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"Academic Patenting in France: evidence on ownership and social structure"

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Background /1 : What is an *academic patent*?

Academic patent = Patent signed by (at least one) academic scientist [name-matching methodology]

→ University may/may not own the patent:
- business companies
- public research organizations
- individual scientists

} More likely owners

→ Key indicator for IP-related technology transfer in Europe, due to INSTITUTIONAL FEATURES of its academic systems (as opposed to US)
- historical/present limitations to university autonomy
- professor's privilege
- no IP cultural heritage in universities

→ APE = Academic Patenting in Europe

Background /2: Why are we interested in APE?

1. Recent research has proved APE to be relevant in *quantity*, but has cast doubt on *quality*

2. Recent policies push towards a US-like model of university-ownership: What impact? Does it make sense?

3. Academic inventors' position in networks: central or peripheral?

4. ESF funding of research on APE → http://www.academicpatenting.eu

EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

Research Networking Programmes (RNPs)

Social Sciences

Academic Patenting in Europe (APE-INV)

Università Commerciale Luigi Bocconi

About us
- Background
- Objectives
- Activities

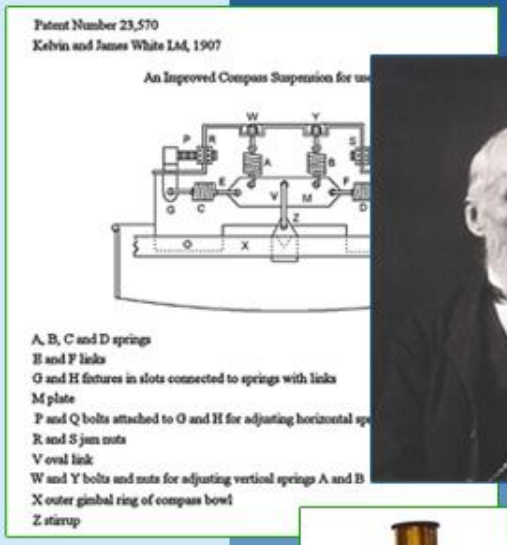
Partecipants

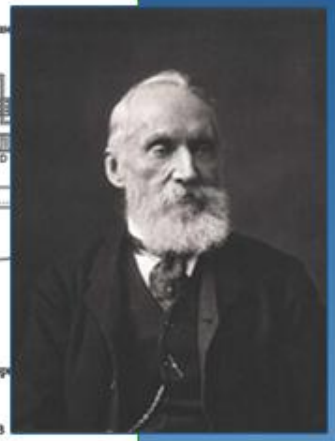
Workshops and Conferences

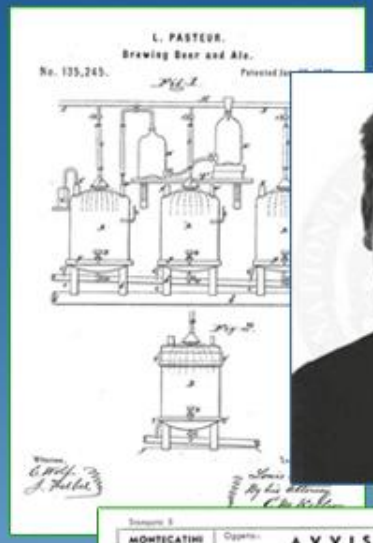
Publications

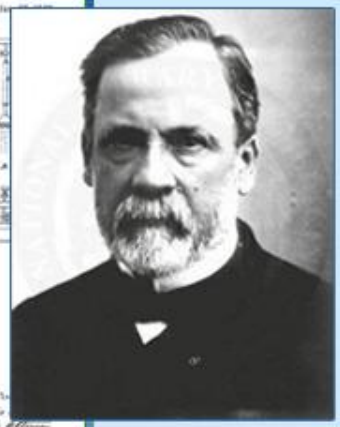
Background Literature

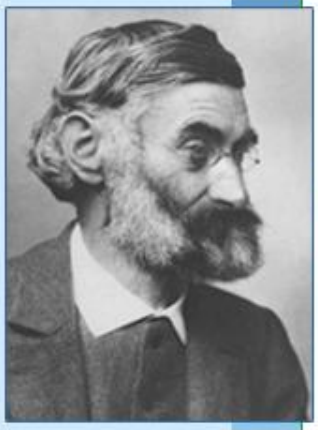
Link

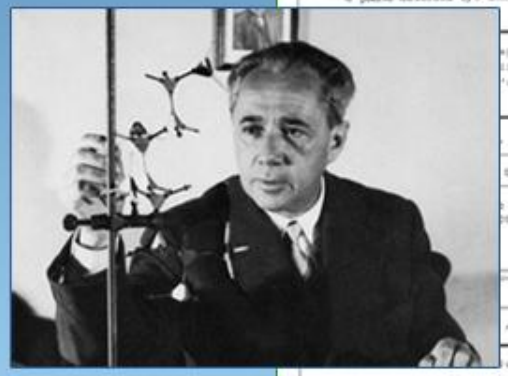












Basic evidence on APE

Lissoni F., P.Llerena, M.McKelvey, and B.Sanditov (2008) "Academic Patenting in Europe: New Evidence from the KEINS Database", *Research Evaluation* 16(2), pp. 87-102

Lissoni F., P. Lotz, J. Schovsbo, and A. Treccani (2009) "Academic Patenting and the Professor's Privilege: Evidence on Denmark from the KEINS database", *Science and Public Policy* 36/8, pp. 595-607

Lissoni F. (2012) "Academic Patenting in Europe: an Overview of Recent Research and New Perspectives", *World Patent Information* (forthcoming)

Lissoni F., Montobbio F. , Seri R. (2011) "Ownership and impact of European university patents"... *a never-ending first draft*

The case of France

Della Malva A., F. Lissoni, P. Llerena (2012) "Institutional Change and Academic Patenting: French Universities and the Innovation Act of 1999, *Journal of Evolutionary Economics* (forthcoming)

Lissoni F., Llerena P., Sanditov B. (2011) "Inventors' small worlds: academic and CNRS researchers in networks of inventors in France"...*a close-to-ending first draft*

APE Methodology

TWO-STEP procedure:

1. Reclassification of patents by inventor
2. Name+matching between inventors and academic scientists

→ Key issue: standardization of names & quality check

- APE-INV NAME GAME WORKSHOPs: http://www.esf-ape-inv.eu/index.php?page=15
- APE-INV FREE DATABASE ON INVENTORS: http://www.esf-ape-inv.eu/index.php?page=3

Additional STEP:

3. Survey work (homonimity & employment check; ad hoc questions)

APE data (next slides)

