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University patenting, licensing and technology transfer: How organizational context and available resources determine performance

8th Ph.D. School on Innovation and Economic Development

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Somewhat different problem

- Globelics Academy : Public policies towards development
- Practical issue: how to improve efficiency of university technology transfer?

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UNIVERSITY PATENTING, LICENSING AND TECHNOLOGY TRANSFER: HOW ORGANIZATIONAL CONTEXT AND AVAILABLE RESOURCES DETERMINE PERFORMANCE

Manuel Mira Godinho, Rui Cartaxo

Cities and Innovation

Document de treball de l'IEB

1. Context: University Patenting
2. Context: Portugal
3. Object of analysis, Hypotheses and Methodology
4. Cluster analysis
5. Partial Least Squares regression
6. Main Results and Final Remarks

How to transfer technology from the university sector? (1/2)

- Background question: what is [should] be the role of universities ?
- The 3 missions: production of knowledge (research); reproduction (teach); dissemination (TT etc.)
- Shall TT be stimulated? In which conditions? Are there any limits?

How to transfer technology from the university sector? (2/2)

Mechanisms for TT

- Individual consulting
- Providing services to industry (testing, allocation of research facilities and equipment…);
- Joint U-I research
- Spinning off research-based firms
- Patenting (and spinning off)
- Patenting (and licensing)

What are the determinants of U.-I. TT?

What does affect the rate and pattern of U-I TT [*or specifically of academic/university patenting*]?

What does the literature on U.-I. TT tell us?

a) Institutional framework
b) Quality and disciplinary breakdown of research
c) Cultural environment
d) “Demand”

a) Institutional framework

- Ownership of the universities (public, private)
- Laws regulating university patenting and transfer
  (Professor Privilege; Bayh-Dole Act…)
- Sources of funding
  (research councils, PROs, private foundations and other phillantropic sources, private business firms)
- Laws and procedures regulating academic promotion
  (how is tenure granted? How much [ISI] publications are valued? Does TT has any consideration in promotion?)
- Professionalization of TT function at the universities
  [does a TLO/TTO exist? How many staff? What's their experience and business network?]

b) Quality and disciplinary breakdown of research

- Balance natural sciences/ humanities/social science
- Balance biology+medicine vs. physics+engineering etc.

- Higher patenting levels associated with academic excellency (complementarity rather than trade-off between basic research and applied work)

c) Cultural environment

- Attitudes
- Tradition

d) Demand

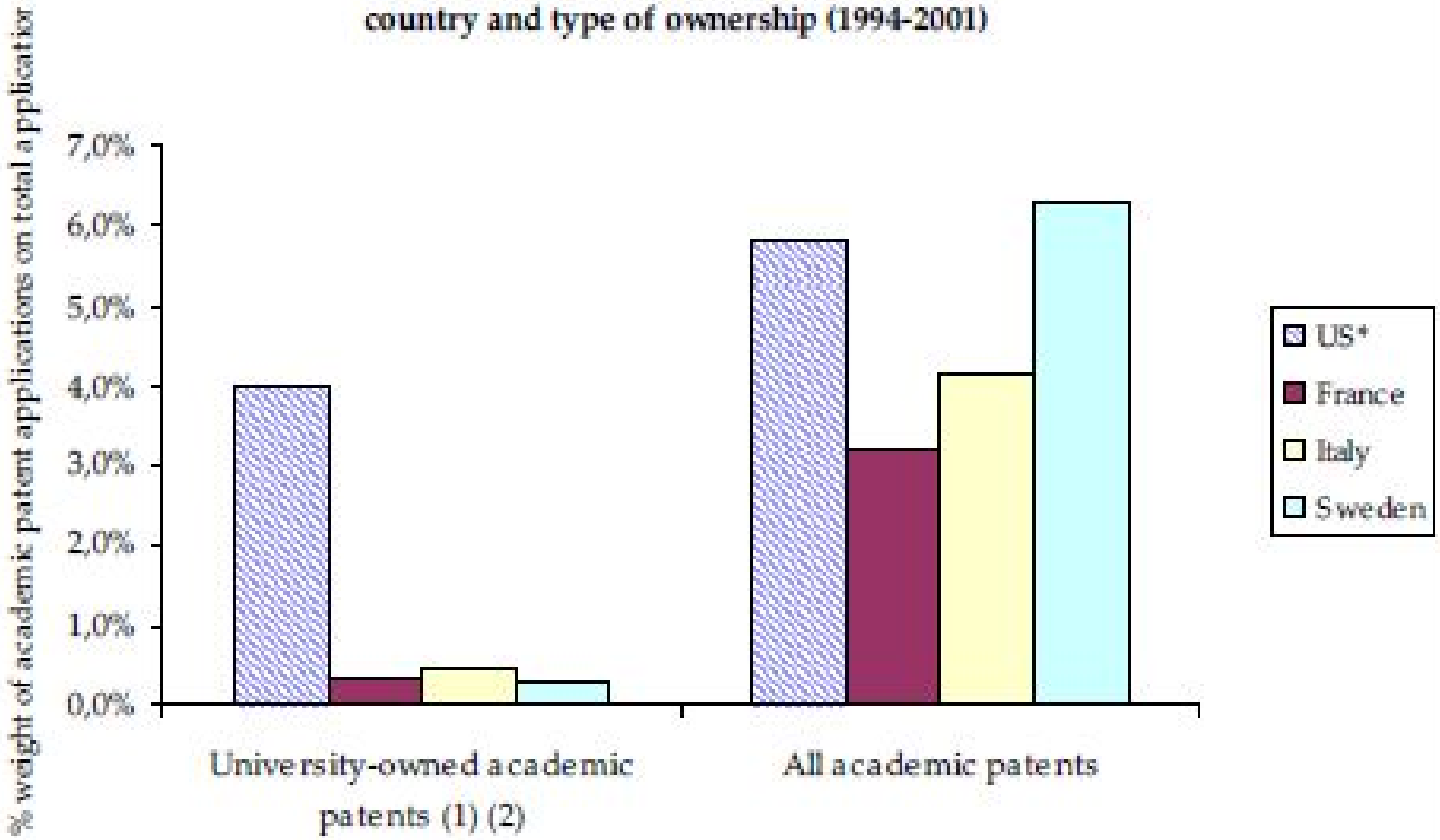
- Technological intensity of business sector firms
- Role and weight of science-intensive firms
- Technological specialization of the country/region

What is the evidence on university [academic] patenting?

