Inventors and Invention Processes in Europe:
Policy Implications from the PatVal-EU Survey

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Objectives of this presentation

- Present (briefly) the PatVal-EU questionnaire and how it was conducted
- Discuss its main findings and policy implications

Background papers

- Giuri, Mariani et al. (2007) “Inventors and invention processes in Europe: Results from the PatVal-EU survey”, ***Research Policy****,* October
- See also the Final Report on the PatVal-EU survey (www.alfonsogambardella.it)
- Three more papers in the same **Research Policy** issue (October) on 1) Markets for Patents; 2) Inventors; 3) German Inventors’ Compensation Act
- Gambardella, Harhoff, Verspagen (2007) “The Value of European patents”, draft
- Gambardella, Harhoff, Verspagen (2007) “Exploring the Determinants of the Value of European Patents”, draft

The PatVal-EU questionnaire

- EPO patents with priority date 1993-1997 (survey conducted in 2003-4)
- France, Germany, Italy, Netherlands, Spain, UK (later Denmark, Hungary)
- Questionnaire sent to first inventor (if not available: any other inventor)
- Several questions about patent, inventor, invention process, invention characteristics
- 27,000 questionnaires mailed, about 9,000 responses (9550 w/ DK & HU)

Sections of the questionnaire

- Inventor’s Personal Information
- Inventor’s Education
- Inventor’s Employment & Mobility
- The Innovation Process
- The Value of the Patent

Sample vs population

Table 1. The PatVal-EU Survey: targeted number of patents and response rates. Distribution by country.

	GER	SP	FR*	IT	NL	UK	EU6
Number of patents whose inventors were contacted	10,215	815	4,199	1,857	2,594	7,846	27,531
Number of patents whose inventors responded	3,346	269	1,486	1,250	1,124	1542	9,017
Response rate (Responses/Contacts)	32.8%	33.0%	35.4%	67.3%	43.3%	19.7%	32.8%
Country share of patents in the final sample	37.1%	3.0%	16.5%	13.9%	12.5%	17.1%	100%

* The French survey was directed to both inventors and applicant organisations.

- EU6 = 42% of all 93-97 EPO patents & 88% of all EU-15 patents
- Our target (27K patents) more than 50% of population (49K patents)
- Country shares in full population (EPO 93-97):
  - GE 50%; FR 20%; IT 9%; NL 6%; SP 1%; UK 15%

Oversampling important patents

- B/c of skewed distribution, we looked for a sizable share of “important” patents
- All opposed or cited patents in our target + random set of the others
- 43.2% opposed or cited patents in final sample vs 28.5% in population

Other sampling issues

- Three pilot surveys at different scales
- We sampled 1993-1997 and not later b/c we wanted enough time for some information to be produced (eg citations)
- Are inventors the right target for our type of analysis, i.e. vs managers?
  - We figured out that it was really the best we could do if we wanted a large scale survey

Searching for inventors

- Inventors w/ exact address in patent document and phone books (64%) ⇒ send the quest.re
- O/w look for later EPO patents. If exact match ⇒ send the questionnaire
- If not:
  - Check for same names in city (if 2-3 call to find who was the inventor)
  - If fails, repeat for same region/country.
  - If fails, call the 2° or 3° inventor and ask about the 1°. If 1° cannot be found interview the inventor you found
  - If fails, check for inventor in US patents or surfed the internet

Searching for inventors

- We obtained on average
  - 88% exact matches
  - 7% inventors found in a later EPO patent
  - 5% inventors found with other procedure
- Since there were originally 64% exact matches, there is a potential bias
- UK different, only 18% exact matches (phone book regulations)

Sample by sectors and type of inventors' employers

Table 2. Composition of the sample by "macro" technological classes and by type of inventors' employers

	Large firms	Medium sized firms	Small firms	Private Research Inst.	Public Research Inst.	University	Other Govt Inst.	Others	Total
Electrical Eng. (15.8%)	79.9%	5.5%	9.1%	0.4%	1.8%	2.9%	0.1%	0.3%	100%
Instruments (10.9%)	60.4%	7.9%	16.7%	3.2%	3.8%	7.0%	0.1%	0.9%	100%
Chemicals & Pharm (18.5%)	81.1%	4.9%	4.9%	0.6%	2.6%	5.7%	0.1%	0.1%	100%
Process Eng. (24.9%)	64.4%	12.3%	17.2%	0.7%	2.2%	2.4%	0.2%	0.6%	100%
Mechanical Eng. (29.8%)	67.8%	10.5%	17.8%	0.2%	1.1%	1.2%	0.2%	1.2%	100%
Total (100%)	70.6%	8.8%	13.7%	0.8%	2.0%	3.2%	0.2%	0.7%	100%

Number of observations = 8,809. The share of patents by technological class (first column) use 9,014 observations.

Source: Giuri, Mariani et al. (2007) Research Policy

Lessons for Policy (I)

- More than 2/3 of the patents are held by firms w/ > 250 employees
- Large firms cannot be ignored in this area
- Have we overestimated the importance of patenting by universities or even smaller firms for society as a whole?

Who are the European inventors?

Table 3. Sex, age and education of inventors. Distribution by technological class.

	% of female inventors	Average age of inventors*	% of inventors with tertiary education	% of inventors with PhD degree	% of inventors who changed employer after innovation
Electrical Engineering	2.0%	43.3	82.3%	19.1%	27.04%
Instruments	2.7%	44.6	82.0%	33.4%	25.42%
Chemicals & Pharm	7.4%	44.5	91.8%	59.1%	19.99%
Process Engineering	2.1%	46.6	72.7%	22.4%	21.20%
Mechanical Engineering	1.1%	46.2	66.3%	9.3%	21.54%
Total	2.8%	45.4	76.9%	26.0%	22.47%

Number of observations differs across columns, between 8,861 (age) and 8,963 (gender).

Mobility by country: Sp 11%; Ge 17%; Fr 17%; It 25%; Nl 30%; Uk 35%

% females by country: Sp 8%; Ge 2%; Fr 5%; It 3%; Nl 2%; Uk 3%

Source: Giuri, Mariani et al. (2007) Research Policy

Lessons for Policy (II)

- The typical European inventor is *a 45 year old male with tertiary education employed in an established firm*
- In chem & pharma has a PhD (scientist)
- Few women, few young people, which is consistent with employment in established firms

Lessons for Policy (II)

- How to increase the supply of potential inventors?
- ***The gender issue*:** In Europe a large fraction of women gets a S&E degree but then do not enter in the labor market
- ***A time constraints explanation?*** … more women in pharma, cosmetics, biotech
- ***A cultural explanation?*** … in Hungary 19% PatVal inventors are women (Denmark 6%)
- Policy: changing the profile of the European inventor?

