



# The determinants of national patent ownership by Public Research Centres

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## Introduction

- PRCs = Universities + PROs
- Rise of PRC-owned patents
- Caused by changes in knowledge production, society demand and funding conditions
- Positive and negative consequences
- Usually explored through output approach
- Alternative: input approach

## Contributions of this paper

- US is said to outperform EU in the number of PRC-owned patents –what if measured in terms of the patent/R&D ratio?
- The EU viewpoint –are any member states more efficient than others at producing PRC-owned patents?
- Universities have received more attention than the other main scientific producers have in the public system – what about PROs?
- PRC-owned and invented patents –complements or substitutes?

## The differences between PRC-owned patents revisited: EU vs. US

- Is increasing university patent ownership the path to follow the US model?
  - Little quantitative evidence at country level for the EU
  - University-owned patents as a percentage of total patents -complexity into the world ranking (OECD, 2007) and incipient reversal of the trend in US (Leydesdorff and Meyer, 2008)
  - What if measured in terms of the patent/R&D ratio?
- Hypothesis 1. The US tends to outperform the EU in the number of PRC-owned patents even after controlling for the money PRCs spend on R&D

## Returns to scale to university-owned patents

- Microeconomic works on the US case (Foltz et al., 2000; 2003, Carlsson and Fridh, 2002, Payne and Siow, 2003, Stephan et al., 2007, Coupé, 2003) –decreasing returns to scale?
- Microeconomic studies about the European context (Azagra, Fernández, Gutiérrez, 2003; Azagra, Carayol, Llerena, 2006) –decreasing returns to scale
- Hypothesis 2. As apparently occurs in microeconomic studies, the returns to scale in the production of university-owned patents are also decreasing at macroeconomic level

## Universities and PROs

- Greater heterogeneity of PROs regarding patent ownership
  - Patent production function for PROs: Microeconomic evidence for the case of CSIC, the largest Spanish PRO (Azagra, Plaza, Romero, 2007) –increasing returns to scale
- Hypothesis 3. PRO-owned patents present a different behaviour than that of university-owned patents regarding the impact of their inputs and the types of returns to scale

## Compatibility between alternatives of technology transfer

- The number of academic-invented patents may considerably exceed the number of academic-owned patents (Azagra, Carayol and Llerena, 2006)
- US gives more incentives for the predominance of academic-owned patents whereas in many European countries academic-invented patents are more abundant (Crespi et al., 2006).

→ Hypothesis 4. The higher the implication in patents invented by PRCs, the smaller the production of patents owned by PRCs

## Data

- Number of PRC-owned patents (Eurostat)
  - PCT applications designating the EPO
  - 1982-2004, i.e. 23 years
  - 27 EU Member States and US, i.e. 28 countries
  - Distinction among institutional sectors - Eurostat's project on Data Production Methods for Harmonised Patent Statistics (Van Looy et al., 2006)
- PRC R&D expenditure in millions of PPS at 1995 prices (Eurostat)
  - Lagged one period to prevent some endogeneity

