Determinants of Firm Innovation

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Motivation

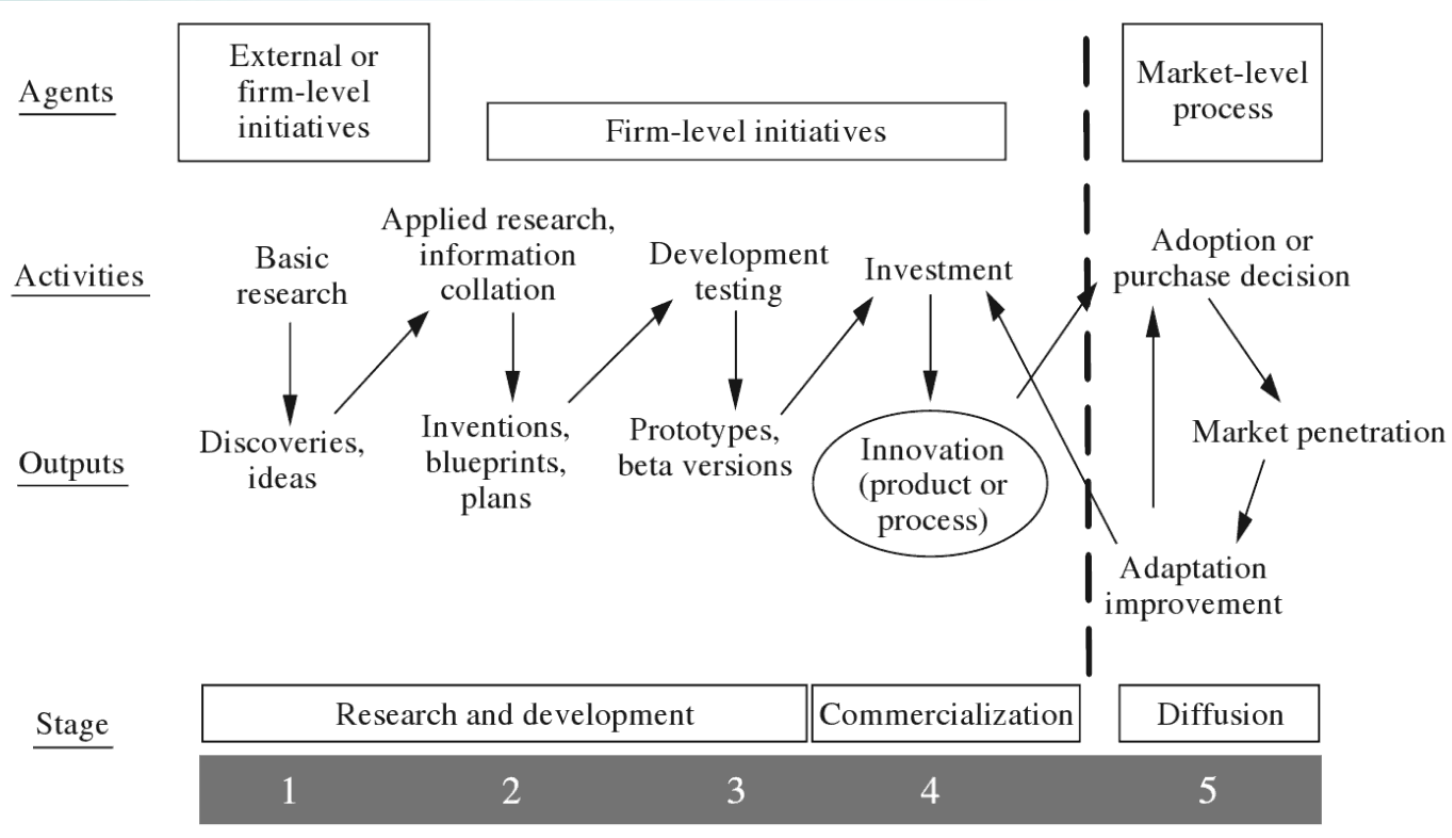
- Governments subsidize private R&D
- CDM approach and CIS data

Presentation overview

1) CDM and innovation definition
2) Recent innovation determinants evidence
3) Czech firms innovation determinants