Inventors' motivations (1-5)

Table 4. Inventors' rewards

	GER	SP	FR	IT	NL	UK	Total
Average importance of inventors' rewards							
Monetary rewards	3.0	2.1	3.6	3.0	2.7	3.0	3.1
Career advances and opportunities for new/better jobs	2.7	2.6	3.3	3.1	2.9	3.3	3.0
Prestige/reputation	3.7	3.3	2.9	3.1	3.2	3.7	3.4
Innovations increase performance of the organisation the inventor works for	4.1	4.1	4.1	4.0	4.1	3.9	4.0
Satisfaction to show that something is technically possible	4.0	4.0	3.9	3.9	3.9	4.0	3.9
Benefits in terms of working conditions as a reward by employer	3.0	2.2	1.9	2.8	2.2	2.4	2.6
Share of inventors who received monetary compensation							
% Monetary compensation	61.3%	14.7%	NA*	23.1%	17.5%	28.2%	41.7%
% Permanent	4.6%	3.2%	NA*	5.2%	3.8%	3.2%	4.6%
% Transitory	56.7%	11.5%	NA*	17.9%	13.6%	25.0%	37.1%

Number of observations differs across rows, between 7,360 (monetary compensation) and 8,424 (satisfaction).
* France not included because of too many missing data.

Source: Giuri, Mariani et al. (2007) Research Policy

Lessons for Policy (III)

- European inventors have ***motivations similar to scientists***
- Policy should preserve this ethos b/c it produces effort and spillovers
- Thinking about policy:
  - A German Inventor Compensation Act?

Collaborations

Table 5. Research collaborations in the innovation process

	% co-applied patents among independent organisations	% co-applied patents	% patents with external co-inventors	% patents developed in collaboration with other partners	% patents developed with formal collaborations	% patents developed with informal collaborations
GER	3.1%	5.0%	15.4%	13.3%	9.5%	3.8%
SP	3.0%	3.4%	9.4%	19.6%	16.9%	2.7%
FR	5.4%	7.0%	12.3%	22.7%	19.8%	2.9%
IT	4.0%	4.8%	9.6%	21.9%	14.3%	7.6%
NL	3.3%	8.2%	15.9%	34.5%	26.9%	7.6%
UK	2.8%	7.8%	21.1%	23.3%	19.0%	4.3%
Total	3.6%	6.1%	15.0%	20.5%	15.8%	4.7%

Number of observations differs across columns, between 8,501 (collaborations) and 9,013 (co-assigned patents).

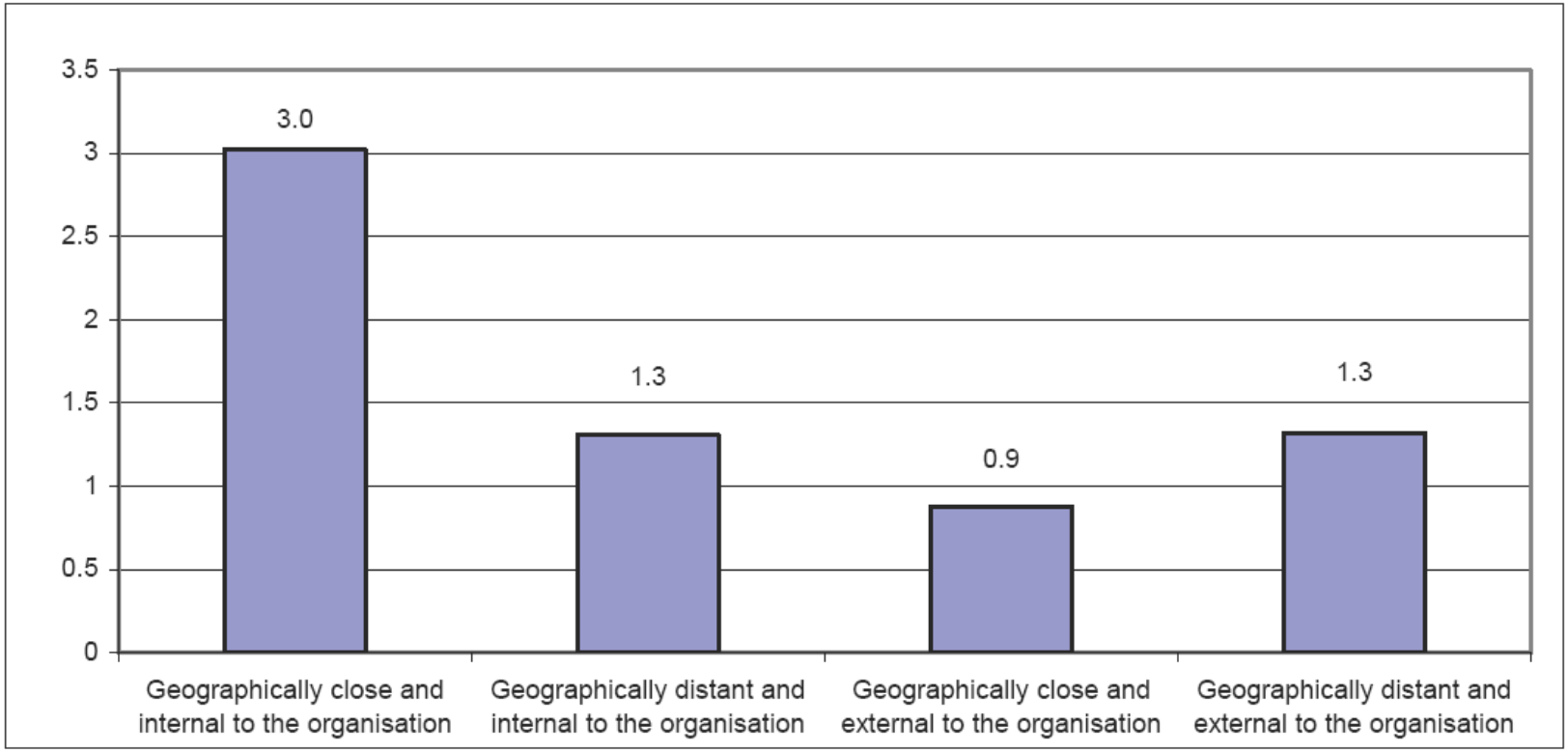
Source: Giuri, Mariani et al. (2007) Research Policy

Lessons for Policy (IV)

- Lots of collaboration in patented inventions in Europe
- (more than predicted by co-applied patents)
- UK and NL lead, while lowest % is in Germany
- Policy?