## Methodology

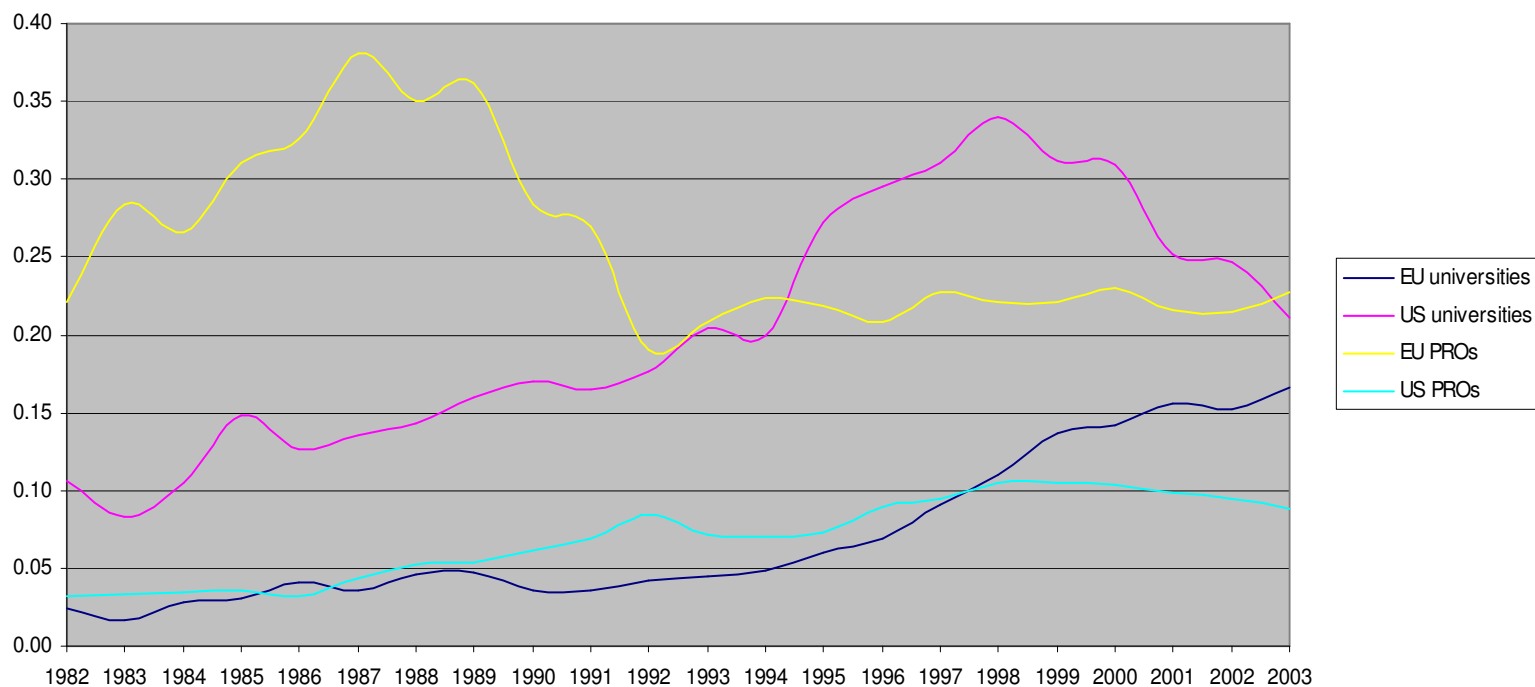
- Ratio of PRC-owned patents over PRC R&D expenditure – descriptive analysis
- Econometric estimations of the numbers of university and PRO-owned patents
- Panel regression models
- Independent variables
  - Expenditure on R&D (other measures of R&D size also tried)
  - Share of business funding, government funding and other funding of R&D
  - Firms' patent/R&D ratio
  - Space left for PRC-invented patents – a proxy!

$$\text{Space for PRC}_i\text{-invented patents} = \frac{\text{Business-owned patents}}{\text{Business-owned patents} + \text{PRC}_i\text{-owned patents}}$$