Patents & Inventors: 1994-2001ca

Professors: one-year observation, in between 2004 and 2007

Key drawback: time-related measurement error

→ under-estimation of "academic patent dummy" increases as we go back in time

→ Unreliability for longitudinal studies on APE growth

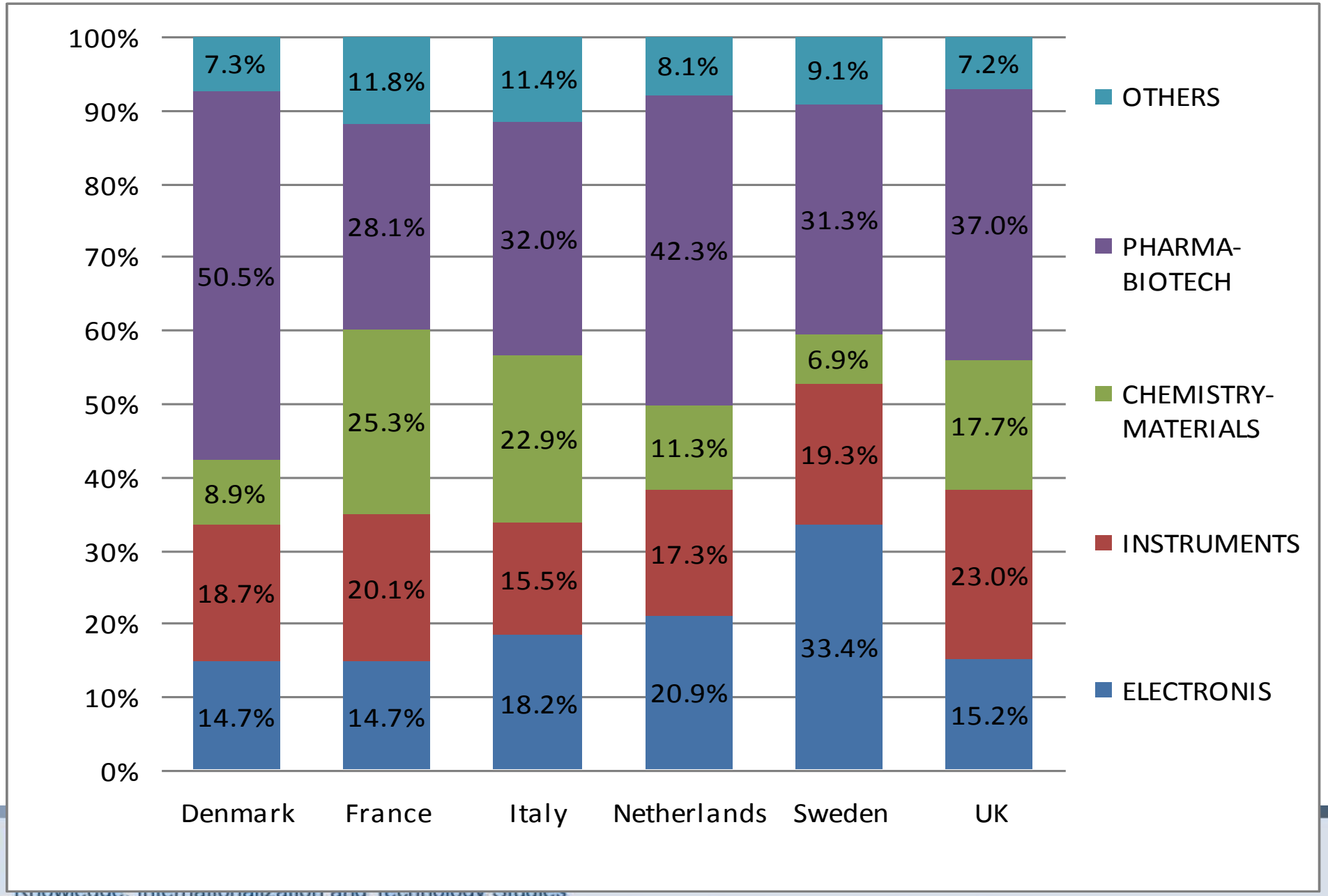
Academic inventors in Denmark, France, Italy, the Netherlands, Sweden, and the UK; nr. and % over nr. of professors

	Academic inventors (nr) [1]	Academic inventors (% of prof.)[1]	Academic inv., incl. unchecked (nr) [2]	Academic inv., incl. unchecked (% of prof.)[2]
Denmark	306	4,14	825	11,15
France	1205	3,99	1822	6,04
Italy	1353	4,29	1395	4,42
Netherlands	600	2,75	731	3.35
Sweden	725	4,55	773	4,86
UK	630	2,30	4826	17,66

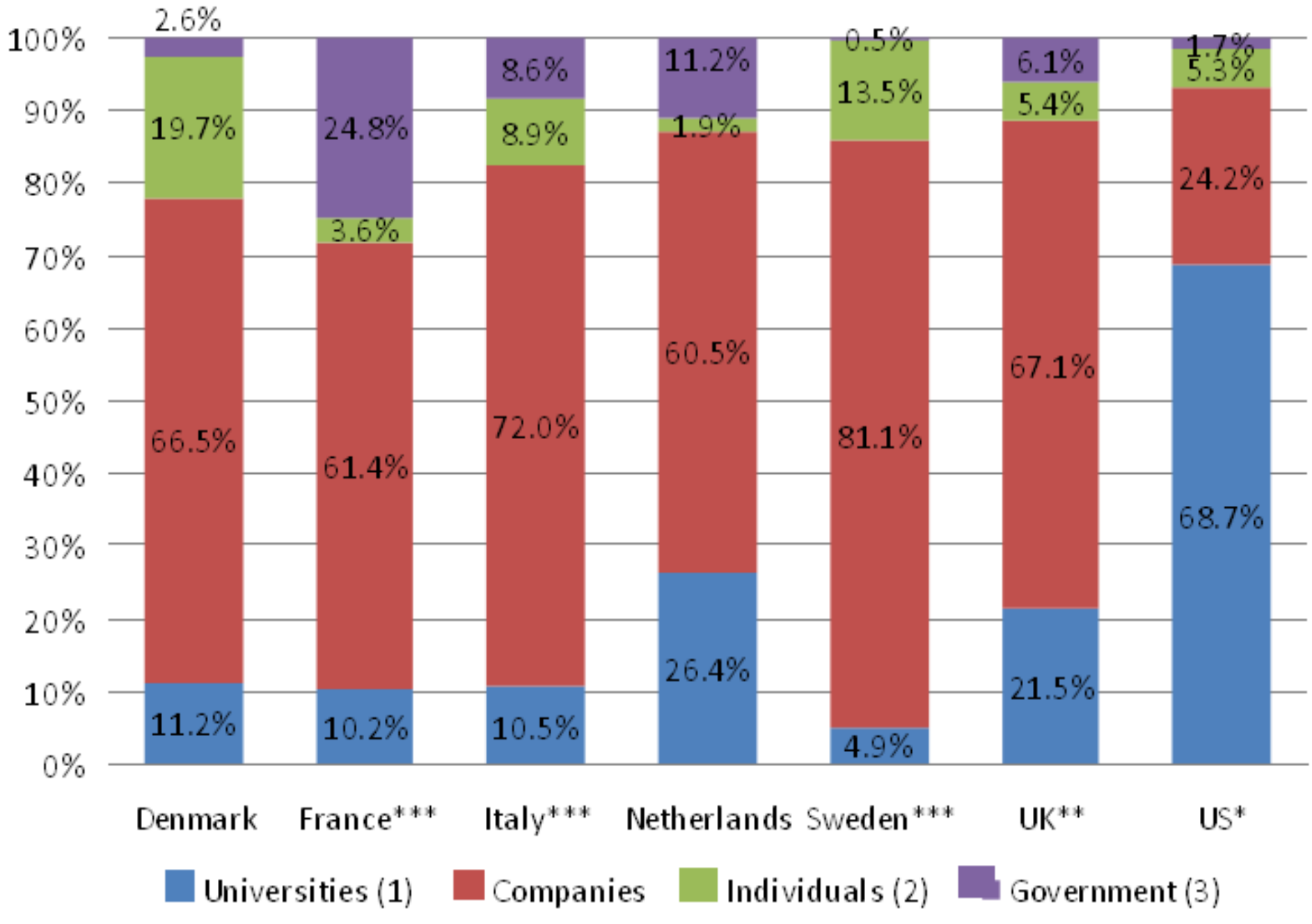
[1] Data from checked professor-inventor matches (professors confirmed to be the inventors)

[2] All positively checked and unchecked records (records for which professors denied being the inventors are excluded)