Geographical & organizational proximity

Figure 1. Importance of geographical and "organisational" proximity of inventors. Scale: 1 (not important) to 5 (very important)



Number of observations = 8,180

Source: Giuri, Mariani et al. (2007) Research Policy

Lesson for Policy (V)

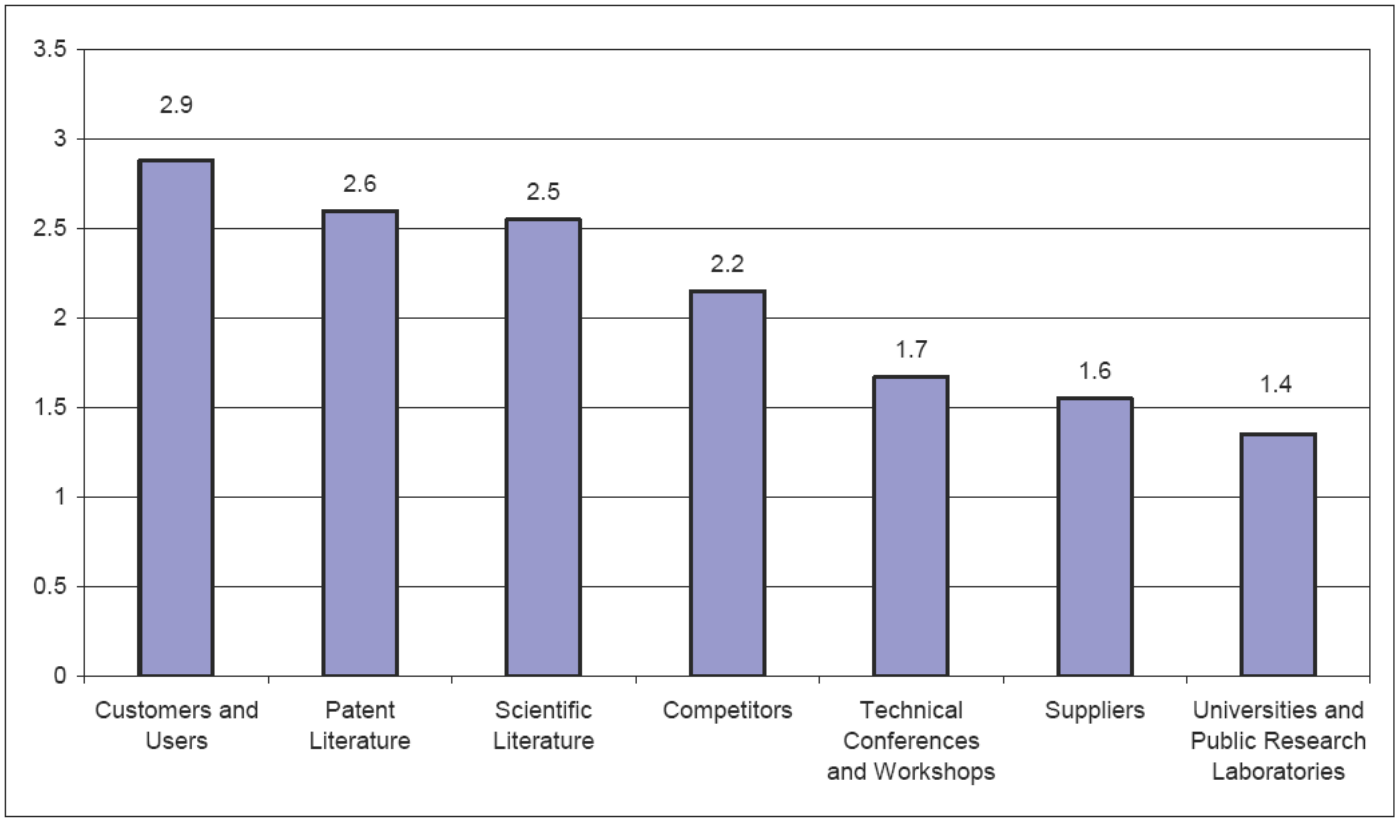
- Most interactions within the organization (and location) (80%)
- Next are the “distant” interactions outside the organization
- Giuri & Mariani (2008) (“Proximity of Inventors”) show that these are PhDs with their int’l networks

Lesson for Policy (V)

- Overemphasis on geography vs organization as vehicle for spillovers?
- Policy
  - local spillovers vs local formation of human capital

Sources of knowledge

Figure 2. Average importance of six sources of knowledge used to develop innovation (Scale 1 to 5)



Number of observations = 8,824.

Source: Giuri, Mariani et al. (2007) Research Policy

Lessons for Policy (VI)

- Customers and users are the most important source of knowledge for patented inventions
- Well known (SAPPHO, Von Hippel)
- Reiterates that innovation policy should also be about demand

Patent uses

Table 6. Patent use. Distribution by technological class

	Internal use	Licensing	Cross-licensing	Licensing & Use	Blocking Competitors (unused)	Sleeping Patents (unused)	Total
Electrical Engineering	49.2%	3.9%	6.1%	3.6%	18.3%	18.9%	100.0%
Instruments	47.5%	9.1%	4.9%	4.3%	14.4%	19.8%	100.0%
Chemicals & Pharm	37.9%	6.5%	2.6%	2.5%	28.2%	22.3%	100.0%
Process Engineering	54.6%	7.4%	2.0%	4.9%	15.4%	15.7%	100.0%
Mechanical Engineering	56.5%	5.8%	1.8%	4.2%	17.4%	14.3%	100.0%
Total	50.5%	6.4%	3.0%	4.0%	18.7%	17.4%	100.0%