i = university, PRO

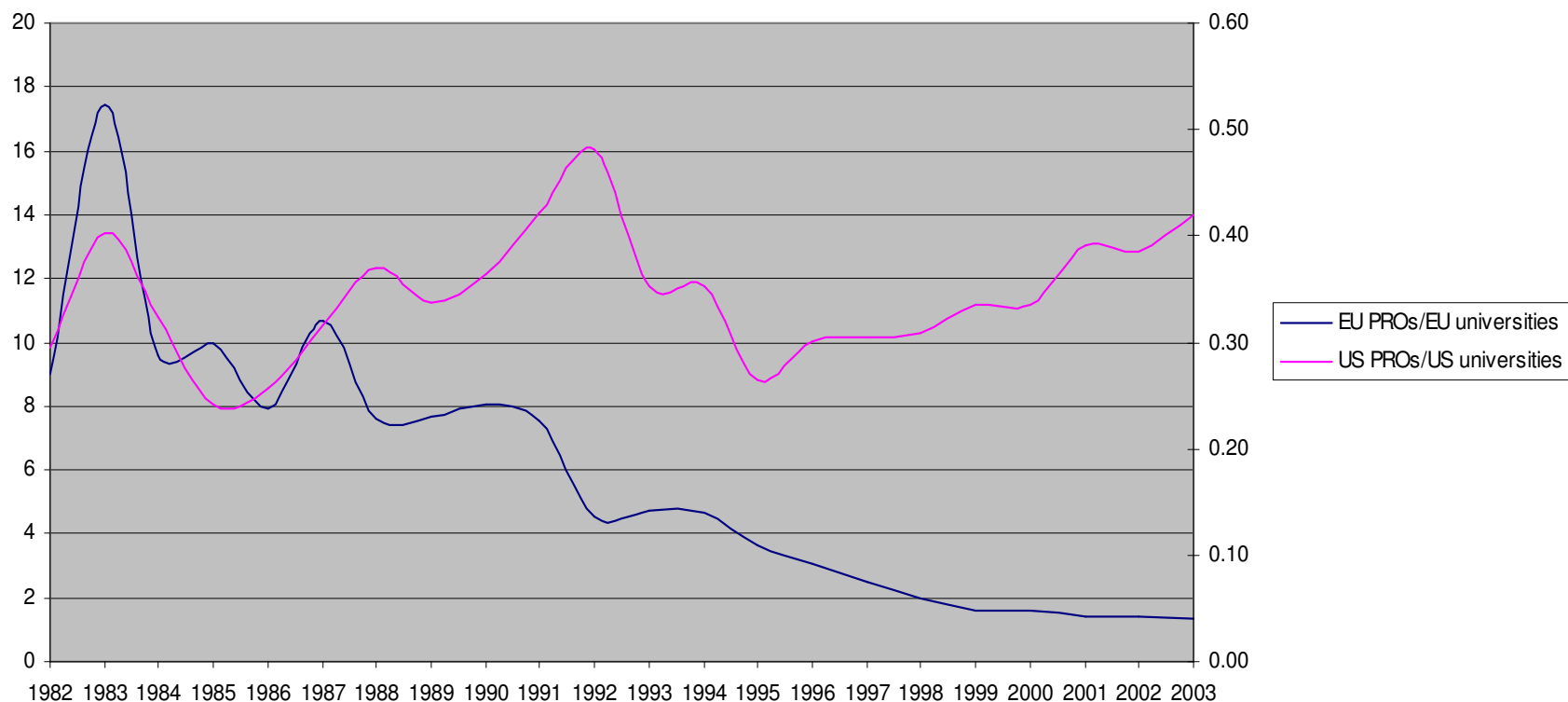
- Equal to 1 if PRC staff only appeared as inventors in business patents and 0 if they only appeared as inventors in PRC-owned patents
  - Correlated with the measure by Crespi et al. (2006) for universities
  - Lowly correlated with number of PRC-owned patents
- R&D expenditure is the only scale variable (Furman et al., 2002)

