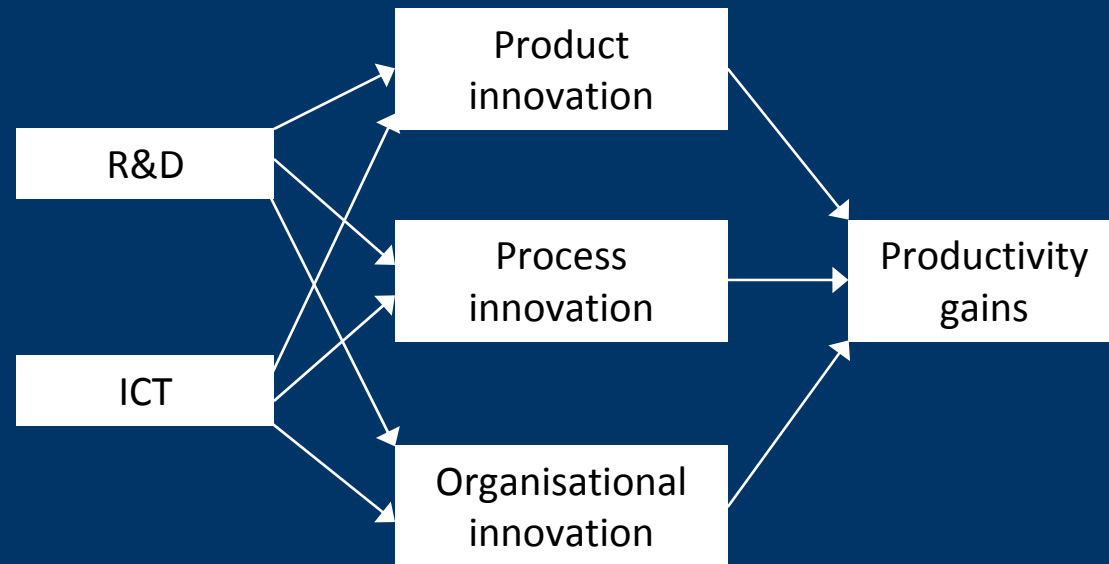
Van Leeuwen, 2009 (Eurostat project)

# Structure of the model



Recent extension, e.g. Griffith et al. (2006) and Robin and Mairesse (2008)

# Structure of the model



This research: encompassing model structure



# Implementation

Questions:

- Productivity effects of innovation modes?
- Is there any complementarity between modes?
- Effect of ICT on innovation?



## Data

- CIS 2002-2006 (3.5, 4, 4.5)
- E-commerce/ICT-use survey
- Production statistics (PS)
- Investment statistics (ICT investment)