Number of observations = 7,711

Source: Giuri, Mariani et al. (2007) Research Policy

Patent uses by inventors' employer

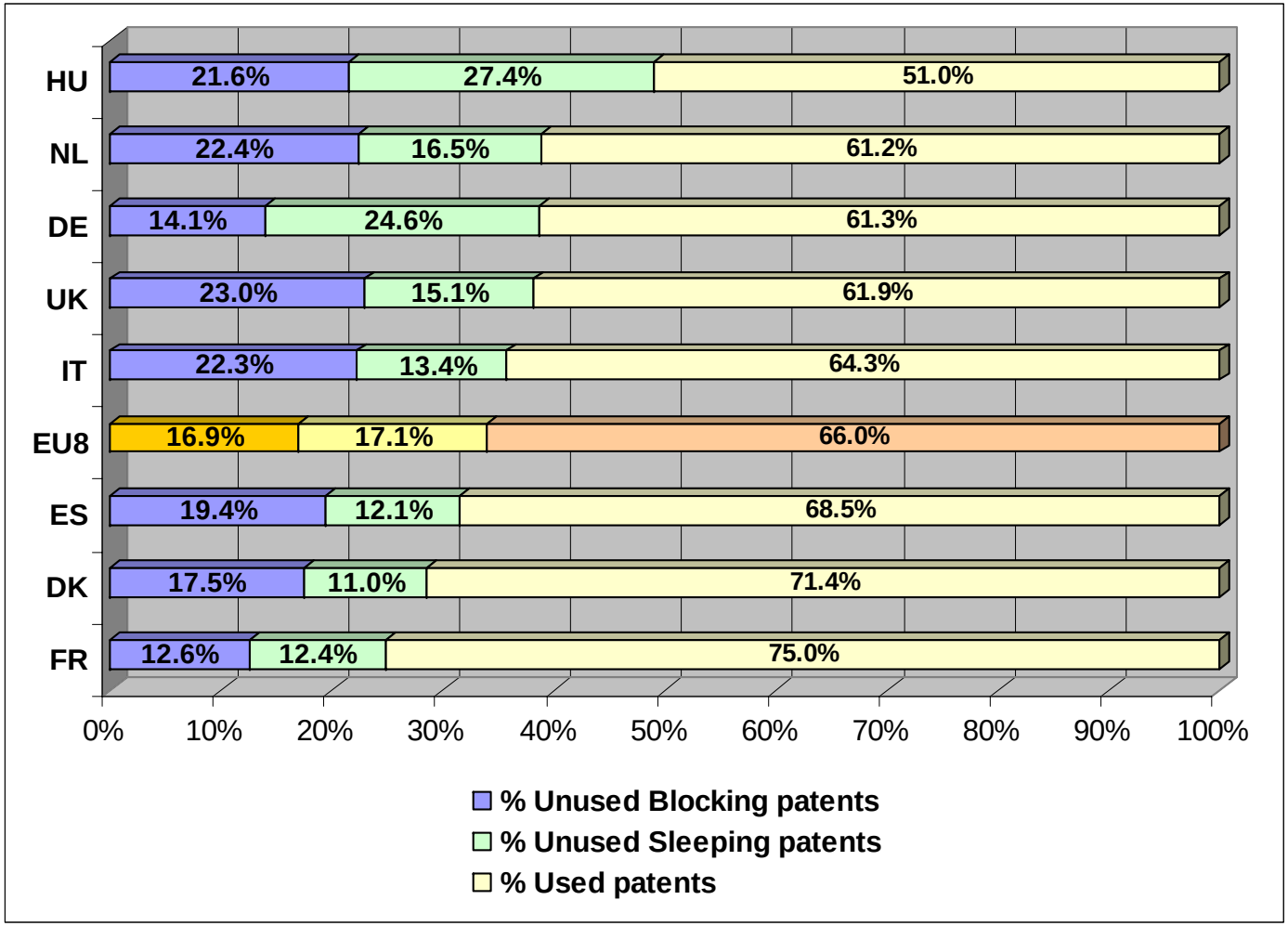
Table 7. Patent use. Distribution by inventors' employer

	Internal use	Licensing	Cross-licensing	Licensing & Use	Blocking Competitors	Sleeping Patents	Total
Large companies	50.0%	3.0%	3.0%	3.2%	21.7%	19.1%	100.0%
Medium sized companies	65.6%	5.4%	1.2%	3.6%	13.9%	10.3%	100.0%
Small companies	55.8%	15.0%	3.9%	6.9%	9.6%	8.8%	100.0%
Private Research Institutions	16.7%	35.4%	0.0%	6.2%	18.8%	22.9%	100.0%
Public Research Institutions	21.7%	23.2%	4.3%	5.8%	10.9%	34.1%	100.0%
Universities	26.2%	22.5%	5.0%	5.0%	13.8%	27.5%	100.0%
Other Govt. Institutions	41.7%	16.7%	0.0%	8.3%	8.3%	25.0%	100.0%
Other	34.0%	17.0%	4.3%	8.5%	12.8%	23.4%	100.0%
Total	50.5%	6.2%	3.1%	3.9%	18.8%	17.5%	100.0%

