

Geographic Proximity and Technological Transfer In Italy

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Workshop **Le trasformazioni dei sistemi produttivi locali**
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Motivation

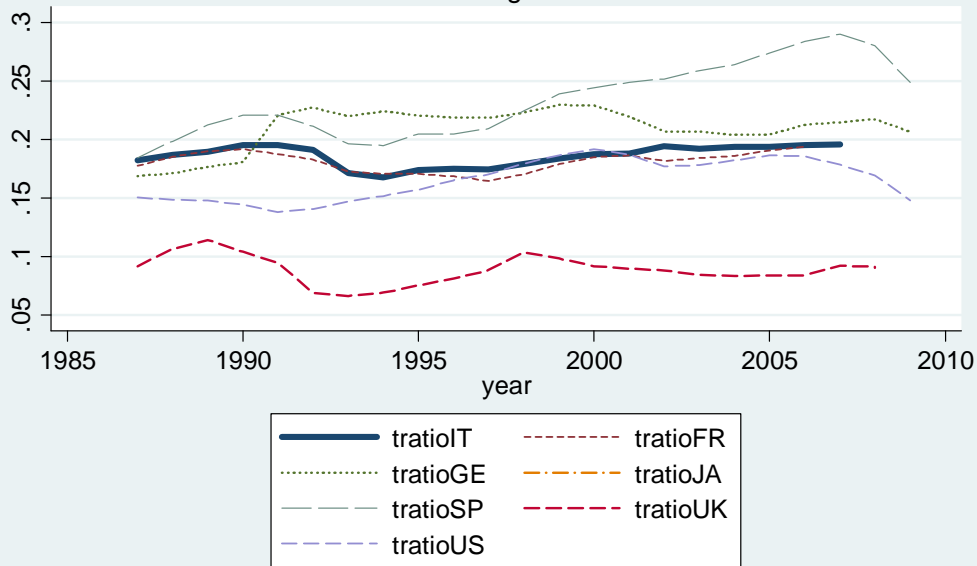
- Low and not growing R&D private corporate expenditure, as a percentage of GDP, in Italy
- Are external sources of innovation available to firms? In particular, do public research and Universities play a fundamental role for the Italian R&D corporate system?
- Which factors facilitate knowledge transfer from universities to companies?



FIRM'S CHARACTERISTICS: large size, willingness to invest in immaterial assets (technological transfer is complementary to intramural corporate research)

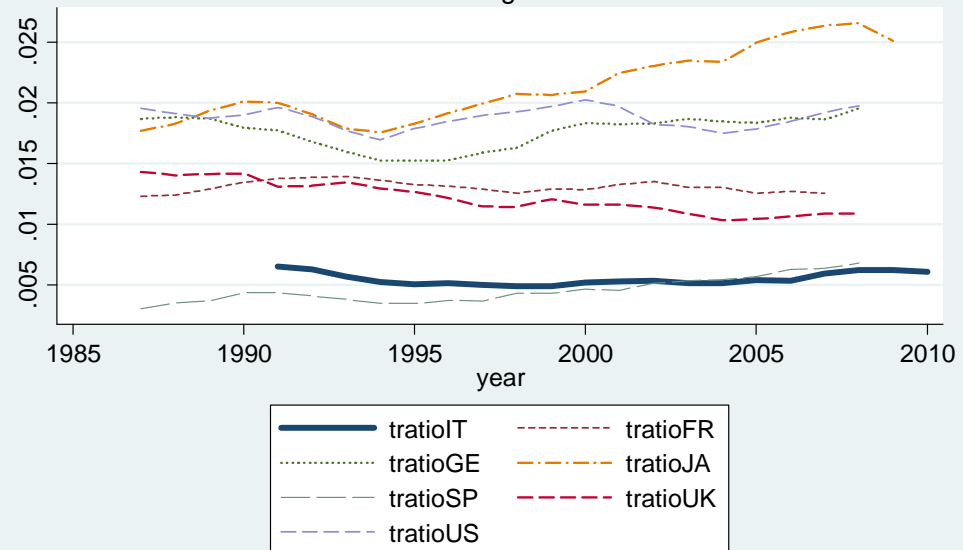
SCIENTIFIC RESEARCH SUPPLIERS' CHARACTERISTICS: geographic proximity of top-quality academic research centres to companies