## The growth of PRCs' patent/R&D ratio

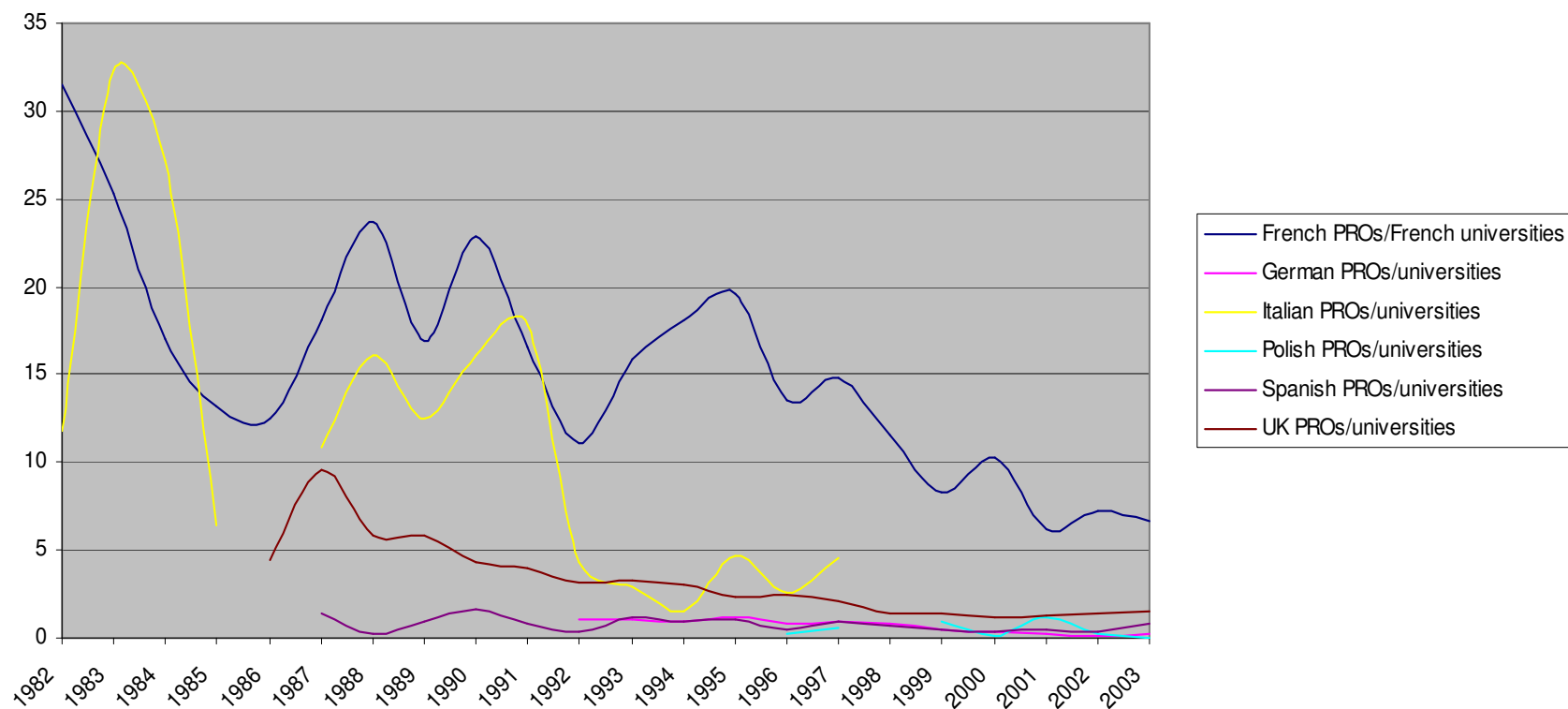


➔ Hypothesis 1. The US tends to outperform the EU in the number of PRC-owned patents even after controlling for the money PRCs spend on R&D ✓/✗

## The divergent evolution of the PROs/universities ratio of patent/R&D ratios



## The decline of the PRO/universities ratio of patent/R&D ratios in the six largest EU member states



## Econometric estimations – Hypothesis 2 to 4

→ Hypothesis 2. As apparently occurs in microeconomic studies, the returns to scale in the production of university-owned patents are also decreasing at macroeconomic level ✓

Model	OLS	REM
Dependent variable	Ln number of university-owned patents	Ln number of PRO-owned patents
Number of observations	290	277
Adjusted R <sup>2</sup>	.95	.95
Variable	Coefficient (t-ratio)	Coefficient (t-ratio)
Constant	16.07 (13.19)	11.01 (6.35)
Ln {PRC} R&D expenditure in millions of PPS	.30 (3.49)	1.05 (9.45)
Share of business funding of {PRC} R&D expenditure	4.88 (3.63)	
Space for {PRC}-invented patents	-15.24 (-13.01)	-15.37 (-9.91)
Ln firm patent/R&D	.88 (11.10)	.83 (8.13)

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## Conclusions

- Limitations – publications & national PRC-IPR legislations
- If the fear is that US outperforms EU, EU should take into account that the patent/R&D ratio of its PROs is stagnating
- Lack of a clear positive impact of university-owned patents or decreasing returns to scale?
- PROs and constant returns to scale
- Public technology ownership may not be compatible with other (direct) alternatives for technology transfer