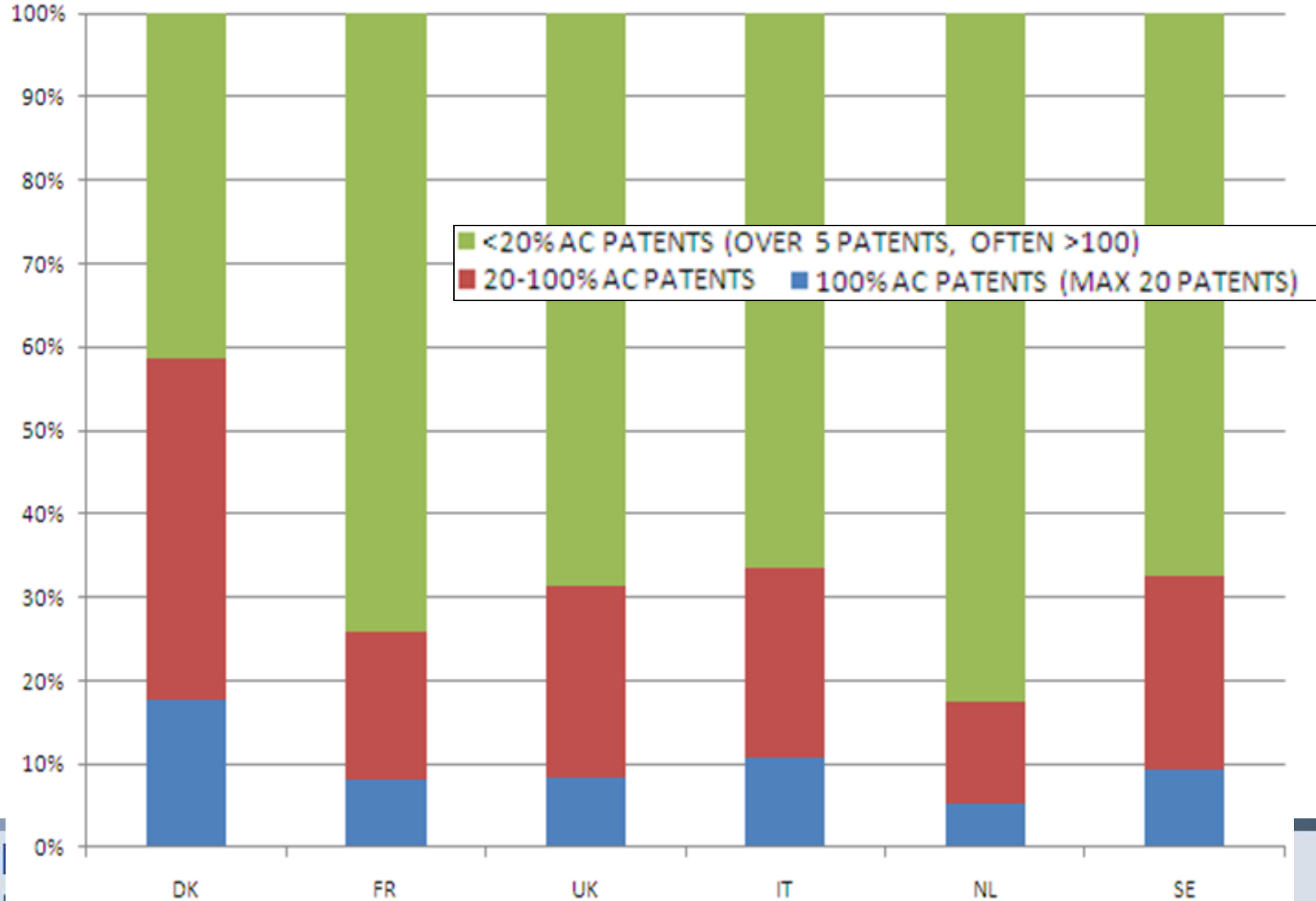
Technological distribution of academic patents



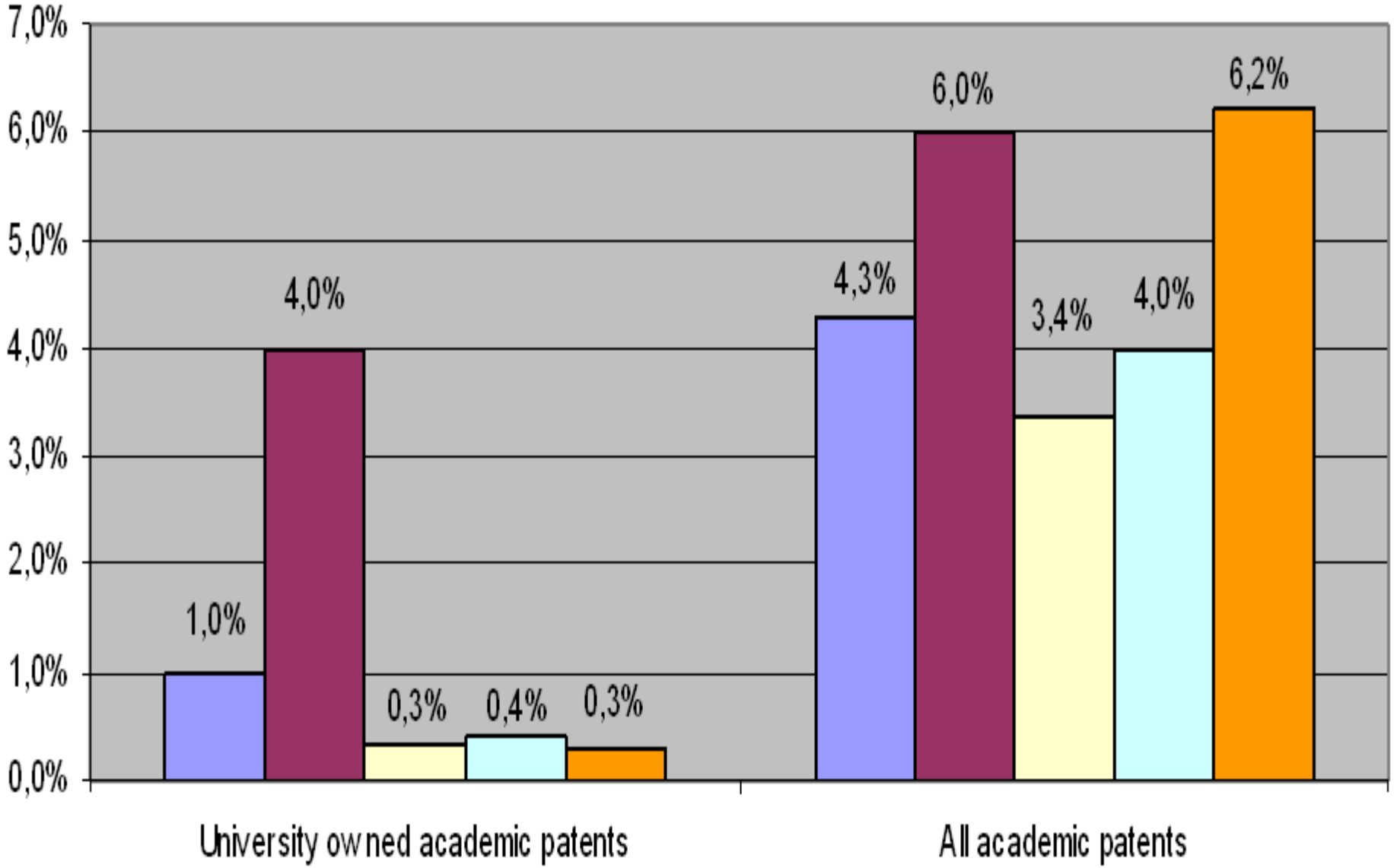
Ownership of academic patents, various countries