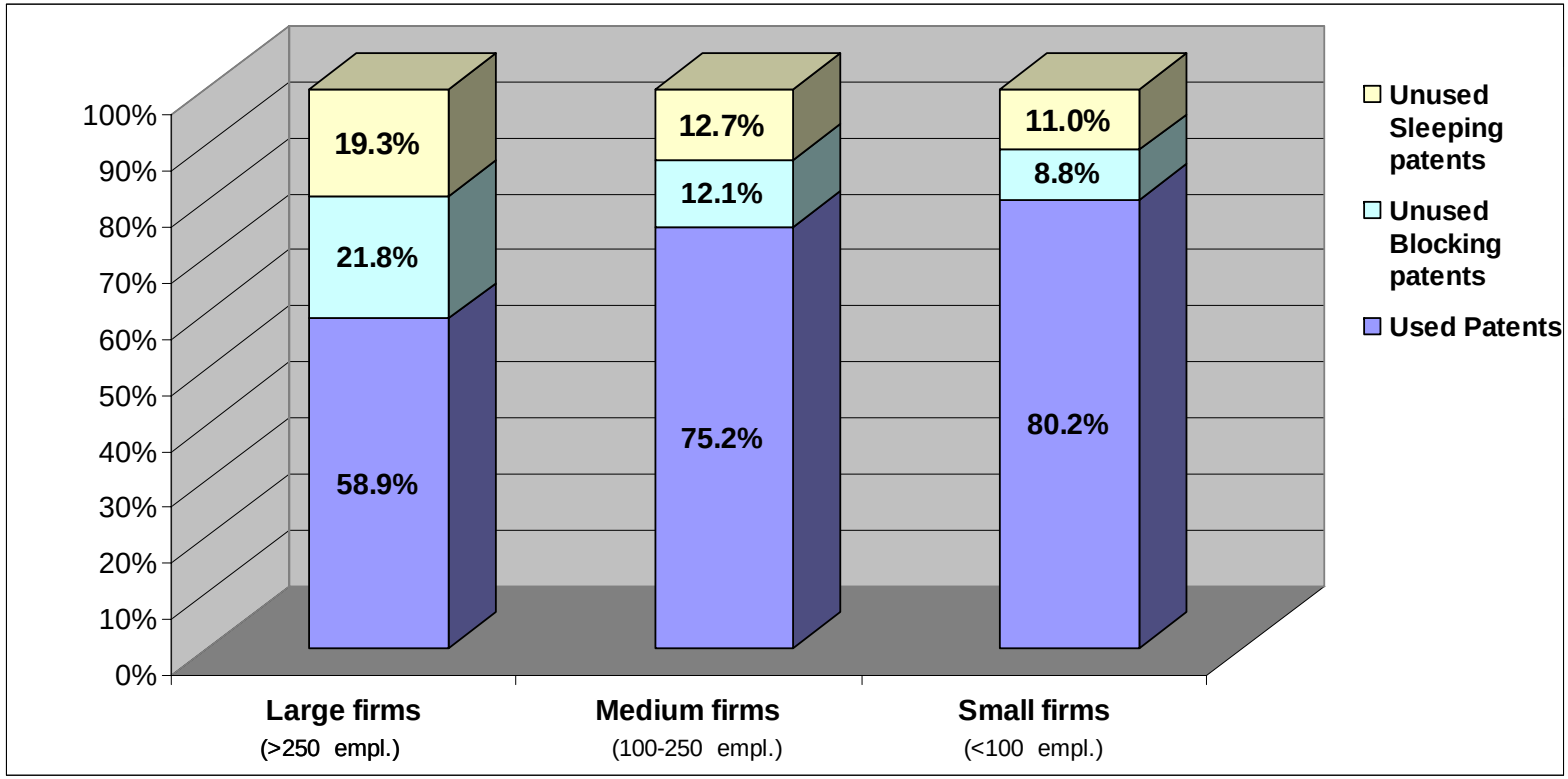
Number of observations = 7,556

Source: Giuri, Mariani et al. (2007) Research Policy

Share of unused patents



Share of unused patents



SMEs = higher utilization rates;

Large Firms = more blocking and more sleeping patents

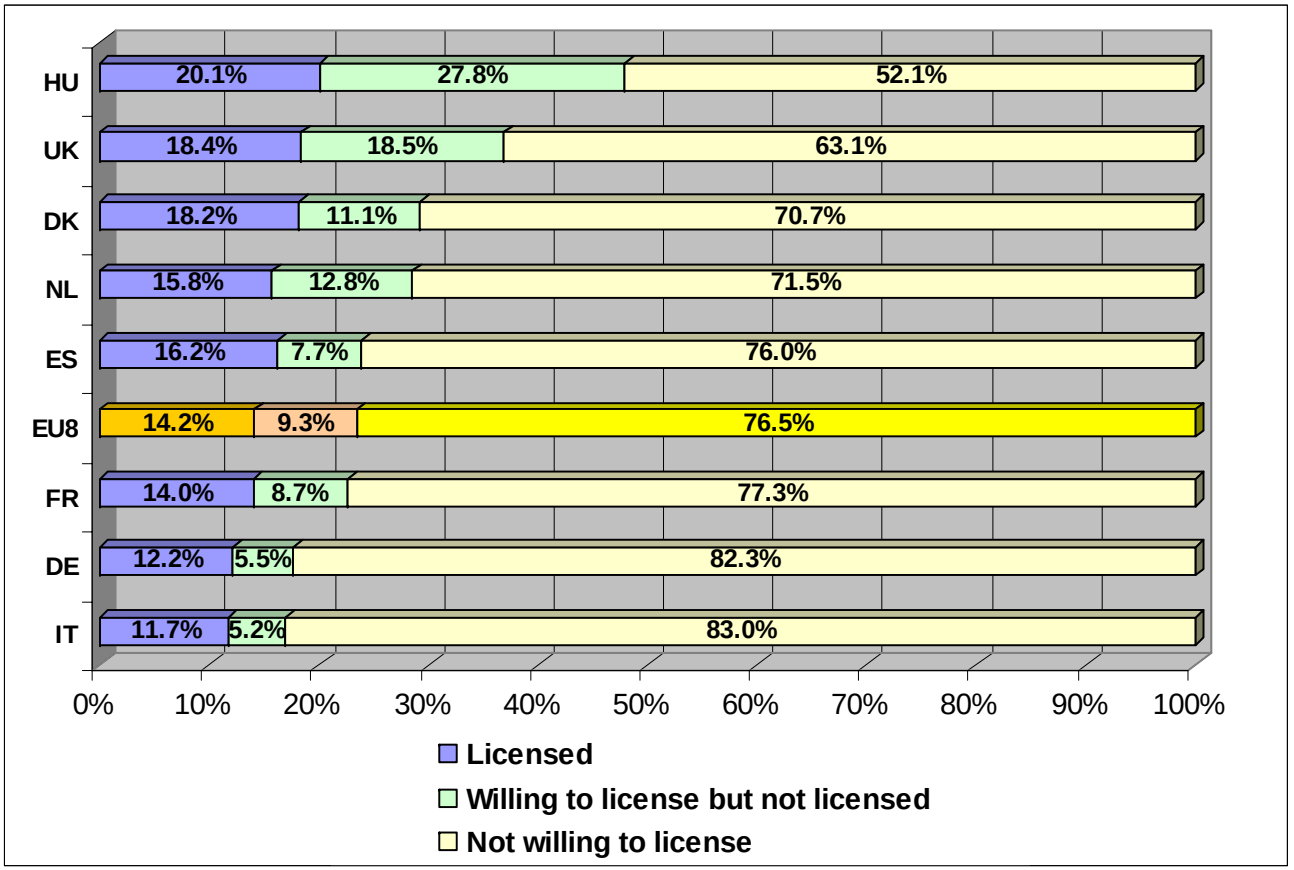
Lessons for Policy (VII)

- Policies for increasing the utilization rate of patents
- Two areas:
  - Blocking/strategic patenting (not dicussed here, see Harhoff, Hall, Schankerman)
  - Licensing