Important distinction:

- University patents: assignee is the university
- Academic patents: al least one inventor is a university researcher (the owner might be the researcher, a business firm, a PRO...)

Figure 10. Weight of academic patents on total patents by domestic inventors, by country and type of ownership (1994-2001)

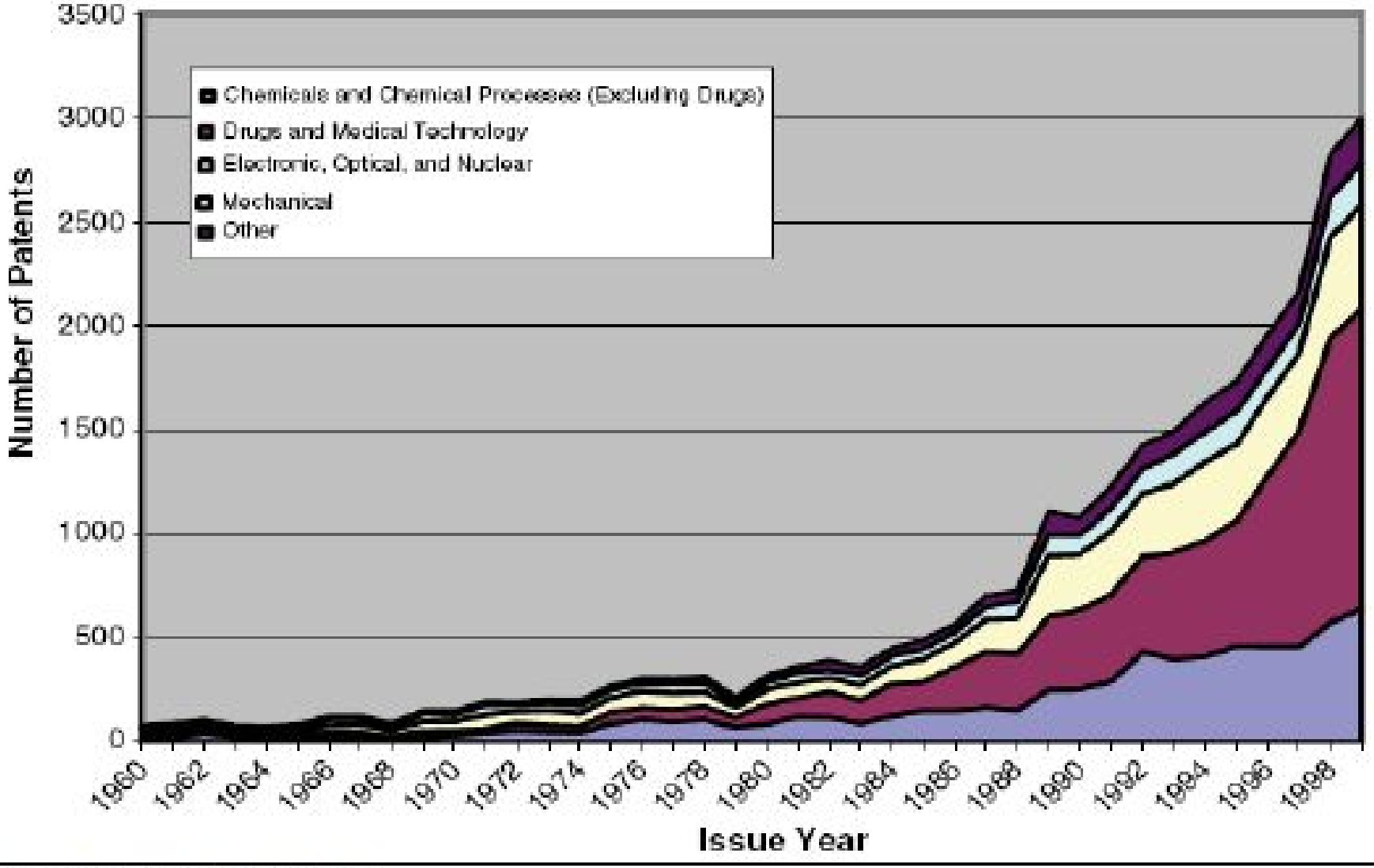


(1) US univ-owened patent include no-profit organizations (4,2% of tot obs); all data include co-assigned patents (source: Thursby et al., 2006)

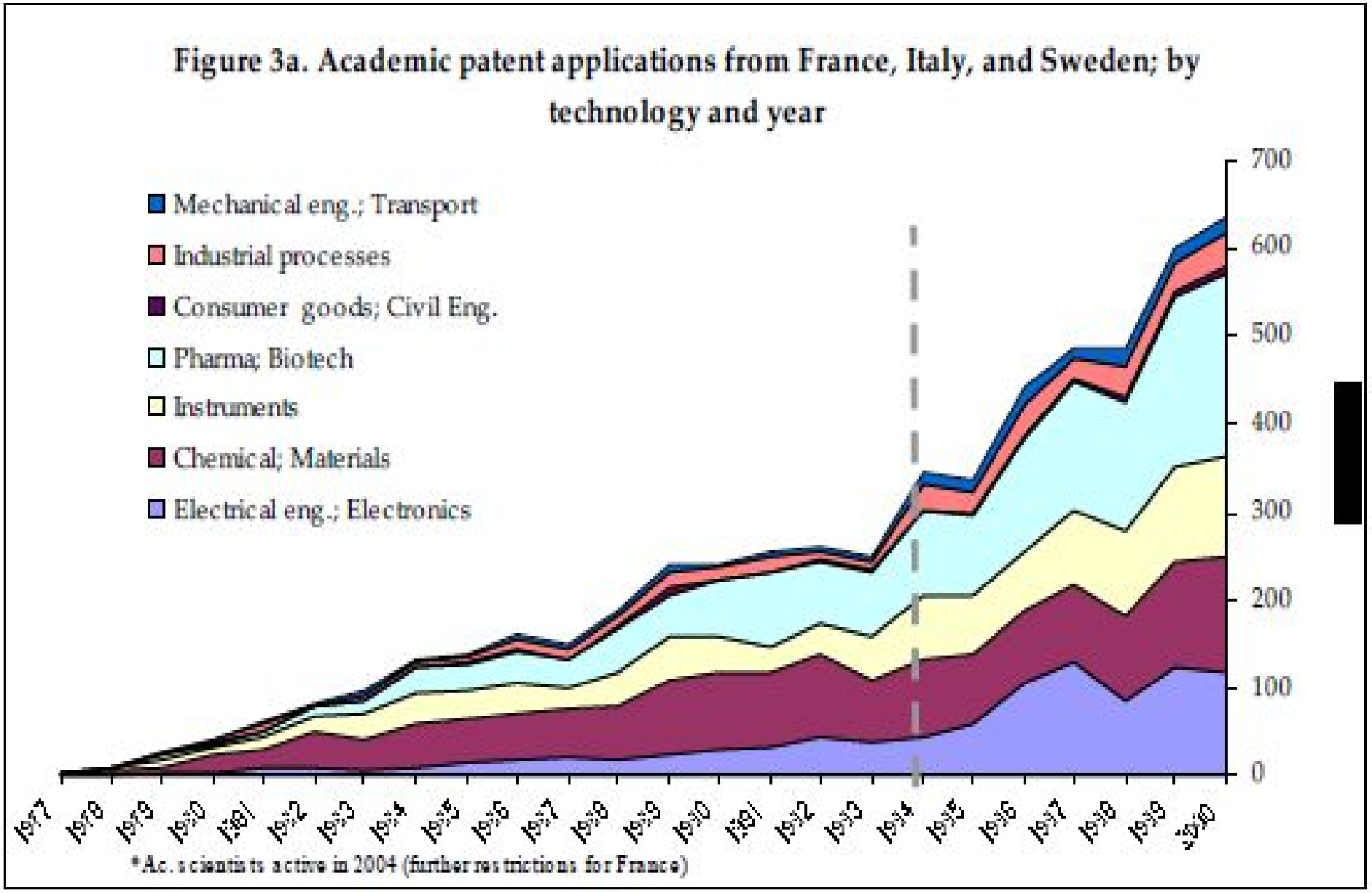
(2) Estimate of weight of univ-owned patents in 1999, from Mowery and Sampat (2006)