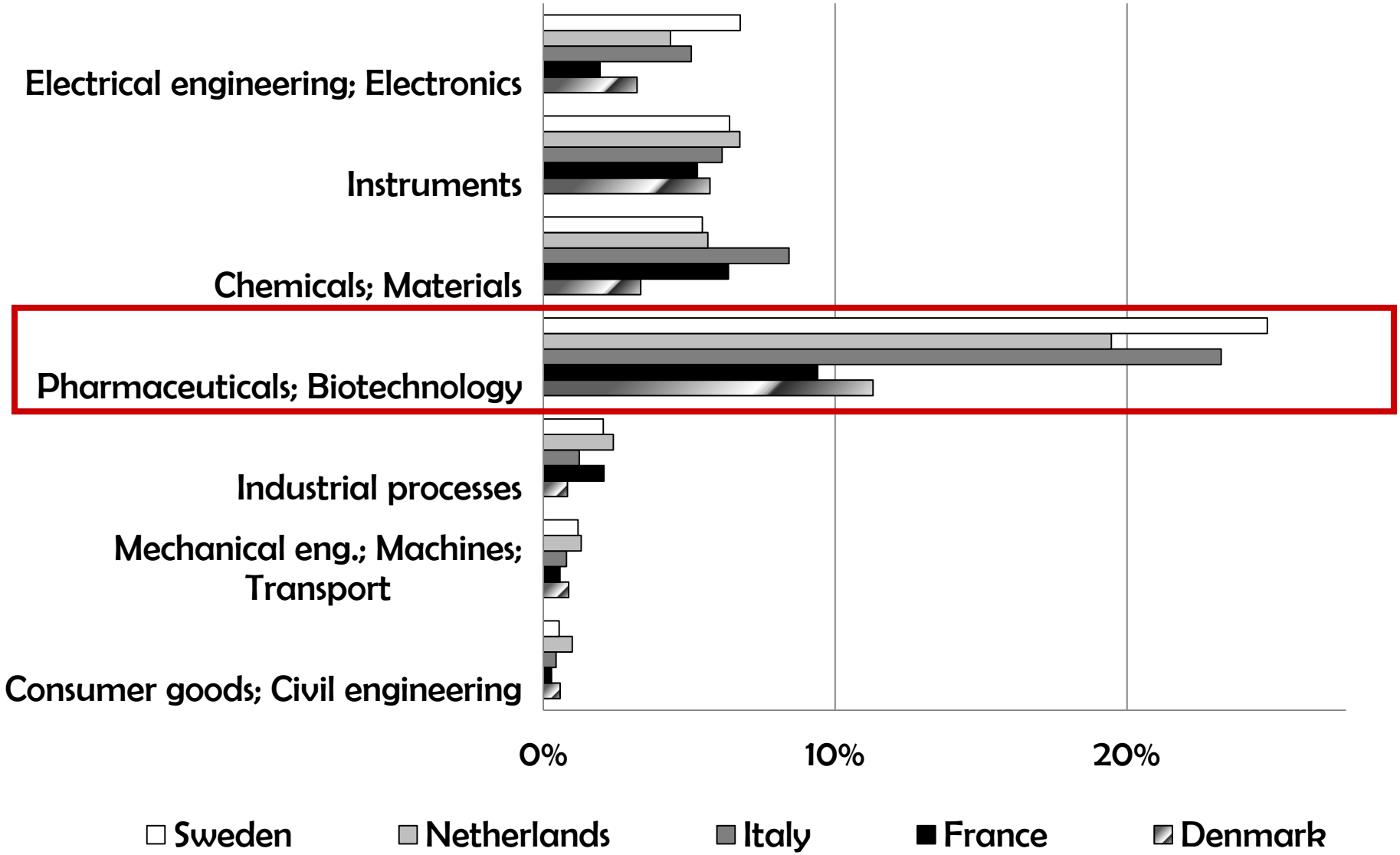
Company-owned patents



Weight of academic patents on the total patents by domestic inventor, by country and type of ownership (1994-2001)



Share of Academic patents on the country total in 5 European countries, 1995-2001; by techn. and country



Ownership distribution of Danish academic patents, before/after the abolition of the professor's privilege *

	1977–1999	2000–2003
Companies	67.6%	72.9%
Individuals	23.2%	5.7%
Universities	5.6%	20.0%
Government	3.5%	1.4%
Total	**100%**	**100%**

* % over total no. of patents

Citation-based quality indicators academic vs non academic patent applications (5 countries: DK, FR, IT, NL, SE)

	Fwd cit/4 (avg/s.e.)	Avg F/ lag (avg/s.e.)	General. (avg/s.e.)	Original. (avg/s.e.)
Non academic	1.06/ 2.13	3.84/ 1.98	0.30/ 0.38	0.31/ 0.37
Academic	1.12/ 2.03	3.65/ 1.88	0.37/ 0.39	0.36/ 0.39
Company-owned	*1.22/ 2.19*	*3.62/ 1.83*	*0.35/ 0.39*	*0.34/ 0.38*
University-owned	*0.75/ 1.33*	*3.60/ 2.00*	*0.48/ 0.41*	*0.37/ 0.41*
Individually-owned	*1.04/ 1.49*	*3.96/ 2.05*	*0.36/ 0.37*	*0.42/ 0.42*
Government-owned	*0.92/ 1.51*	*3.87/ 1.98*	*0.47/ 0.41*	*0.38/ 0.41*

Econometric analysis of citations (Survival Analysis: Event=Citation) - Country-specific models (selected est. coefficients)

	DK	FR	IT	NL	SE
Company-owned	-0.11	0.04	0.07	0.15**	-0.17***
Individual-owned	0.24	0.22	0.20	0.15	0.35*
University-owned	-0.35	-0.42**	-0.55***	-0.02	0.09
Gov't&PRO-owned	0.28	-0.10	-0.05	-0.17	0.87
Tech. Dummies	Y	Y	Y	Y	Y
Control Variables	Y	Y	Y	Y	Y
n.obs	8765	72161	30204	22999	26419

Academic Patenting in France French Universities and the Innovation Act of 1999

Universities and IPRs in France

- 1982: "Research Act": creation of ANVAR and CRITTs
- 1992: "Code de la propriètè intellectuelle" (no mention of public research)

→ No mention of IPRs as university-industry tech transfer tool

- 1999: "Innovation Act" (Loi Allègre): a set of reforms

→ to increase tech. transfer from PROs to industry, *via* - labour mobility

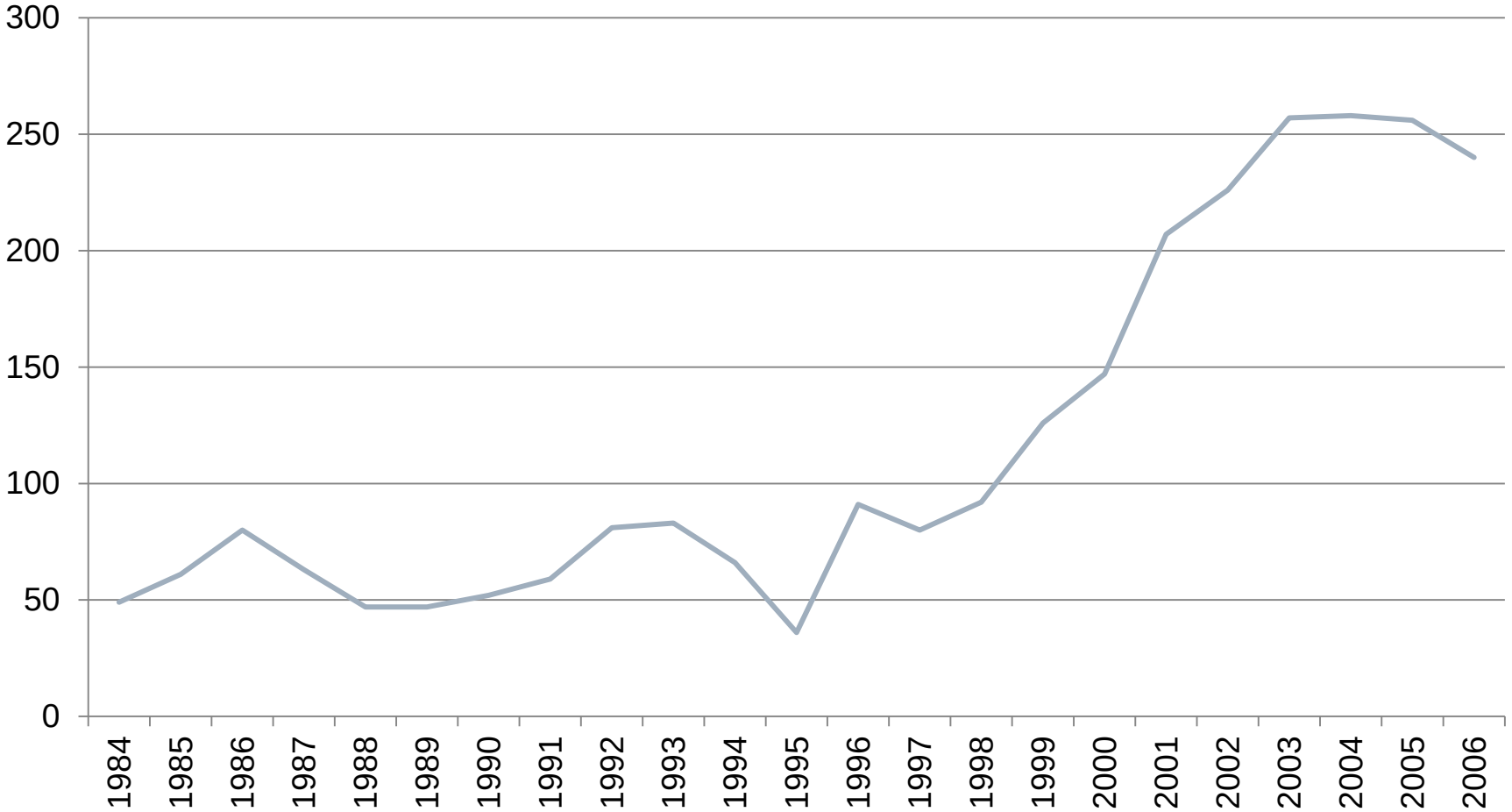
- spin-off creation
- IPR management → no changes to *Code de la propriètè intellectuelle* , bu