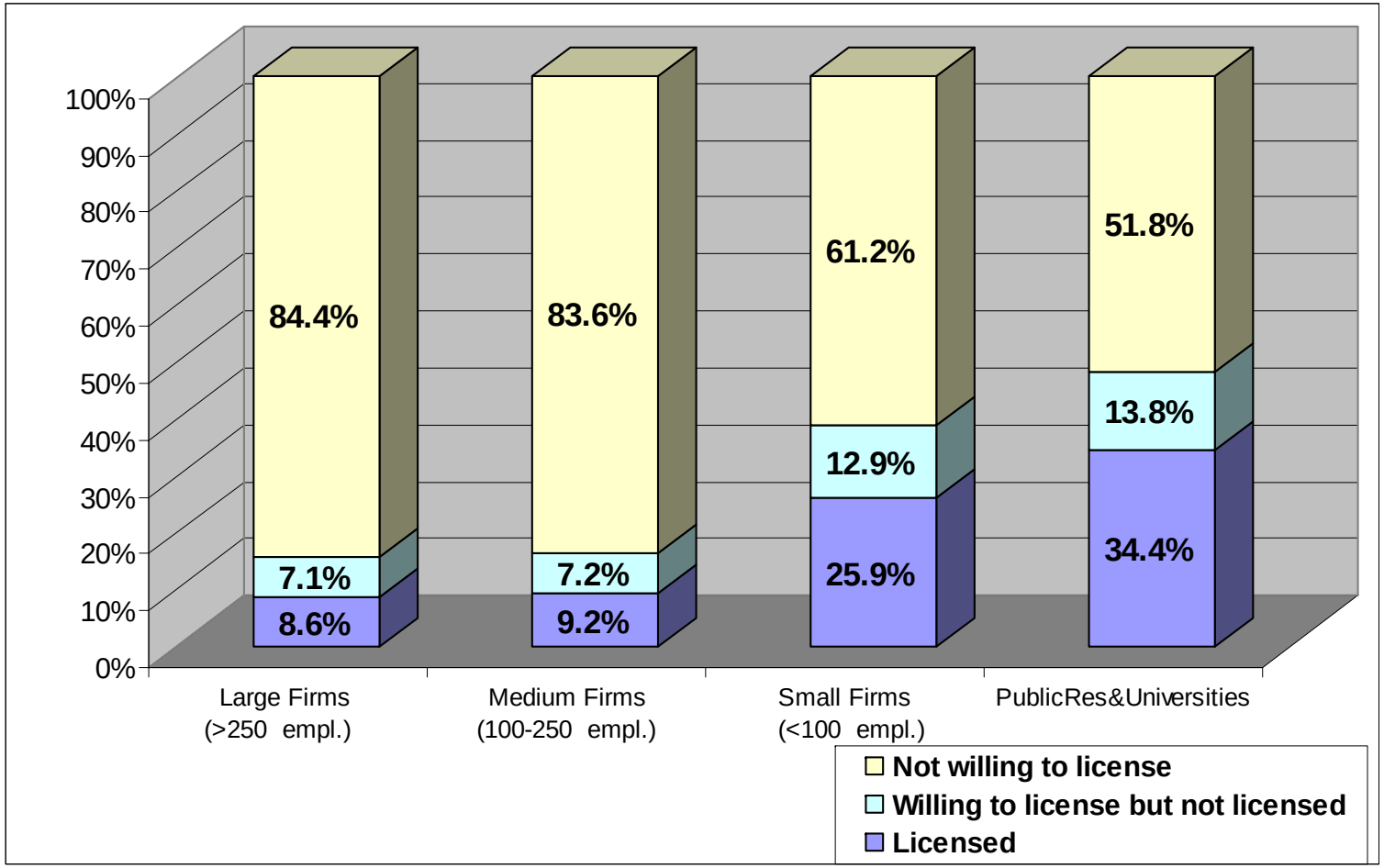
Lessons for Policy (VII)

- Growth of technology markets
- With efficiency advantages (divsion of labor)
- But transaction costs

Share of licensed patents



Share of licensed patents

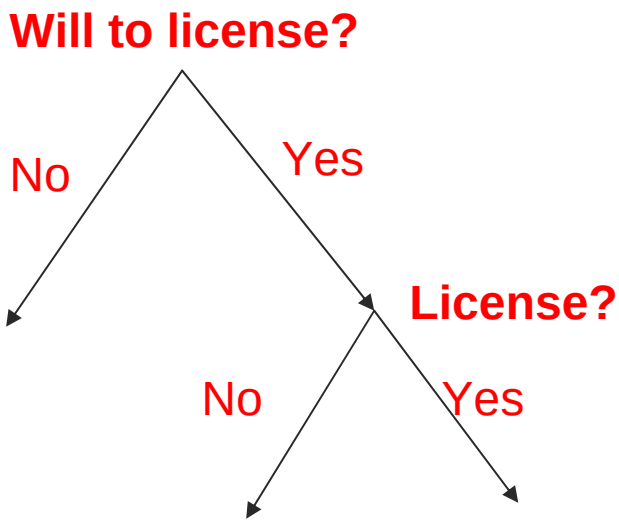


Markets for Patents in Europe

- We explored the determinants of licensing in greater detail
- Gambardella, Giuri, Luzzi (2007) Markets for Patents in Europe, ***Research Policy***, October

Markets for Patents in Europe

- Patent licensed? (PatVal's question)
  - Yes (11%)
  - No, but willing to (7%)
  - No, and not willing to (82%)
- "No but willing" is important
- We studied (Heckman Probit)
  - Willing to license? (Selection equation)
  - If so, actually licensed? (Selected sample)



Market for patents in Europe

- Most important determinant of patent licensing is firm size/type
- In particular, large firms are
  - less willing to license their patents
  - less likely to license even when they want to license
- Willingness vs Actual Licensing
  - Large firms 16% vs 9%
  - Small firms 37% vs 26%

Market for patents in Europe

- Why?
  - Potential licensee may fear to buy technology from a serious competitor
  - Large firms may not exert much effort b/c they have alternative businesses to focus upon
- Large firms are notable reservoirs of licenseable technologies (policy)