Source: Lissoni et al. (2007), Academic Patenting in Europe: New Evidence from the KEINS Database

Figure 3b – Technology field of US Research Universities' patents



Source: Mowery and Sampat (2005)



Source: Lissoni et al. (2007), Academic Patenting in Europe: New Evidence from the KEINS Database

Table 2. Academic vs. non-academic patents in 5 European countries, 1995-2001; by country

	Non-academic (i)		Academic (ii)		All (i)+(ii)	
	nr	*% of All*	Nr	*% of All*	nr	*% of All*
Denmark	5424	*(95,5%)*	254	*(4,5%)*	5678	*(100%)*
France	47322	*(96,6%)*	1651	*(3,4%)*	48973	*(100%)*
Italy	23537	*(95,5%)*	1103	*(4,5%)*	24640	*(100%)*
Netherlands	19660	*(94,6%)*	1116	*(5,4%)*	20776	*(100%)*
Sweden	14223	*(94,1%)*	895	*(5,9%)*	15118	*(100%)*
Total	110166	*(95,6%)*	5019	*(4,4%)*	115185	*(100%)*

Source: elaborations of EP-KITES database. All data refer to applications at the European Patent Office

Source: Lissoni et a. (2010), Ownership and impact of European university patents.

EU5: 4,4%; 859 academic patents in 1999; 859/150M
US: c. 6%; 3000 university patents in 1999; 3,000/300M

Value of University Patents
(How do they score vis-à-vis business patents?)

Financial value

Crespi et al. (2006) found that university owned patents are not that different from business owned patents

Technological value (How often a patent is cited by other patents in a given period of time?)

Lissoni et al. 2010 conclude that: “European universities’ patent portfolios do not contain patents of higher value (higher citation rates) than companies [...]. This is in contrast with common findings for the US”