1. Explicit mentioning of commercial exploitation of ideas among universities missions
2. Creation of SAIC=Service d'Activités Industrielles et Commerciales, to be staffed also with external personnel andrun with business-like accounting rules

KITe
Knowled

A university-patent boom in France, too?

EPO Applications by French Universities, 1984-2006



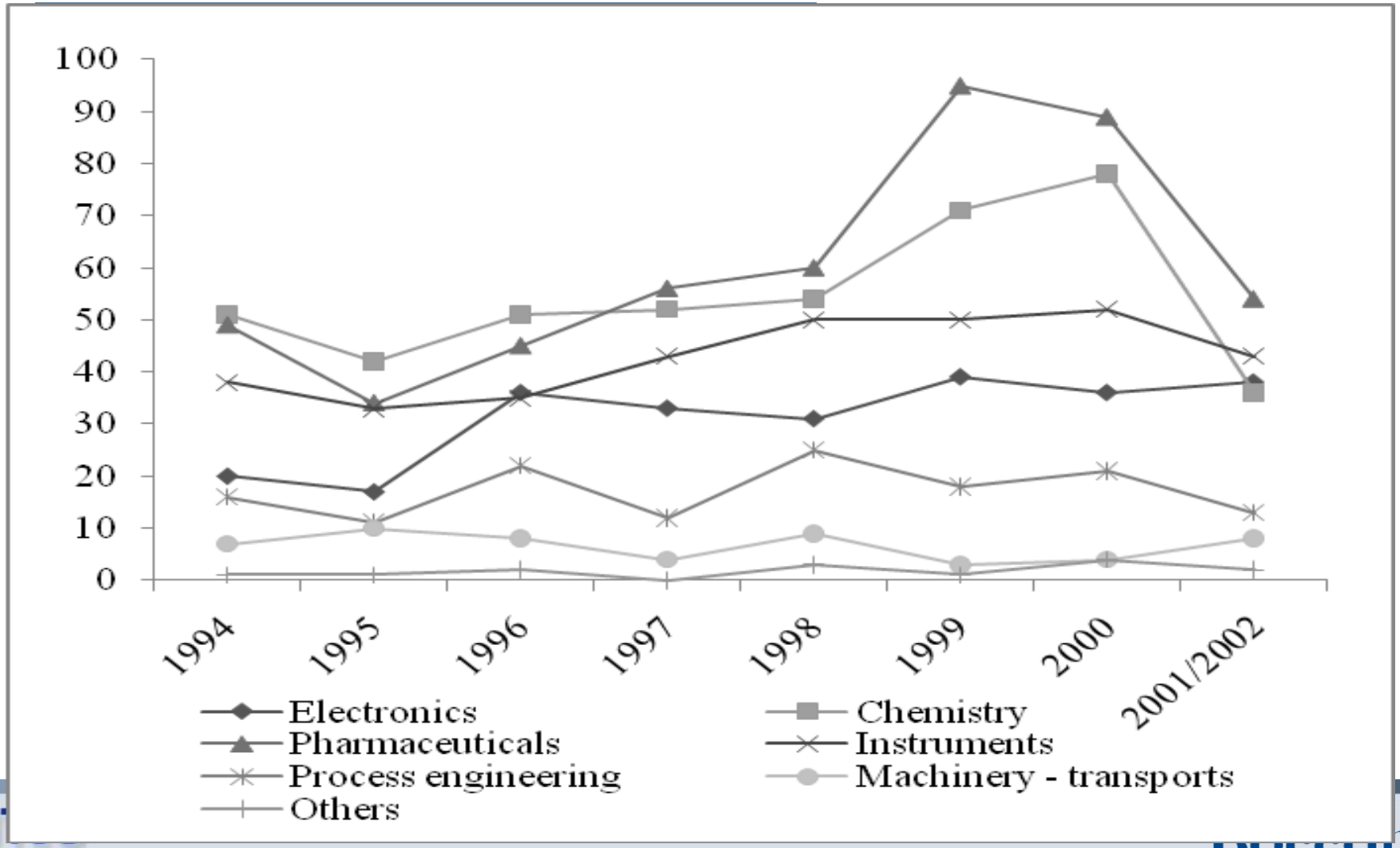
Or a change of hands?