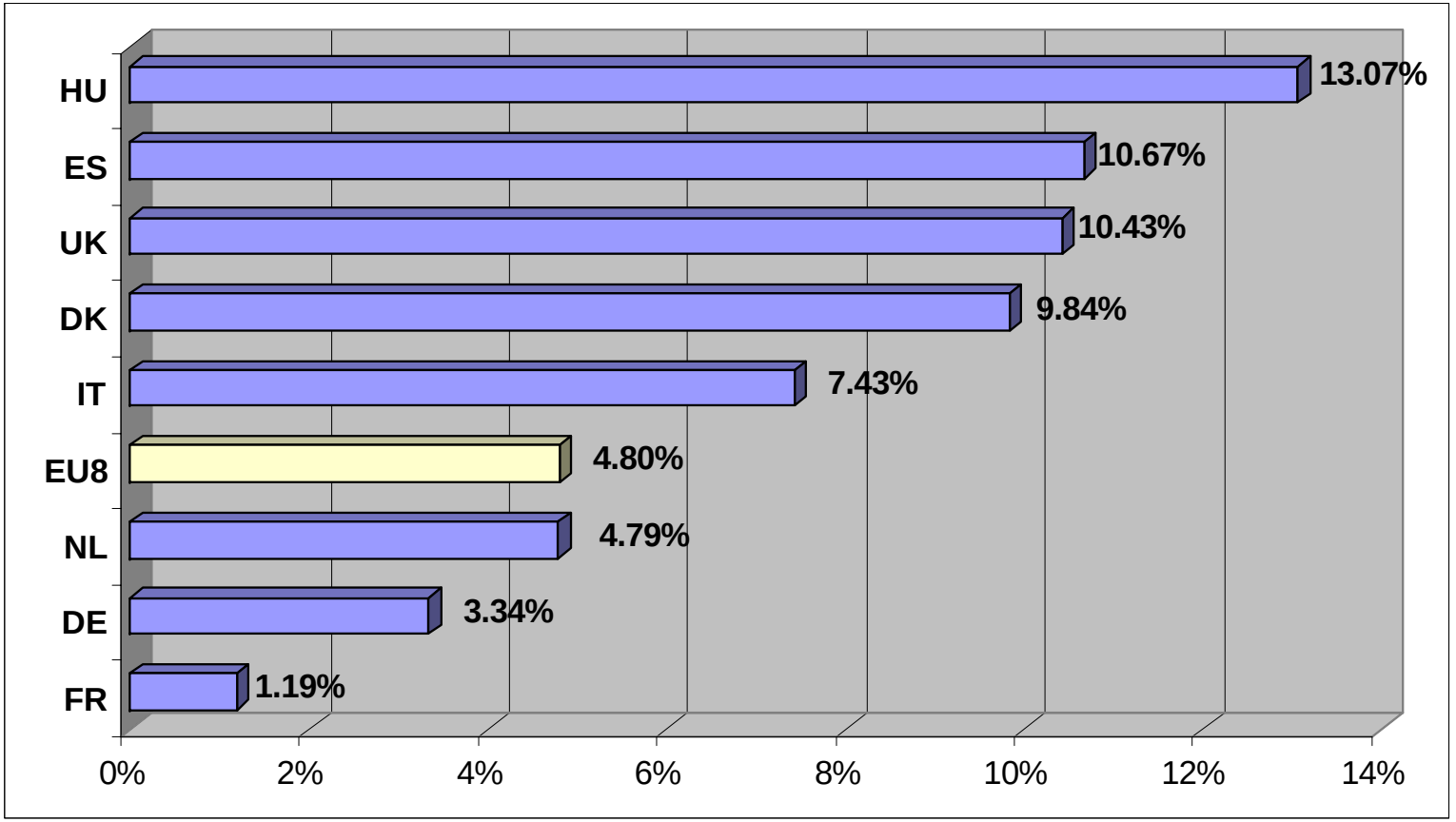
Market for patents in Europe

- We also explored whether willing but not licensed patents are of lower quality?
- We find no difference with licensed patents suggesting *transaction costs*

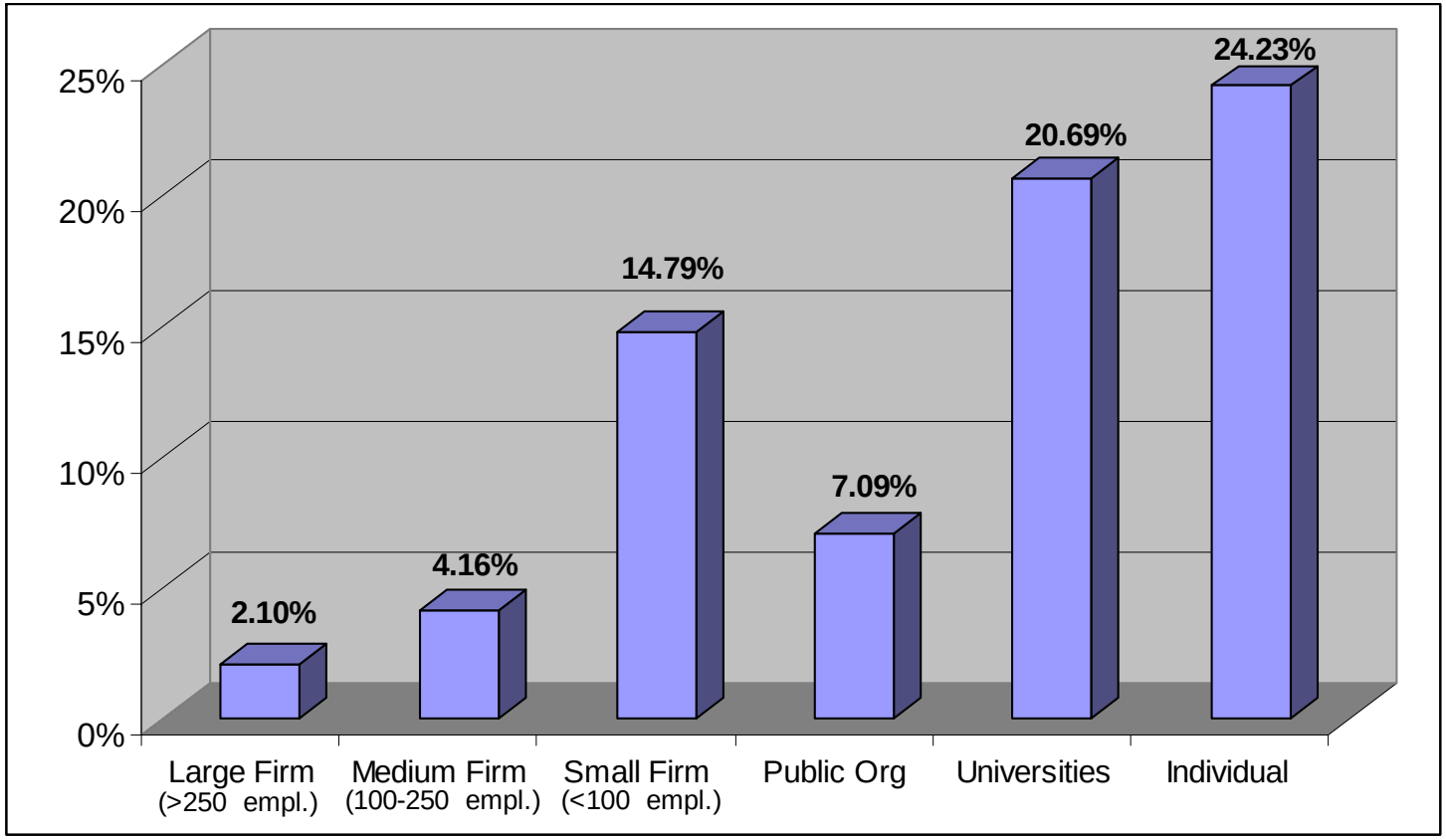
Lessons for Policy (VII)