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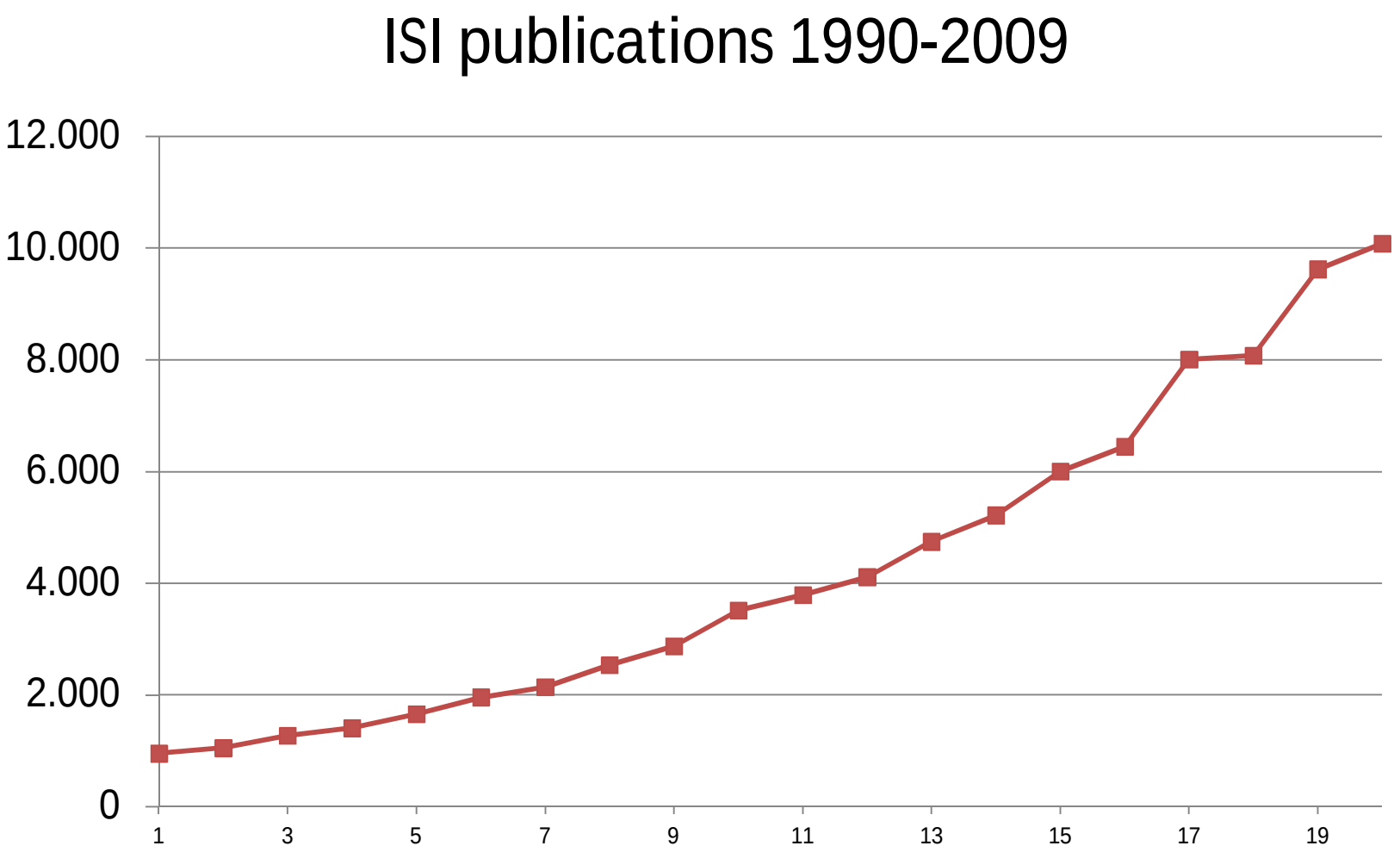
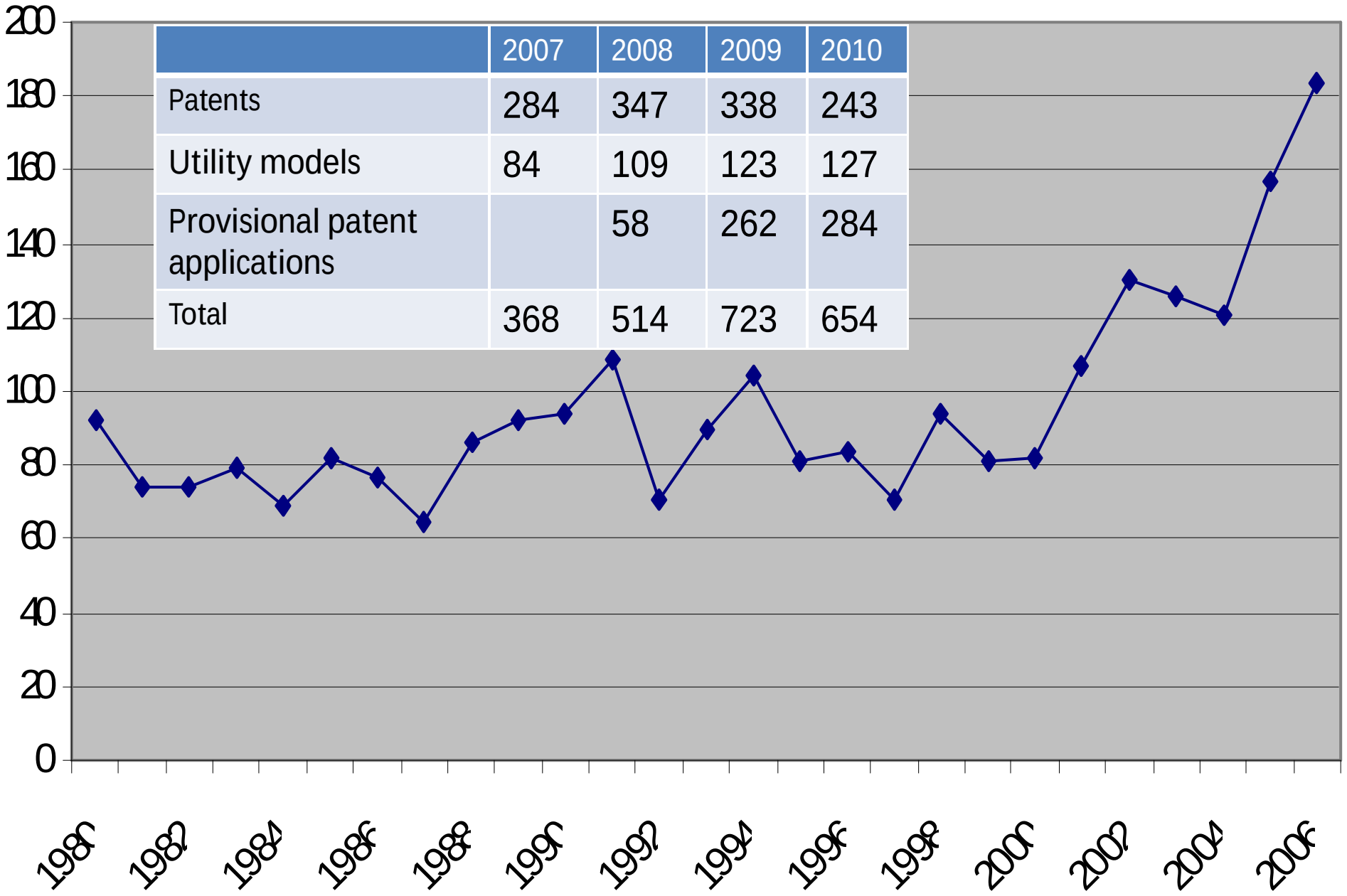
A few facts about Portugal (1/2)

- Interesting case from an economic development perspective
- Small country / small economy
- European periphery but important role in global economic history
- GDPpc growth: top 10 in 1951-2000 (after Japan, 4 dragons and Ireland)
- Current crisis: financial mismanagement + structural weakness
- Economic structure: moved from low to medium tech since 1986, but still very low weight of HT and KIBS

A few facts about Portugal (2/2)



Applications for national patents by residents, 1980-2006 + 2008-2009



	2007	2008	2009	2010
Patents	284	347	338	243
Utility models	84	109	123	127
Provisional patent applications		58	262	284
Total	368	514	723	654