2 hypotheses to be tested

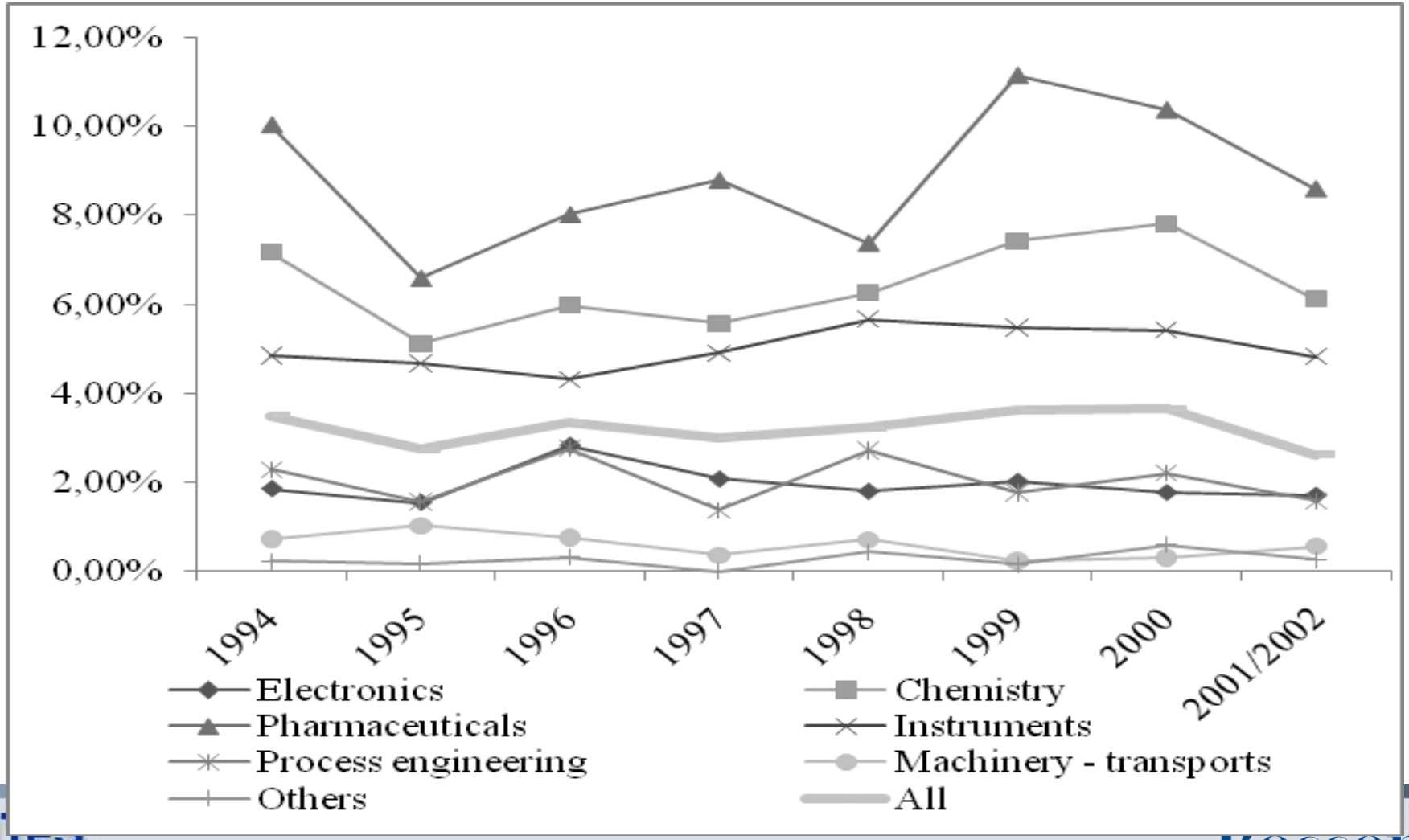
1) Has the Innovation Act increased universities' propensity to own or co-own their inventors' patents?
2) If *1)* is true, has university's share of patents increased at the expenses of PROs' or companies' share?

- Important control: following a decade of earlier reforms, the most research-intensive universities had already set up their own TTOs (even before creation of SAICs)

Number of Academic Patents by Technology, 1994-2001/02



Share of *Academic Patents* over *All Patents*, by Technology; 1994-2001/02



Ownership of Academic Patents: Categorization

- **Companies**: both business companies (French and foreign) and individual inventors → **C**

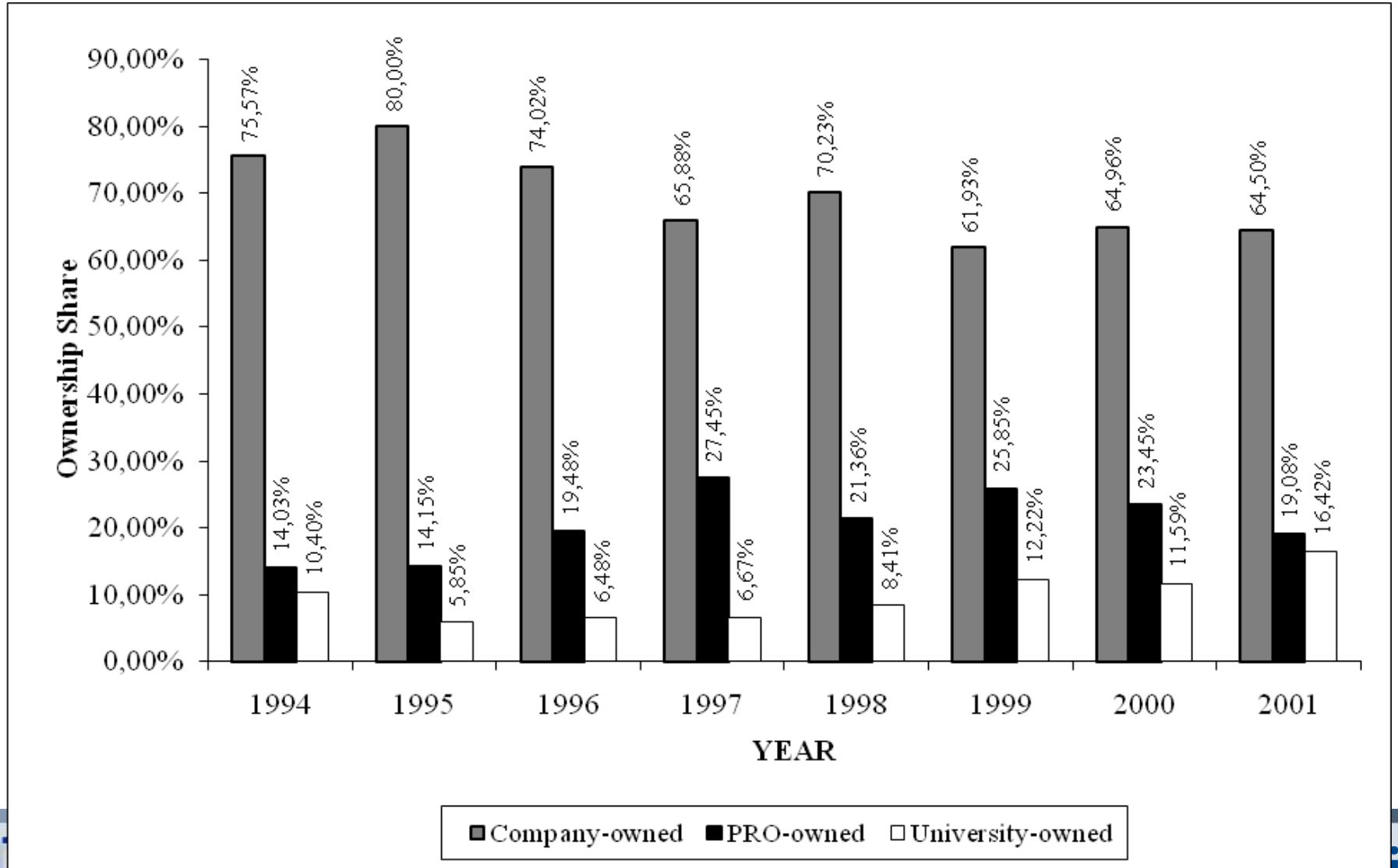
- **PROs**: *Etablissements Public à Caractère Scientifique et Technique* (EPST→CNRS, INSERM…) or *Etablissements Public à Caractère Industriel et Commercial* (EPIC→CEA, SNCF…), as listed on the website of the French Ministry of Research → **PRO**

- **Universities**: as listed in the same database ofprofessors' names and info → **U**

Ownership distribution, by technology

	TYPE OF APPLICANT (fractional counts)					
	C	PRO	UNI	%C	%PRO	%UNI
Electronics	237	44	23	*78,0%*	*14,5%*	*7,6%*
Instruments	331	86	49	*71,0%*	*18,5%*	*10,5%*
Chemicals	391	85	25	*78,0%*	*17,0%*	*5,0%*
Pharmaceuticals	378	209	93	*55,6%*	*30,7%*	*13,7%*
Process engineering	110	40	25	*62,9%*	*22,9%*	*14,3%*
Machinery - transports	55	4	7	*83,3%*	*6,1%*	*10,6%*
Others	13	1	0	*92,9%*	*7,1%*	*0,0%*
Total	1515	469	222	*68,6%*	*21,4%*	*10,1%*