1) CDM and innovation definition

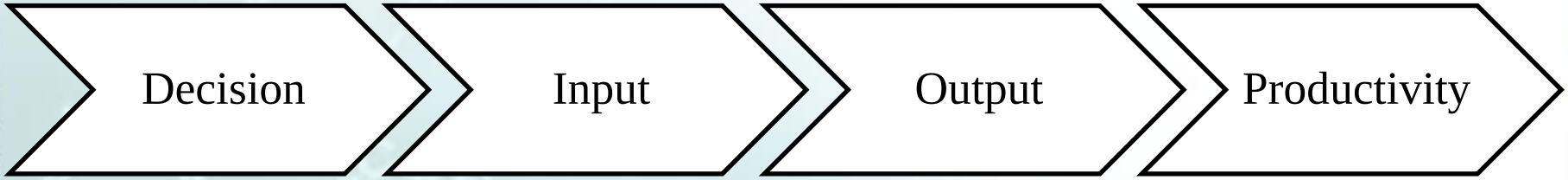
Innovation definition



Greenhalgh, C., & Rogers, M. (2009). *Innovation, Intellectual Property, and Economic Growth*. Princeton University Press.

1) CDM and innovation definition

CDM Approach



- Close to Innovation definition
- Make the most from CIS data
- Sequential estimation approach
- Casual chain

2) Recent evidence

Autor	Country	Year - Span	Decision sample	R&D sample	R&D, and Q Estimation
Crepon et al (1998)	France	1986-1990	6145	4164	ALS
Hashi&Stojcic (2010)	16 EU states	2004	85777	15644	3SLS
Griffith et al (2006)	France	1998-2000	3625	1270	PROBIT ME IV OLS IV
Griffith et al (2006)	Germany	1998-2000	1123	442	PROBIT ME IV OLS IV
Griffith et al (2006)	Spain	1998-2000	3588	750	PROBIT ME IV OLS IV
Griffith et al (2006)	UK	1998-2000	1904	509	PROBIT ME IV OLS IV
Masso&Vahter (2008)	Estonia	1998–2000	1321	369	PROBIT ME IV OLS IV
Masso&Vahter (2008)	Estonia	2002-2004	953	406	PROBIT ME IV OLS IV
Polder et al (2009)	Netherland Manufacturing	2002-2006	8536	2578	PROBIT ME IV OLS IV
Polder et al (2009)	Netherland Services	2002-2006	18375	1676	PROBIT ME IV OLS IV
Loof&Heshmati (2006)	Sweden Services	1998	1974	903	2SLS
Loof&Heshmati (2006)	Sweden Manufact.	1998	1081	363	2SLS
Castellacci, F. (2009)	Norway	1998-2006	12954	3570	G2SLS RE
Janz et al (2003)	Germany	1998–2000	575	352	2SLS
Janz et al (2003)	Sweden	1998–2000	474	206	2SLS
Roud, V. (2007)	Russia	2005	3408	497	2SLS
Ebersberger&Lööf (2005)	Denmark	1998–2000	844	429	2SLS
Ebersberger&Lööf (2005)	Finland	1998–2000	818	516	2SLS
Ebersberger&Lööf (2005)	Norway	1998–2000	2327	1119	2SLS
Ebersberger&Lööf (2005)	Sweden	1998–2000	1197	694	2SLS
Damijan et al (2008)	Slovenia	1996-2002	4947	4947	PROBIT ME IV OLS IV
11 papers	**12 (16) EU Countries**	**1986-2005**	**161946**	**41404**	**Probit, IV, xLS**

2) Recent evidence

1) Typical firm having R&D expenditures is larger, orienting itself on foreign markets.

2) Typical firm spending more on R&D per employee is rather smaller, face international competition and cooperates. Public policies seem motivating, but there are some doubts in detailed view.

3) Typical firm having innovation output is any size, evidence vary. On average public funding seems to have negative and/or no effect on firm innovation output. Innovation input elasticity gets from .267 to .614 (2SLS).

4) Both physical capital and innovation capital (innovation output) boost productivity of a firm in terms of sales (or turnover, or value added) per employee.

3) Czech firms innovation activities

DATA: Combination of two sources:

- Community Innovation Survey (CIS) 2005 and 2006
  - Innovation activities, expenditures and outcomes
  - Information on subsidies on national and EU level
- Czech Statistical Office (P5) 2004 and 2006
  - Firm size, revenues, ownership, date of registry
  - Industry level characteristics (concentration)
- Sample: 2071 firms (52% report innovation)

3) Czech firms innovation activities

Summary: Means

Innovating firm

- Larger (# of employees)
- Higher labour productivity (before and after introduction of innovation)
- Foreign owned
- Foreign markets oriented
- Manufacturing industry
- Less likely a new entrant