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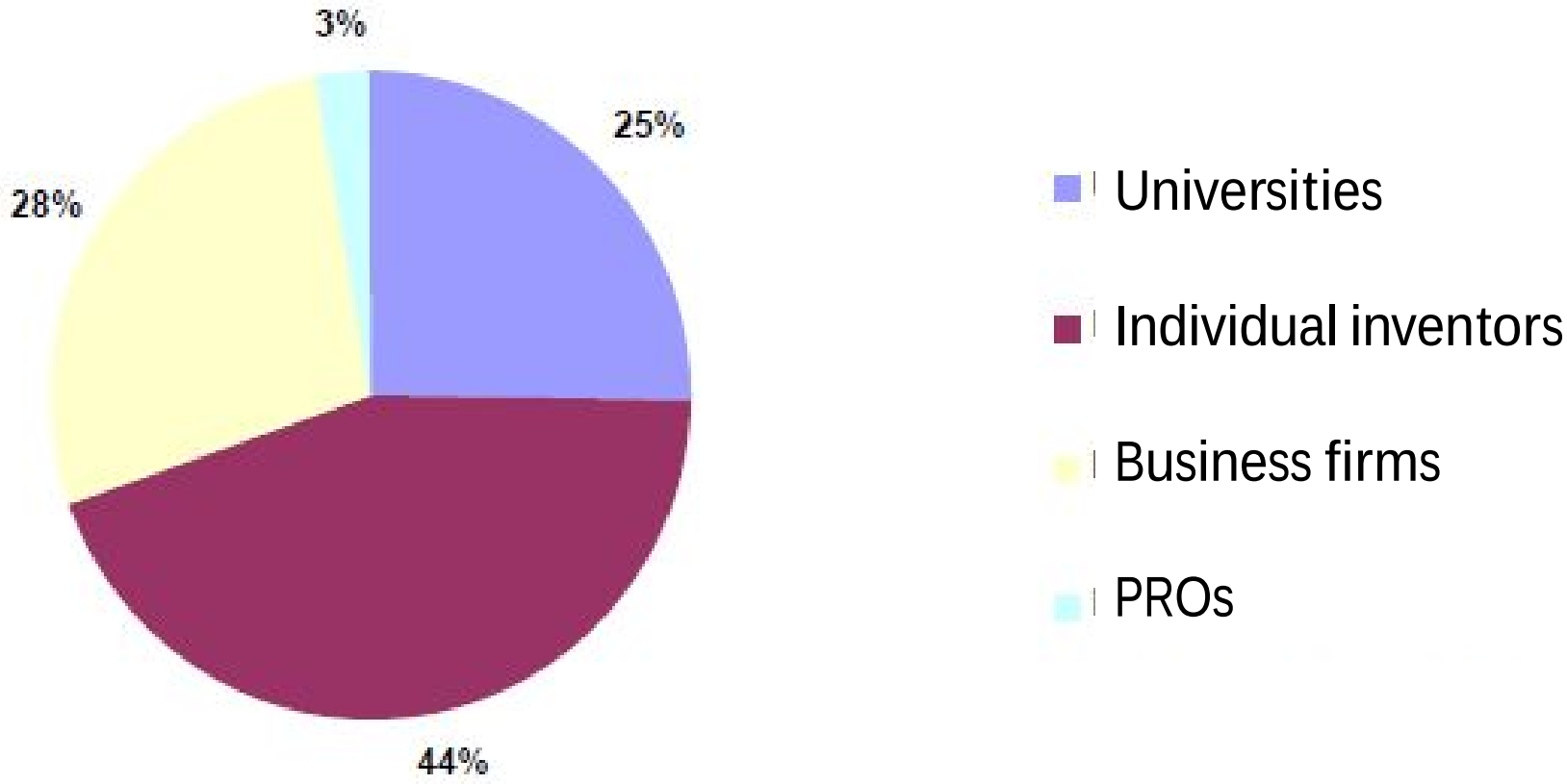
2009 applications



Main Applicants

1980-2008 (with 7 or more filings)		2000-2008 (with 4 or more filings)	
INSTITUTO SUPERIOR TÉCNICO	129	INSTITUTO SUPERIOR TÉCNICO	124
INETI	50	UNIVERSIDADE DO MINHO	43
UNIVERSIDADE DO MINHO	49	UNIVERSIDADE DE AVEIRO	42
UNIVERSIDADE DE AVEIRO	48	UNIVERSIDADE DO PORTO	17
LUÍS MARTINS ALEIXO	21	INETI	16
UNIVERSIDADE DO PORTO	17	INESC INOVAÇÃO	9
ALFREDO FERREIRA DE ABREU	16	INESC PORTO	9
HOVIONE FARMACIÊNCIA, S.A.	16	LEONEL RODRIGUES VIEIRA	8
PEDRO MANUEL BRITO DA SILVA CORREIA	14	RODRIGO DE SOUSA PERES	8
JÚLIO ANTÓNIO SALGADO DA COSTA	13	HOVIONE FARMACIÊNCIA, S.A.	7
LUSAMATEX-MÁQUINAS TÈXTEIS, LDA.	12	UNIVERSIDADE DE ÉVORA	7
MANUEL DE SOUSA PORTUGAL	12	PEDRO BRITO CORREIA	6
AMÉRICO AMBRÓSIO HENRIQUES DA TRINDADE	11	UNIVERSIDADE DE COIMBRA	6
INESC PORTO	11	UNIVERSIDADE DO ALGARVE	6
JOÃO ROBERTO DIAS DE MAGALHÃES QUEIROZ	10	AGOSTINHO VILAÇA DA CUNHA, LDA.	5
PAVICENTRO - PRE-FABRICAÇÃO, SA.	10	FERNANDO NOGUEIRA GONÇALVES	5
RODRIGO DE SOUSA PERES	10	FORTUNATO JOSÉ MOREIRA DA COSTA	5
VITORINO PEREIRA VIEIRA	10	LUÍS MANUEL PINTO FERREIRA DA COSTA	5
FERNANDO AUGUSTO BAPTISTA	9	MARTIFER	5
INESC INOVAÇÃO	9	UNIVERSIDADE DOS AÇORES	5
JOAQUIM ANTÓNIO ABRANTES CANDEIAS	9	GANTLE TRADING & SERVICES, LDª.	4
MARTIN ERNST STIELAU	9	MANUEL DA SILVA E SOUSA LOBO	4
LEONEL RODRIGUES VIEIRA	8	PEDRO MANUEL BRITO SILVA CORREIA	4
LUÍS MANUEL PINTO FERREIRA DA COSTA	8	SILVINO POMPEU SANTOS	4
ANTÓNIO DA COSTA GONÇALVES	7	TECMINHO	4
HELDER TRIGUEIROS DE BRITO PINTÃO	7		

Principais inventores, 2000-2008

1	ARLINDO JOSÉ DE PINHO FIGUEIREDO E SILVA	22
2	ARMANDO J. L. POMBEIRO	17
3	JOÃO ANTÓNIO LABRINCHA BATISTA	11
4	LEONEL RODRIGUES VIEIRA	8
5	FERNANDO NOGUEIRA GONÇALVES	7
6	MÁRIO SERAFIM DOS SANTOS NUNES	7
7	HENRIQUE MIGUEL MARQUES DROGUETE COSTA FERREIRA	6
8	AGOSTINHO VILAÇA DA CUNHA	5
9	JOSÉ MARIA DA FONTE FERREIRA	5
10	ANTÓNIO PONTES	4
11	DAVID ALEXANDER LEARMONTH	4
12	FORTUNATO JOSÉ MOREIRA DA COSTA	4