Ownership distribution of ac. patents, 1994-2001



Effects of the Innovation Act /1 - Logit regression

- Dependent Variable:
  - ✓ University-ownership (exclusive or co-owned)
- Key variables of interest
  - ✓ ACT dummy (=1 after 1999) *or* Year dummies (1999 reference year)
  - ✓ TTO dummy (=1 after adoption of explicit IPR policy in the academic inventor's university; from BETA-EcoSc database)
- Controls:
  - ✓ Type of University (dummies for DEP/MENESR classification)
  - ✓ Size of University (dummies for largest, large, medium, and small, as from quartile distribution of staff)
  - ✓ Technology
  - ✓ Regional dummies

Logit regression: Marginal effects (key regressors)

	(1)	(2)	(3)	(4)
Act	0.057***		0.047***	
1994		-0.022		-0.016
1995		-0.044**		-0.042**
1996		-0.051***		-0.049***
1997		-0.052***		-0.048***
1998		-0.040**		-0.040**
2000		-0.013		-0.018
≥ 2001		0.033		0.020
KITTO			0.056***	0.056***

Logistic: Marginal effects (controls)

	(1)	(2)	(3)	(4)
School of Eng.	0.073	0.068	0.034	0.029
University w/out Medical Schools	0.043	0.039	0.041	0.036
Scientific University	-0.026	-0.026	-0.025	-0.025
Large	0.001	0.000	0.018	0.016
Medium	-0.068***	-0.067***	-0.037	-0.037
Small	-0.053**	-0.050*	-0.012	-0.008
Pharma-Biotech	0.007	0.007	0.014	0.013
Instruments	-0.028	-0.029	-0.024	-0.025
Electronics	-0.054***	-0.054***	-0.049***	-0.050***
Chemicals	-0.080***	-0.078***	-0.074***	-0.073***
Regional dummies	Y	Y	Y	Y

Effects of the Innovation Act /2 - Multinomial Logit

- Dependent Variable:
  - ✓ PRO-ownership (exclusive or with companies) = 1
  - ✓ Company-ownership (exclusive) = 2
  - ✓ University-ownership (exclusive or co-owned with PRO or Company) = 3

- Key variables of interest and Controls: as in Logit

Multinomial Logit: Marginal effects (key regressors)

	PRO		COMPANIES		UNIVERSITIES	
	(1)	(2)	(1)	(2)	(1)	(2)
Act	0.023		-0.073 ***		0.05 ***	
1994		-0.102 ***		0.125 ***		-0.023
1995		-0.098 ***		0.145 ***		-0.048 ***
1996		-0.067 **		0.12 ***		-0.054***
1997		0.013		0.037		-0.05***
1998		-0.028		0.071 *		-0.043**
2000		-0.018		0.038		-0.02
2001 onwards		-0.091 ***		0.076 *		0.015
TTO	-0.015	-0.013	-0.042	-0.044	0.057 ***	0.056 ***

Universities with Medical Schools and *Schools Engineering* host moreUMRs → CNRS and oth PROs have more bargaining power

Companies better control IPRs from *Scientific Universities*, which is the category of universities most engaged in contract research

	PRO		COMPANIES		UNIVERSITIES	
	(1)	(2)	(1)	(2)	(1)	(2)
School of Eng.	-0.03	-0.027	-0.003	-0.001	0.032	0.028
University w/out Medical Schools	-0.080 **	-0.086 **	0.042	0.055	0.038	0.031
Scientific Univ.	-0.115 ***	-0.113 ***	0.148 ***	0.146***	-0.033	-0.033
Large	0.105 ***	0.108 ***	-0.131 ***	-0.13***	0.025	0.022
Medium	0.053	0.055	-0.019	-0.02	-0.034	-0.035
Small	0.01	0.009	-0.001	-0.004	-0.009	-0.005
Pharma-Biotech	0.089 ***	0.077 *	-0.107 **	-0.095**	0.018	0.017
Instruments	-0.008	-0.015	0.033	0.041	-0.025	-0.026
Electronic	-0.064 *	-0.071 **	0.116 ***	0.123***	-0.051 ***	-0.052 ***
Chemicals	-0.035	-0.042	0.111 ***	0.118***	-0.076 ***	-0.076 ***

Conclusions

- French universities (co-)own only a minor share of their scientists' patented inventions → due to institutional factors, and not to any peculiarity in the technological distribution
- Ongoing changes in the institutional setting (Innovation Act) → increase in co-ownership, at expenses of Companies' exclusive control of IPRs → DO WE LIKE IT? IS IT WHAT THE LEGISLATOR EXPECTED?
- Many universities' decision to open a TTO pre-dates the Act, and anticipats its effects
- Differences exist between type and size of universities

Limitations & Further Research

- Time series not reliable to perform robust analysis
  - ✓ Censoring: spell after 1999 too short
  - → French participation to APE-INV project will produce updates
- No Welfare analysis
  - ✓ No info on licensing, revenues from licensing, sponsored research and their variation
  - → Survey work necessary
- Some endogeneity of TTO dummy
  - ✓ Strategic change anticipated by some entrepreneurial universities
  - → Need of better econometric analysis (two-step)

Bocconi

Small Worlds in Networks of Inventors and the Role of Science: An Analysis of France

- Structure of inventors' networks in France:
  - Are they "small worlds" (*tightly knit communities of inventors & few "shortcuts" between communities*)?

- Role of academics and CNRS researchers in inventors' networks
  - Do they contribute to "small-world" structure (*bridging distant communities of inventors*)?