	Innovating firms		**Non-innovating firms**	
	Mean	SE	Mean	SE
Firm size	616***	[73]	259***	[14]
Labour productivity (2004)	2,234***	[74]	1,915***	[76]
Labour productivity (2006)	2,639***	[92]	2,191***	[86]
Foreign ownership	0.35**	[0.015]	0.31**	[0.015]
Entrant	0.03***	[0.005]	0.06***	[0.007]
Market:				
-regional	0.11***	[0.010]	0.27***	[0.014]
-national	0.38	[0.015]	0.4	[0.015]
-EU	0.41***	[0.015]	0.29***	[0.014]
-other	0.10***	[0.009]	0.04***	[0.006]
Industry				
-manufact.	0.68***	[0.014]	0.46***	[0.016]
-services	0.19***	[0.012]	0.28***	[0.014]
-trade	0.04***	[0.006]	0.09***	[0.009]

3) Czech firms innovation activities

Model 4-stages CDM: Crepon et al (1998), Hashi&Stojcic (2010)

Stage 1+2: determinants of decision to innovate and consequent innovation investment, Estimated using generalized tobit routine

1. **Decision to innovate g_i:** based on the investment decision criterion g_i^*

$$g_i^* = \beta_0 x_i^0 + u_i^0; \quad g_i = 1 \text{ if } g_i^* > 0 \text{ and } g_i = 0 \text{ if } g_i^* \leq 0$$

2. **Innovation investment (input):** sum of innovation expenditures 2004-06

$$k_i^* \mid (g_i^* > 0) = \beta_1 x_i^1 + u_i^1; \quad k_i = k_i^* \text{ if } k_i^* > 0 \text{ and } k_i = 0 \text{ otherwise}$$

- subsidies (regional, national, EU level)
- other exclusion restrictions

3) Czech firms innovation activities

Model 4-stages CDM: Crepon et al (1998), Hashi&Stojcic (2010)

Stage 3+4: interdependency between innovation and productivity
3SLS estimation to account for the two-way relationship

3. Production of innovation output s_i: share of sales of new products/services in the total revenue of the firm in the final year (2006)

$$s_i = \alpha_k k_i + \beta_2 x_i^2 + u_i^2;$$

- using Mills inverse ratio to account for selection
- including subsidies (to evaluate the effectiveness)

4. Effect of innovation on productivity q_i: labor productivity measured as total revenues over the employment (2006)

$$q_i = \alpha_s s_i + \beta_3 x_i^3 + u_i^3;$$

- measure of concentration

3) Czech firms innovation activities

Stage 1+2 Results

	Innovation decision			**Innovation investment**	
	coef	SE	Marg. effect	coef	SE
Firm size (ln)	0.120***	[0.028]	**0.048**	**0.672*** **	[0.053]
Access to subsidies					
-national	-	-	-	**0.750*** **	[0.151]
-EU	-	-	-	**0.339***	[0.150]
Market orientation					
- national	0.173*	[0.099]	**0.069**	0.161	[0.210]
- EU	0.307***	[0.114]	**0.121**	**0.442***	[0.231]
-other markets	0.342**	[0.163]	**0.133**	**0.609** **	[0.281]
Foreign ownership	-0.194**	[0.086]	**-0.077**	**0.273***	[0.146]
New entrant	-0.367**	[0.171]	**-0.145**	0.027	[0.334]

3) Czech firms innovation activities

Stage 3+4 Results

	Innovation output	
	coef	SE
Innovation input (ln)	**0.146*** **	[0.027]
Labour productivity (ln)	0.045	[0.132]
Firm size (ln)	**-0.175** **	[0.041]
Access to subsidies		
- national	**-0.158** **	[0.077]
- EU	0.013	[0.102]
Inverse Mill's ratio	**-0.194**	[0.129]

	Labour productivity	
	coef	SE
Innovation output (ln)	**0.531*** **	[0.121]
Firm size	0.039	[0.032]
Foreign investor	**0.289*** **	[0.067]
Future merger	**0.414*** **	[0.161]

Summary for Czech Republic

1) Typical firm having R&D expenditures is larger, orienting itself on foreign markets.

Larger but different dependent

2) Typical firm spending more on R&D per employee is ***rather smaller***, face international competition and cooperates. Public policies seem motivating, but there are some doubts in detailed view.

3) Typical firm having innovation output is ~~any size~~, evidence vary. On average public funding seems to have negative and/or no effect on firm innovation output. Innovation input elasticity gets ~~from .267~~ to .614 (SLS).

smaller

smaller .146

4) Both physical capital and innovation capital (innovation output) boost productivity of a firm in terms of sales (or turnover, or value added) per employee.

Q&A

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