Survey carried out summer 2008, n=27, 10 variables

Resources	1. Staff (employees in the unit) 2. Existence of a database or specialized IT system to support T. T.
Activities	1. Number of training activities promoted 2. Number of studies promoted 3. Number of networks etc in which the unit has been involved 4. Number of fairs etc in which the unit was present
Outcomes	1. Number of patent applications 2. Number of T. T. processes promoted by the unit 3. Number of licensing contracts 4. Number of technology-based spin-off companies

GAPI	OTIC
Gabinetes de Apoio à Promoção da Propriedade Industrial	Oficina de Transferência de Tecnologia e do Conhecimento
2001 →	2005 →
R:10, out of 22	R: 20, out of 22
TLO	TTO
A few merged →	

GAPI IST	OTIC UTL
	OTIC ESB
GAPI Algarve	OTIC Algarve
GAPI UBI	OTIC UBI
	OTIC UNL
GAPI Coimbra	OTIC Coimbra
	OTIC Lusíada
GAPI Aveiro	OTIC Aveiro
GAPI Evora	OTIC Evora
	OTIC Ulisboa *NR*
	OTIC Umadeira *NR*
GAPI Azores	OTIC IPS
	OTIC IPT
	OTIC IPP
	OTIC IPL
	OTIC IPBeja
	OTIC IPCB
	OTIC IPPg
	OTIC IPVC
GAPI+OTIC Porto	
GAPI+OTIC Minho	
GAPI+OTIC UTAD	

H1 & H2

- H1. The different nature of the institutions determines different behaviors

  ("behavior follows structure and objectives")

  - GAPIs → TLO
  - OTICs → TTO
  - Integrated structures (GAPI+OTIC) pursue both objectives

  Institutional theory

- H2. GAPIs and OTICs manage resources with which they engage in activities, therefore producing outcomes

  Resource-based view

Methodology

- H1 tested through cluster analysis.

- H2 tested through factor analysis and estimation of a model using Partial Least-Squares (PLS)
- PLS selected as the small size of the sample and its distribution rule out alternative methods.

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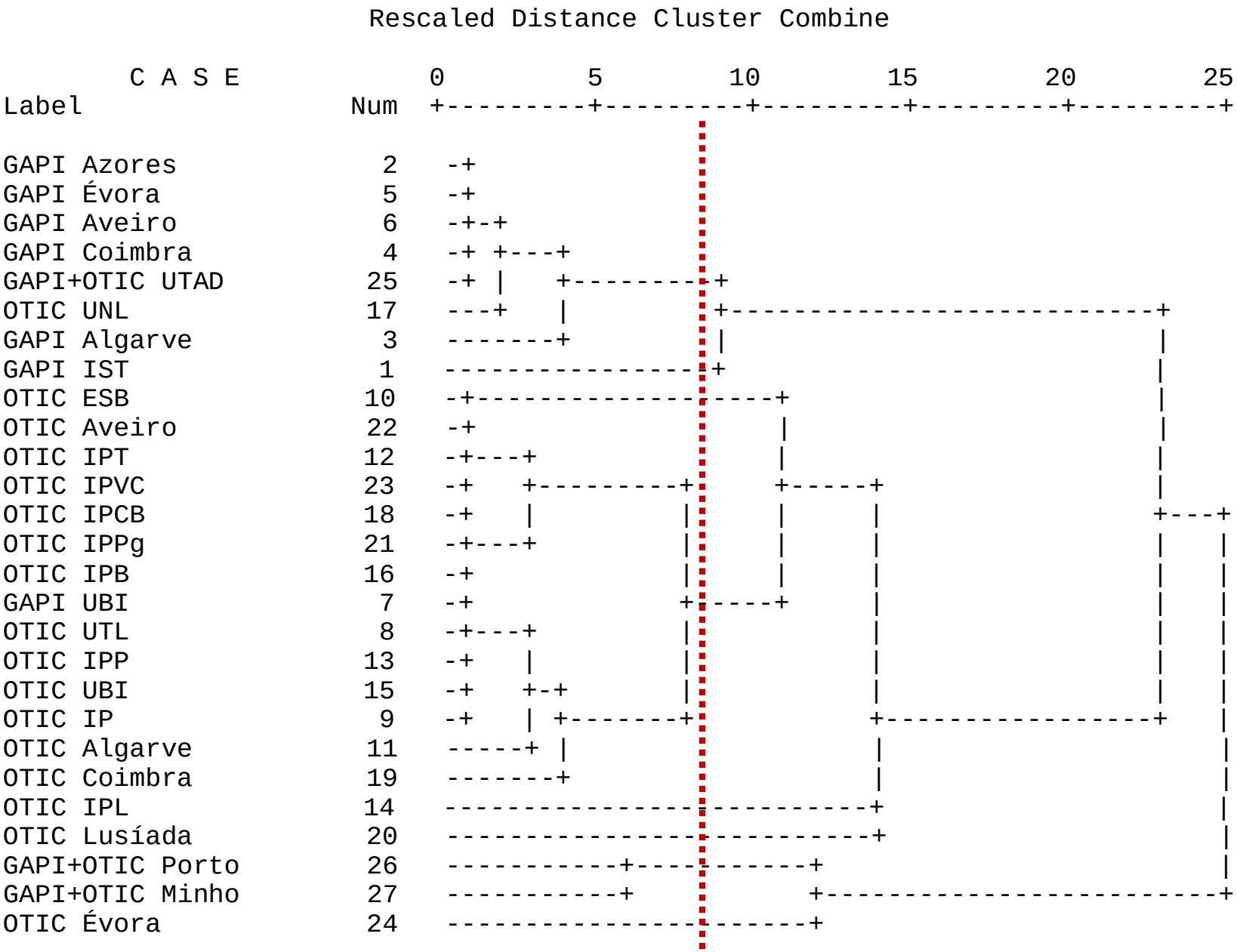
Chart 1 - Dendrogram using Ward Method