Data Sources

- ✓ Academic inventors & patents: from previous papers

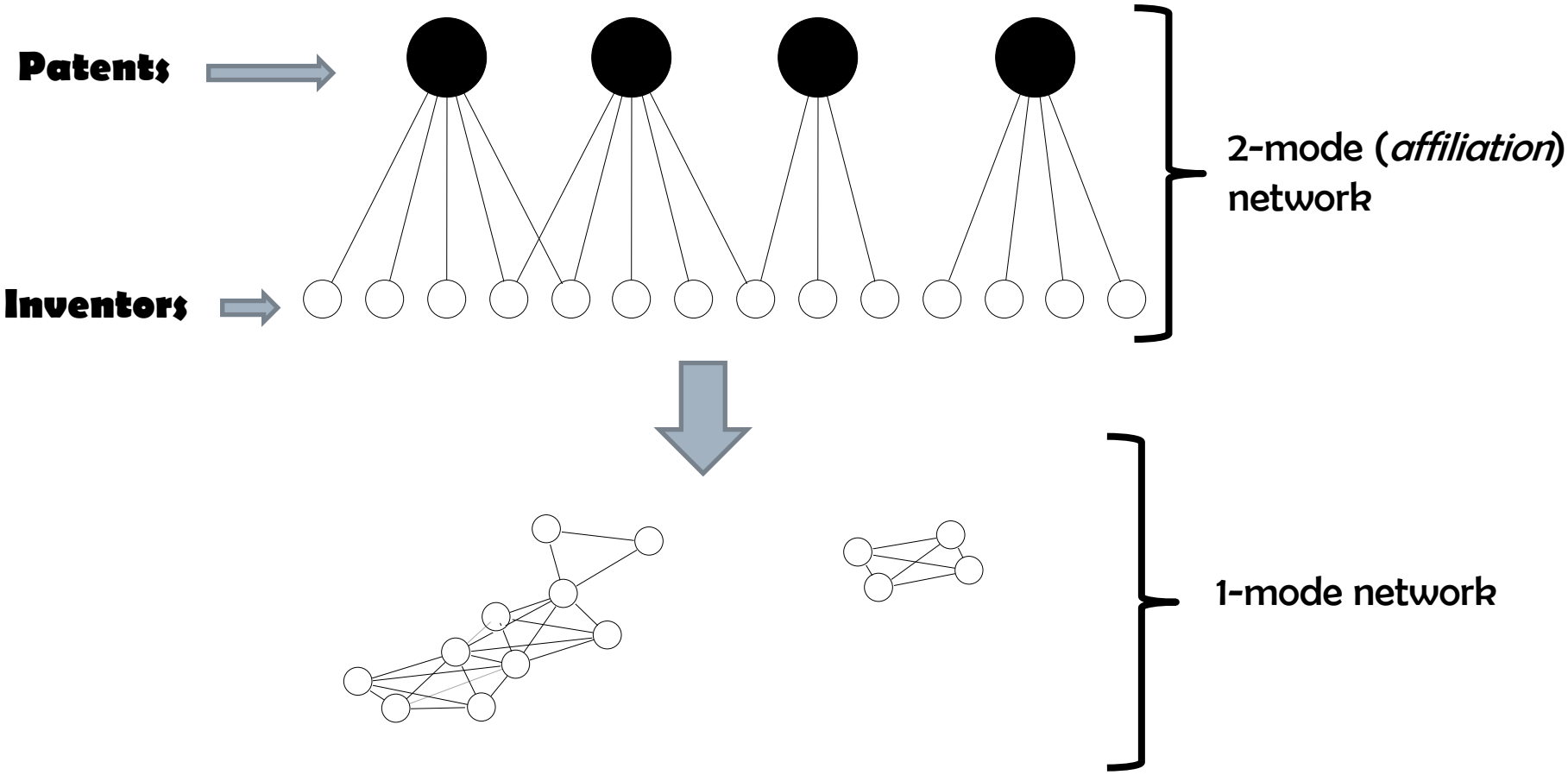
  +

- ✓ Dataset on CNRS inventors (Llerena 2010)
  - APE methodology
  - CNRS researchers on duty in 2007

Academic & CNRS inventors by technological field

TECHNOLOGICAL FIELDS	INVENTORS			PATENTS		
	All	Acad+CNRS		All	Acad+CNRS	
Electrical Eng. Electronics	13610	340	2.50%	18237	504	2.8%
Scientific Instruments	9714	541	5.57%	10164	658	6.5%
Chemicals. Materials	8653	595	6.88%	12157	1336	11.0%
Pharmaceuticals. Biotechnology	5980	676	11.30%	7346	1119	15.2%
Industrial processes	8159	250	3.06%	10043	290	2.9%
Mech. Eng. Machines. Transport	10386	86	0.83%	13796	113	0.8%
Consumer goods. Civil eng.	5158	17	0.33%	7057	24	0.3%

NETWORK OF INVENTORS



Networks of inventors: size of the main components, and distribution of academic inventors, 1994-2004

		ALL COMPONENTS & ISOLATES	LARGEST COMPONENT	2nd LARGEST COMP
Electr. eng.	All inventors	13610	3978	567
Electronics	*Academic*	*217*	*94*	*1*
Instruments	All inventors	9714	2870	70
	Academic	*363*	*147*	*0*
Chemicals &	All inventors	8653	5723	48
Materials	*Academic*	*336*	*268*	*0*
Pharma &	All inventors	5980	3608	19
Biotech.	*Academic*	*396*	*232*	*0*
Industrial	All inventors	8159	2049	18
processes	*Academic*	*153*	*84*	*0*
Mech. Eng.,	All inventors	10386	647	611
Transport	*Academic*	*64*	*2*	*2*
Consumer	All inventors	5158	150	137
goods;	*Academic*	*12*	*1*	*1*

Observed networks vs. simulated benchmark random graph (BRN), by patent field (all patents, 1978-2004)

TECHNOLOGICAL FIELDS		C1	B_{cent}	C	L	Q
Electrical eng. & Electronics	observed	6459	0.19	0.35	12.4	0.6
	simulated	*16922*	*0.07*	*0.26*	*5.5*	
Instruments	observed	4542	0.13	0.55	12.3	1.1
	simulated	*12955*	*0.09*	*0.22*	*5.4*	
Chemicals. Materials	observed	9611	0.12	0.32	8.7	1.6
	simulated	*13784*	*0.04*	*0.10*	*4.2*	
Pharm & Biotech	observed	5213	0.12	0.39	8.8	1.8
	simulated	*7789*	*0.06*	*0.10*	*4.0*	
Industrial processes	observed	3203	0.17	0.35	9.8	1.4
	simulated	*10232*	*0.08*	*0.12*	*5.0*	
Mechanical eng. & Transport	observed	1005	0.48	0.44	10.4	1.4
	simulated	12147	0.08	0.17	5.9	
Consumer goods & Civil eng.	observed	201	0.39	0.31	5.3	2.2
	simulated	5039	0.10	0.15	5.6	

Academic & CNRS inv's as small world catalysts →Centrality

TECHNOLOGICAL FIELDS	Inventors	N	B_{CENT}	C_{CENT}	D_{CENT}
Electrical eng & Electronics	All	3978	0.0024	0.084	4.9
	Academic	*94*	*0.0027*	*0.081*	*5.5*
	CNRS	*49*	*.00370*	*0.086*	*5.5*
Instruments	All	2870	0.0034	0.084	5.7
	Academic	*147*	*0.0069*	*0.084*	*6.5*
	CNRS	*77*	*0.0039*	*0.084*	*5.4*
Chemicals. Materials	All	5723	0.0011	0.121	7.1
	Academic	*268*	*0.0019*	*0.126*	*8.2*
	CNRS	*208*	*0.0019*	*0.126*	*7.9*
Pharma & Biotech	All	3608	0.0018	0.119	6.4
	Academic	*232*	*0.0034*	*0.122*	*7.0*
	CNRS	*183*	*0.0026*	*0.125*	*7.7*
Industrial processes	All	2049	0.0035	0.110	5.6
	Academic	*84*	*0.0081*	*0.115*	*6.8*
	CNRS	*68*	*0.0038*	*0.118*	*6.0*

"Mobility" → Number of distinct applicants normalized by the number of inventor's patents

TECHNOLOGICAL FIELDS	All inventors	Acad. inventors	CNRS inventors
Electrical eng. Electronics	0.32	0.55	0.65
Instruments	0.32	0.59	0.60
Chemicals. Materials	0.28	0.56	0.57
Pharma, Biotechnology	0.29	0.64	0.64
Industrial processes	0.28	0.58	0.57
Mech. Eng.; Transport	0.31	0.49	0.52
Consumer goods. Civil eng.	0.28	0.42	0.75

Academic & CNRS inventors as small world catalysts → Node-deletion test

	Type removed	Nr removed	C1	ΔC1	L	ΔL/L
Electr. Engineer. & Electronics		-	6459		12.4	
	Acad+CNRS	143	6068	391	12.7	2.2%
	Controls	143	6118	341	12.6	1.7%
Instruments			4542		12.3	
	Acad+CNRS	224	3452	1090	12.1	-2.0%
	Controls	224	3971	571	12.6	2.0%
Chemicals & Materials			9611		8.7	
	Acad+CNRS	476	8538	1073	9.6	9.5%
	Controls	476	8827	784	9.0	2.6%
Pharma. & Biotech.			5213		8.8	
	Acad+CNRS	415	4247	966	9.5	8.6%
	Controls	415	4443	770	8.9	1.7%
Industrial processes			3203		9.8	
	Acad+CNRS	152	2769	434	11.2	14.3%
	Controls	152	2882	321	9.9	0.8%

Summary

- Networks of inventors in France appear to be "small worlds"
  - ✓ ...in science-intensive technological fields
  - ✓ ...in which academic & CNRS inventors are important

- Academic and CNRS inventors → "small worlds"
  - ✓ They connect otherwise disconnected components
  - ✓ They bridge between distant communities of inventors shortening distances
  - ✓ They provide shortcuts due to inter-organizational mobility of inventors

Policy conclusions & further research

- Our research does not say anything on desirability of "academic patenting"
  - ✓ It simply exploits evidence of extensive academic patenting to produce "relational data" on academics and other inventors
  - ✓ It points out that academic inventors are in a key structural position in the network

- Further research on:
  - ✓ Dissemination effects (citation analysis)
  - ✓ Leverage and brokerage: access to resources (→ evidence on academic inventors' superior scientific productivity)