Tangibles over GDP Manufacturing & Services



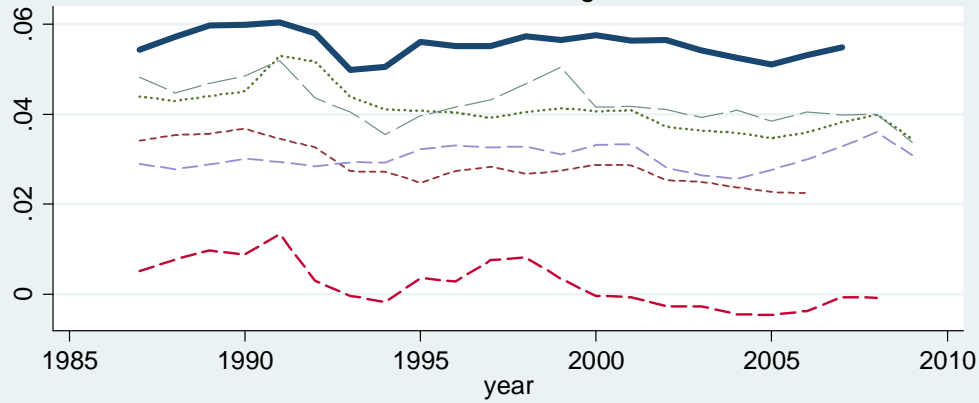
Source: OECD STAN Database (Gross Fixed Capital Formation) & OECD Annual National Accounts (GDP)

Intangibles over GDP Manufacturing & Services



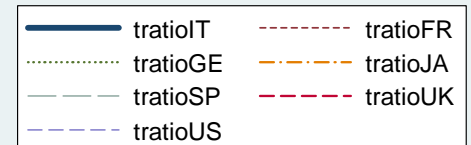
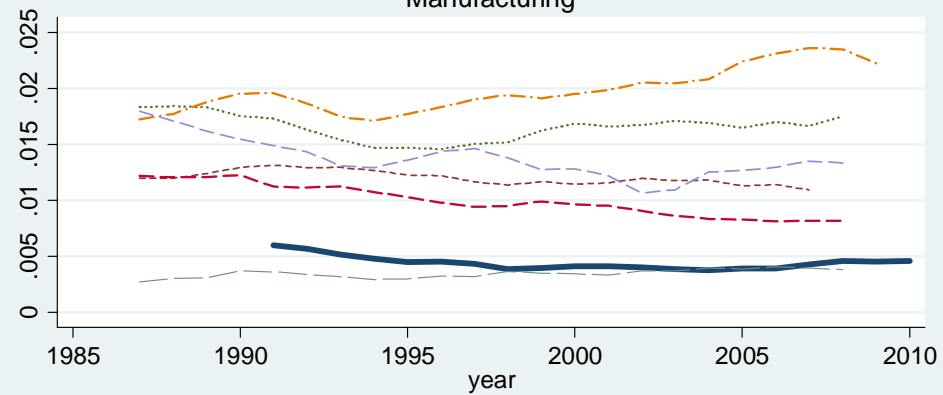
Source: OECD's ANBERD database (R&D Expenditures) & OECD Annual National Accounts (GDP)

Tangibles over GDP Manufacturing



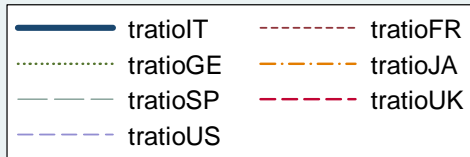
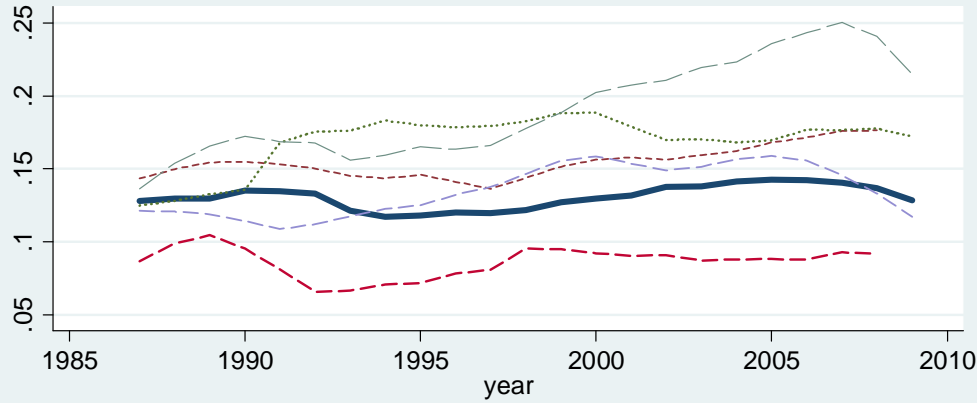
Source: OECD STAN Database (Gross Fixed Capital Formation) & OECD Annual National Accounts (GDP)

Intangibles over GDP Manufacturing



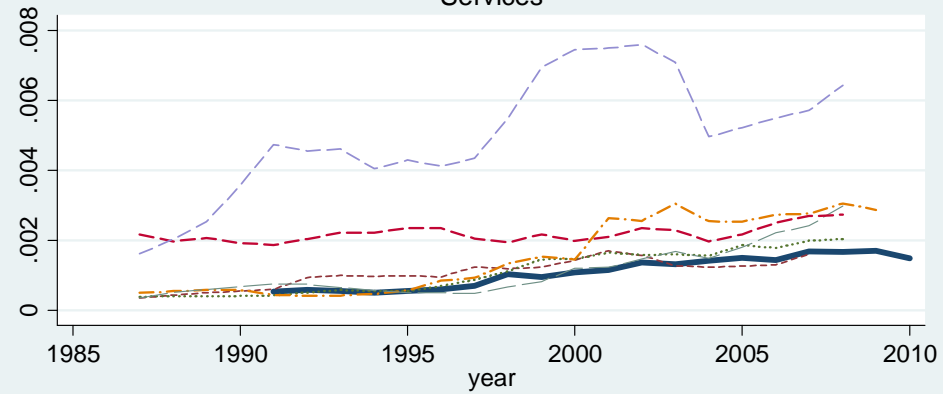
Source: OECD's ANBERD database (R&D Expenditures) & OECD Annual National Accounts (GDP)