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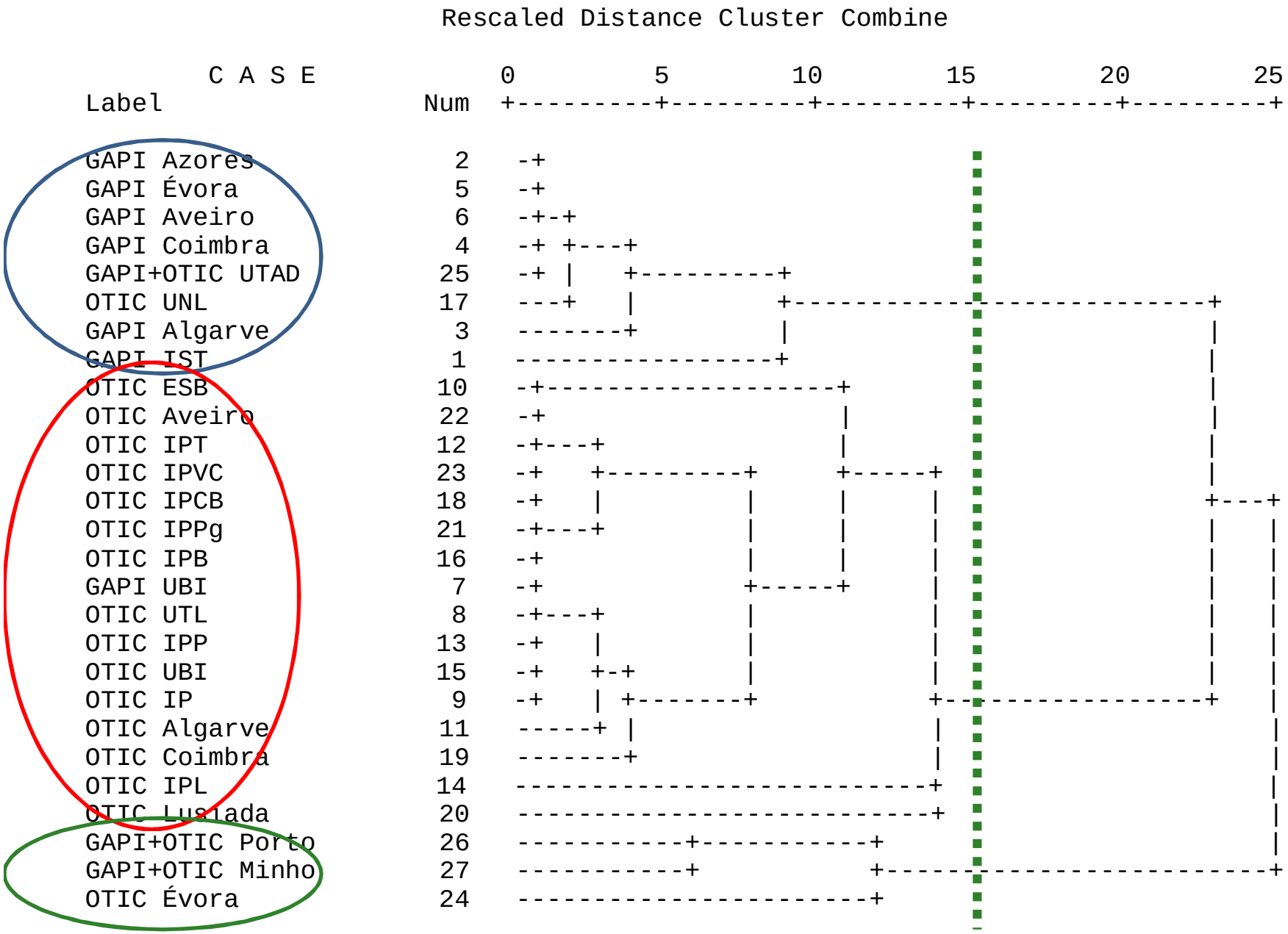

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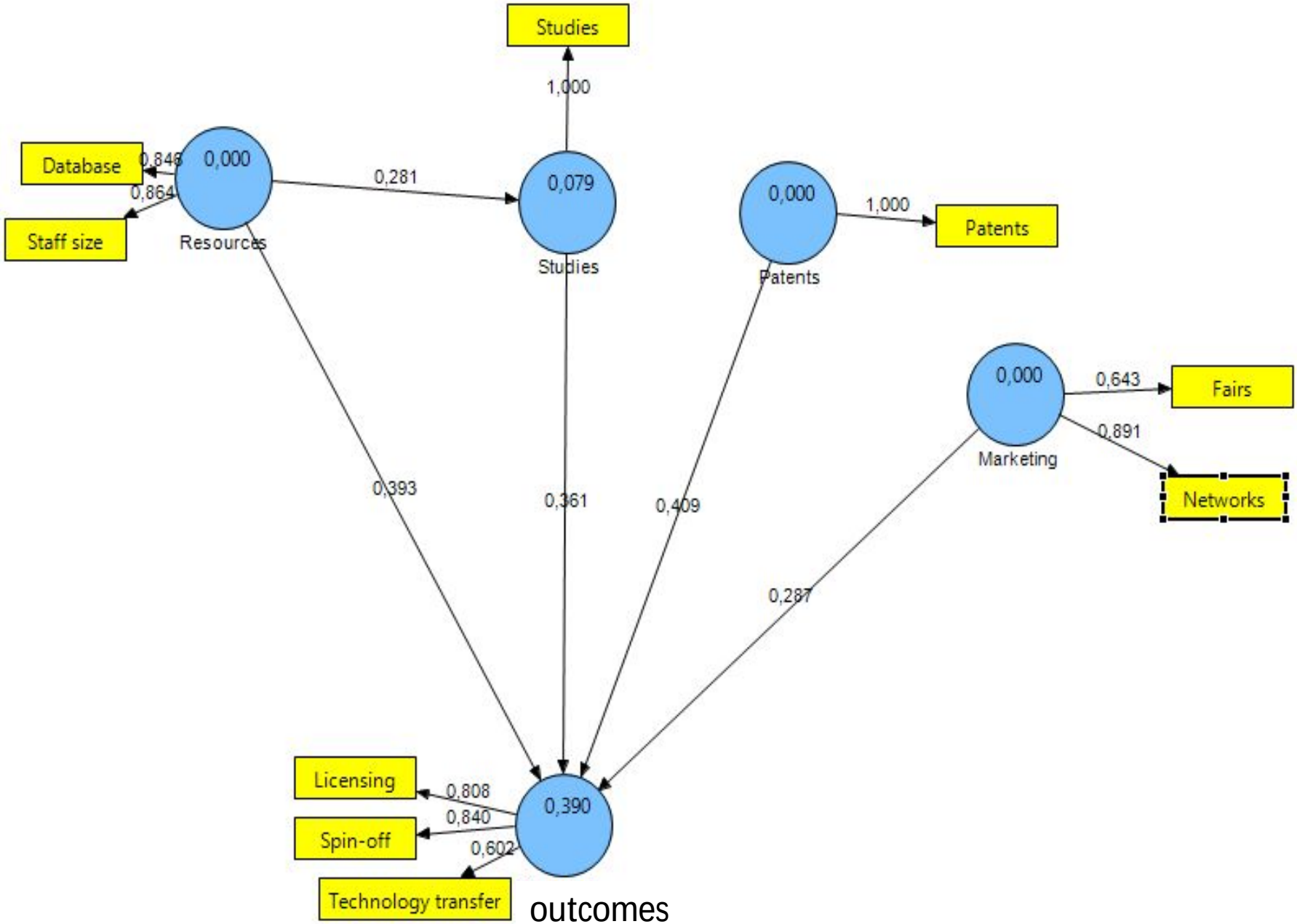
PLS (Partial Least Squares) method