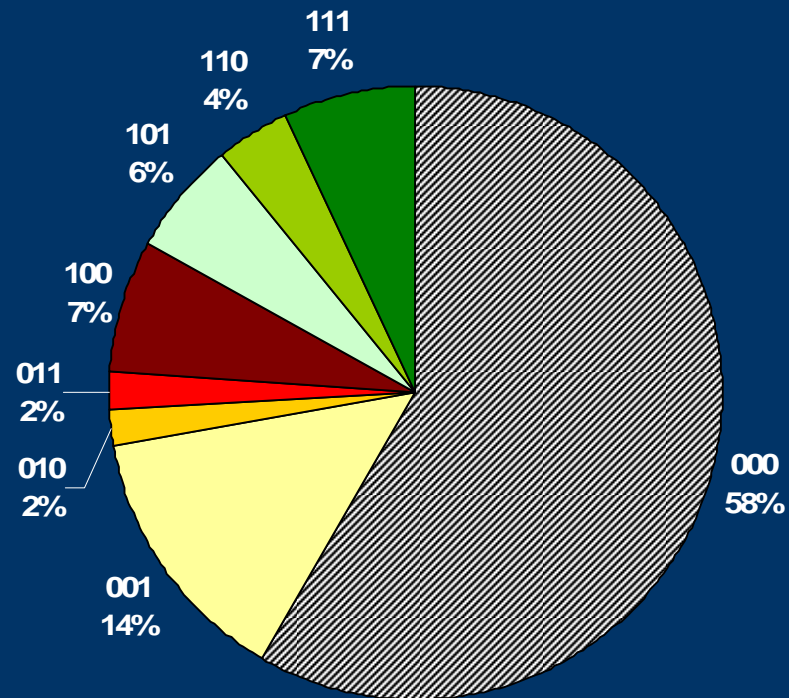


# Implementation

- Issues:
  - A. Selection
  - B. Endogeneity
  - C. Only binary innovation output measures
- Solutions:
  - A. Innovation input equation: type-II tobit
  - B. Endogenous variables replaced by predictions based on ‘exogenous’ variables (Instrumental Variables)
  - C. Innovation output equation is a trivariate probit



# Results: triplets



(X,Y,Z) = (Product, Process, Organisational)



# Results: knowledge production function

MANUFACTURING (N = 2574 )	PRODUCT		PROCESS		ORGANISATIONAL	
	coeff	se (bootstrap)	coeff	se (bootstrap)	coeff	se (bootstrap)
R&D	1.044**	0.435	0.618	0.400	-0.037	0.291
ICT	1.039	1.262	1.415	1.204	1.540*	0.872
access to broadband	0.277**	0.125	-0.033	0.083	0.388***	0.073
Doing e-purchases	0.106	0.357	0.458*	0.270	0.255	0.309
Doing e-sales	0.140	0.200	0.442***	0.128	-0.053	0.162
SERVICES (N = 4913)	coeff	se (bootstrap)	coeff	se (bootstrap)	coeff	se (bootstrap)
R&D	-0.831	0.977	-0.672	0.831	-0.496	0.524
ICT	3.295***	0.897	2.645***	0.747	1.832***	0.506
access to broadband	0.441***	0.070	0.195**	0.079	0.325*	0.077
Doing e-purchases	0.395***	0.080	0.164*	0.096	0.269*	0.150
Doing e-sales	0.329**	0.133	0.161*	0.097	0.191	0.158





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# Results: production function

	MANUFACTURING				SERVICES			
	THREE TYPES		TWO TYPES		THREE TYPES		TWO TYPES	
	coeff	se (btstr)	coeff	se (btstr)	coeff	se (btstr)	coeff	se (btstr)
Capital intensity	0.207***	0.013	0.207***	0.016	0.250***	0.011	0.261***	0.014
Employment	-0.013	0.018	0.038**	0.017	-0.233***	0.014	-0.131***	0.025
TP(0,0,1)	1.654***	0.491			4.345***	0.571		
TP(0,1,0)	-0.905	1.100			-2.703	1.943		
TP(0,1,1)	0.984*	0.537			17.114***	2.213		
TP(1,0,0)	0.468	0.300			0.808	1.275		
TP(1,0,1)	-0.015	0.455			-0.804	0.705		
TP(1,1,0)	-0.130	0.400			-8.327***	1.262		
TP(1,1,1)	0.891***	0.193			3.932***	0.459		
BP(0,1)			0.095	0.485			7.252***	2.357
BP(1,0)			-0.079	0.160			0.917***	0.312
BP(1,1)			0.202***	0.068			-0.033	0.285

TP(X,Y,Z) = (Product, Process, Organisational)

BP(X,Y) = (Product, Process)



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# Summary of results

- Effect of R&D on innovation:
  - Manufacturing: only on product innovation
  - Services: no effect
- Focus on R&D as measure for innovation only appropriate for product innovation in manufacturing



# Summary of results

- Effect of ICT on innovation:
  - All instances of ICT important in services
  - For manufacturing: broadband and e-commerce
  - Stronger effects in services
- ICT important enabler for all types of innovation in both sectors (unlike R&D)



# Summary of results

- Effects of innovation on productivity:
  - Strongest effects for organisational innovation
  - Product and process innovation lead to productivity gains only when combined with organisational innovation
- Shows importance of taking into account non-technological innovation