- Small firm policy supports greater utilization of patents
- But also need to encourage diffusion of unutilized patents by large firms
- *Policy for transaction costs* in technology markets (… standard contracts, enhance licenses of rights policies)

Share of new firms



Share of new firms

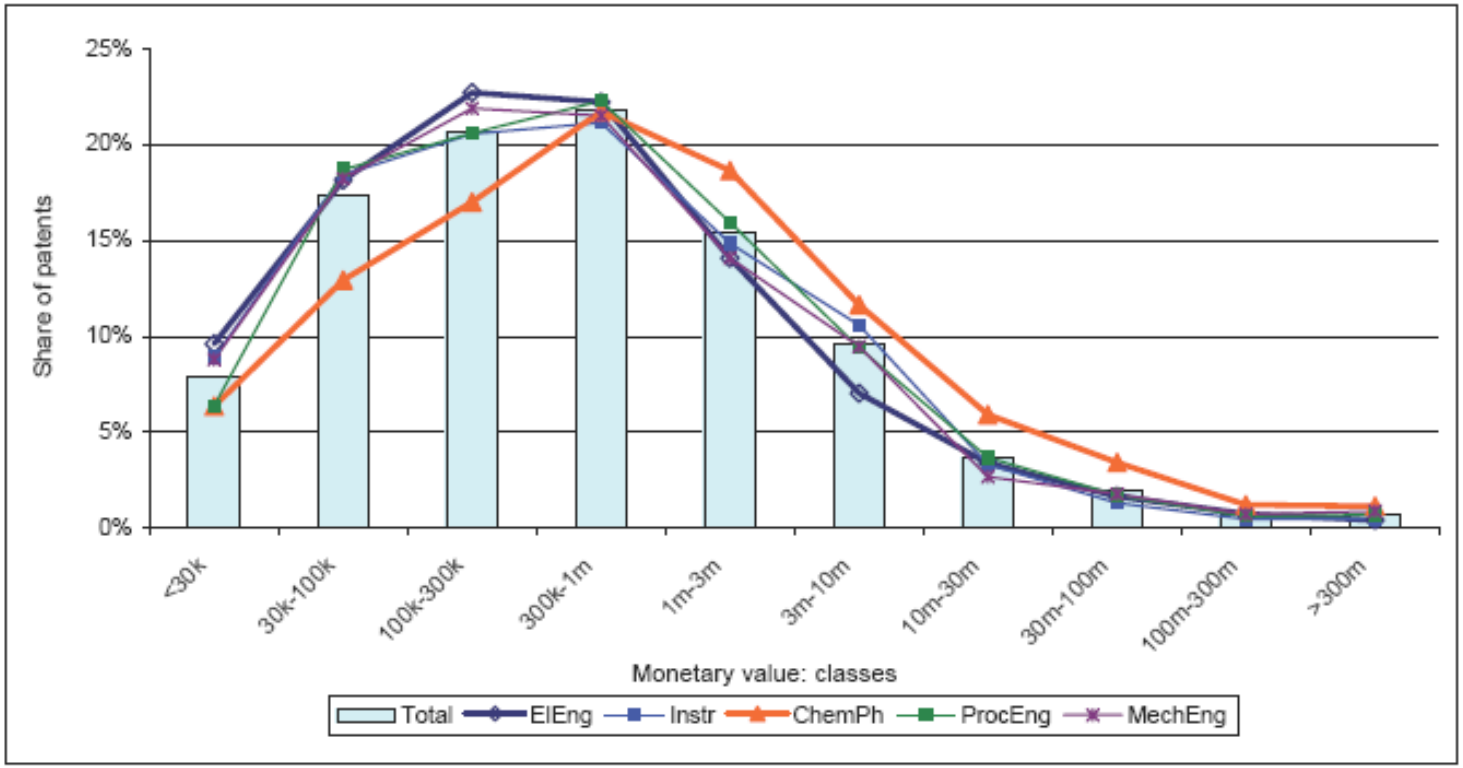


Lessons for Policy (VIII)

- Small firms again (spawn new firms)
- But large firms are also important
  - *a small share of many patents can be many new firms* (too much focus on policies for small firms?)
- New Member States

Value of European patents

Figure 4. The value of European patents across macro technological classes



Number of observations = 7,752.

Source: Giuri, Mariani et al. (2007) Research Policy

Value of European patents

- GHV (2007) finds that the key determinants of higher patent values are:
  - R&D investments
  - Talent of the inventors
- However, only 40% of the projects are expected outcomes of targeted R&D
- Rest is by-products (40%) or serendipituous (20%)

Lessons for Policy (IX)

- The novelty here is that there is no novelty … classical innovation policy:
  - Invest in R&D
  - Invest in Human capital
- Both also useful for by-product and inspiration outcomes (spillovers)

Summary

- Fact I:
  - 2/3 of the patents are from established firms
- Policy Implication I:
  - Any patent policy should weigh its impact on established firms
- Fact II:
  - The European inventor is a “standard” type
- Policy Implication II:
  - Seeking new inventor profiles?

Summary

- Fact III:
  - European inventors exhibit intrinsic motivations
- Policy Implication III:
  - This ethos should be preserved (effort, spillovers)

- Fact IV:
  - There is lots of collaboration in European patented inventions, well beyond co-patenting
- Policy Implication IV:
  - Probably do nothing (apart from monitoring)

Summary

- Fact V:
  - Lots of spillovers inside organizations. PhDs tap into their international networks
- Policy Implication V:
  - Over-emphasis on geography vs firms? Importance of human capital networks
- Fact VI:
  - Users still a key source of knowledge for inventions
- Policy Implication VI:
  - Innovation policy should (also) be about demand

Summary

- Fact VII:
  - At least 1/3 of the European patents is not used (about 50% blocking, 50% sleeping) … higher share in larger firms
  - Small firms and New Member States more likely to license
  - Technology markets are bound by transaction costs
- Policy Implication VII:
  - Technology markets to increase rate of use of patents … policies for reducing transaction costs
  - Special focus on large firms: unused technologies, which are not licensed as they could be

- Fact VIII:
  - Small firms and New Member States also more likely to spawn new firms from patents
- Policy Implication VI:
  - Same as above

Summary

- Fact IX:
  - European patents are valuable
  - Value determined by R&D investments and individual human capital
- Policy Implication VII:
  - Classical policy options: encourage R&D and human capital
  - Moreover, R&D and HK produces spillovers

Thank you

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