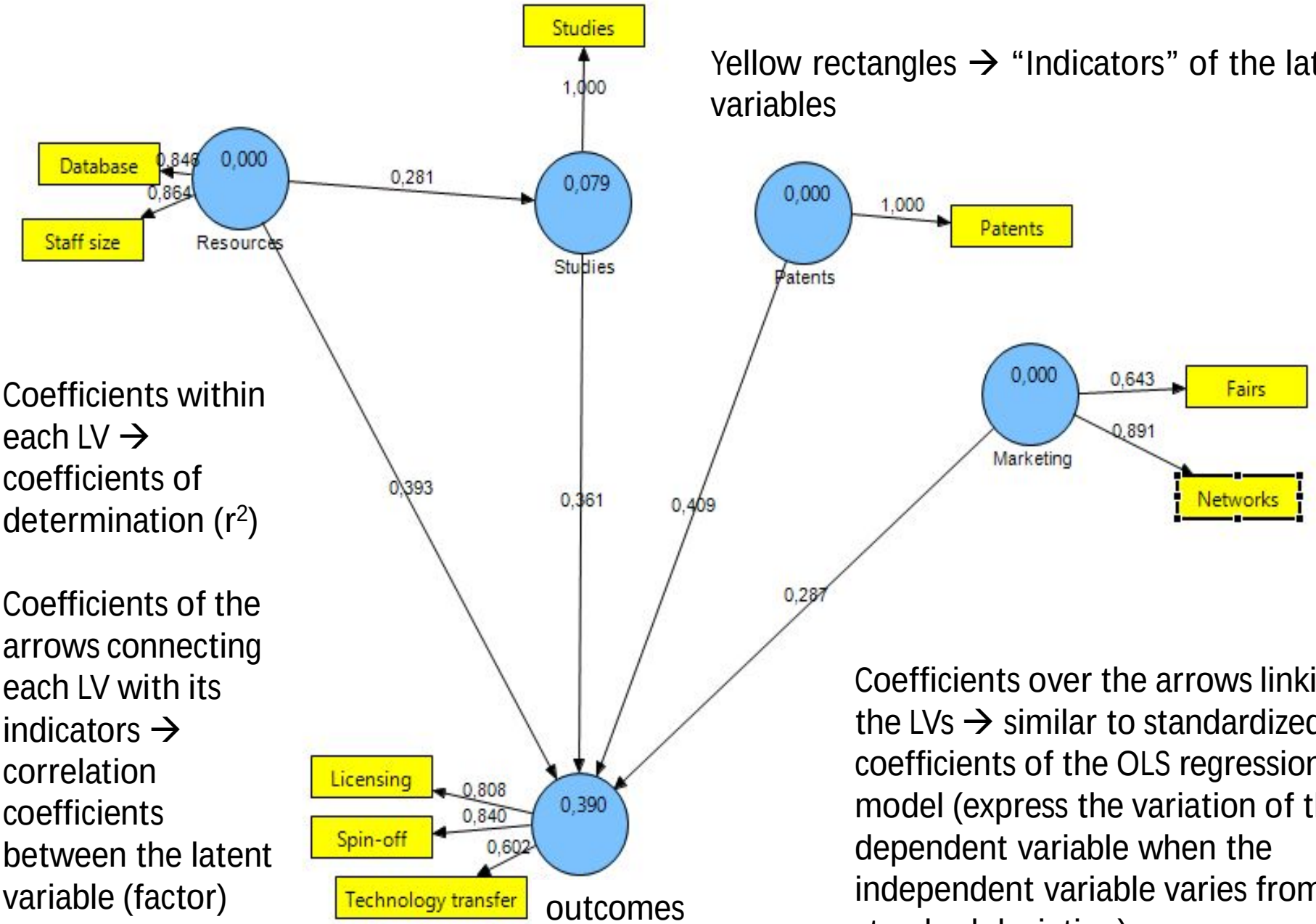
- PLS → method that combines regression techniques with factorization of both the independent and dependent variables
- PLS replaces by the principal components method the various independent variables and the dependent variable by latent variables
- The latent dependent variable is linearly regressed on the latent independent variables


Studies
1,000
Database
0,846
0,000
0,281
0,079
0,000
1,000
Patents
0,864
Staff size
Resources
Studies
Patents
0,000
0,643
Fairs
0,891
Marketing
Networks
0,393
0,361
0,409
0,287
Licensing
0,808
0,840
0,390
Spin-off
0,602
Technology transfer

outcomes

Blue circles → Latent Variables

Yellow rectangles → "Indicators" of the latent variables



Coefficients within each LV → coefficients of determination (r^2)

Coefficients of the arrows connecting each LV with its indicators → correlation coefficients between the latent variable (factor) and the indicator

outcomes

Coefficients over the arrows linking the LVs → similar to standardized coefficients of the OLS regression model (express the variation of the dependent variable when the independent variable varies from one standard deviation)

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Results

- Performances satisfactorily explained (r^2 = .39 etc)
- *Outcomes* accounted 1st of all by *Patents* (which appear as exogenous variable, probably linked to the potential of each university, size and location
- 2nd come *Resources*
- *Studies* depend on the level of *Resources* and are next in importance.
- Finally *Marketing activities* have an influence on *Outcomes*

Final Remarks

- Both institutional characteristics and resources used are relevant in accounting for outcomes
- This confirms H1 and H2
- Steep learning curve ← time, persistence, investment, critical mass
- Further questions: return on investment?