Tangibles over GDP Services



Source: OECD STAN Database (Gross Fixed Capital Formation) & OECD Annual National Accounts (GDP)

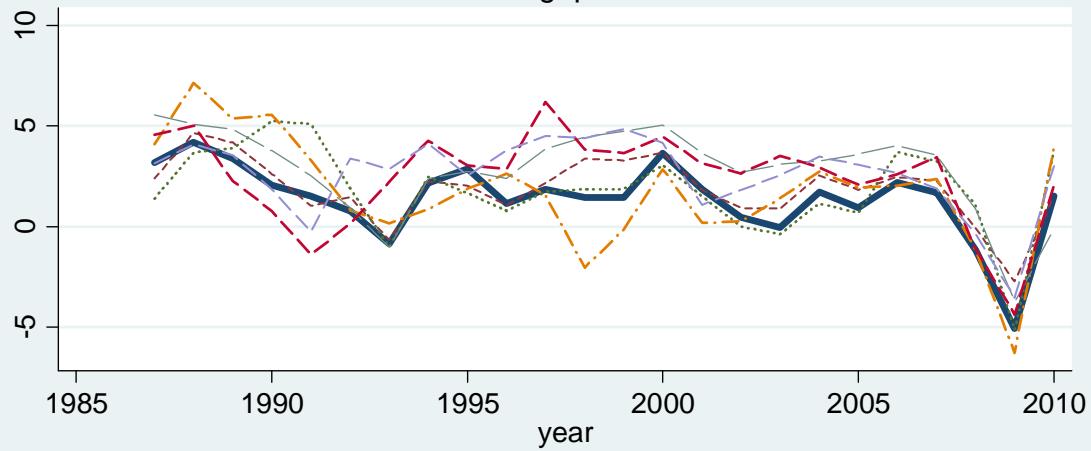
Intangibles over GDP Services



Source: OECD's ANBERD database (R&D Expenditures) & OECD Annual National Accounts (GDP)



Rates of growth gdp



Source: OECD Annual National Accounts (GDP)

Suggestions for the descriptive part

Standard deviation reported in the tables allow for concluding that certain firms' characteristics are (statistically) different from other firms' characteristics.

Readability would be improved by condensing some characteristics (South and Islands...)

Relationships with suppliers/clients trade associations should be better explained. How are defined individual/collective collaborations?

Is it possible that a company simultaneously has more than one source of innovation or type of collaborations with universities; this argument could be better explored.

Reasons for absence of collaborations “idea never considered” and “academic research unrelated to business requirements” could capture the same motivations; the percentage of “other” is high and it would be nice to better understand which motivations are inside it.

Empirical specification

A binary choice model is used to capture the determinants of the probability that a firm i had technology transfer collaborations with a university in 2005-07 ($y_i = 1$):

$$P(y_i = 1 \mid \mathbf{x}_i) = F(\mathbf{x}'_i \boldsymbol{\beta}),$$

where the probability associated to $y_i = 1$ depends on the vector ($1 \times K$) of explanatory variables \mathbf{x}'_i , with K standing for number of covariates; the function $F(\cdot)$ is a cumulative density function, able to guarantee the assumption of probability values only within the $[0, 1]$ interval; the vector ($K \times 1$) of parameter, $\boldsymbol{\beta}$, contains the effects (positive or negative and their related extension) exerted by every explanatory variable.

The authors select for the function $F(\cdot)$ the standardised normal distribution (probit model).

Suggestions for the empirical specification – part 1

- Why so many non responses: about 4000 firms in 2007 and 3102 observations in the estimates → 25% non-response rate
- How many observations (firms) have technology transfer collaboration? 22% of 3102 means about 692 companies.
- The choice of the functional forms is not easy (Amemiya, 1981), but the logistic distribution could be a robustness check.

The logit model is to be opted for if there are no prior reasons to maintain that all variables included in the model have a Gaussian like distribution.

Results between probit and logit can differ if the sample is not equally distributed between $y_i = 0$ and $y_i = 1$, and/or some relevant regressors are characterised by a high variability

A mathematical advantage of the logit model is that the summing up, on the whole of the sample observations, of the estimated probability equals the frequency of cases where the dependent variable assumes a unitary value. Compared to the probit model, the logit model tends to make the case $y_i = 0$ more probable when $\beta' x_i$ is small (and vice versa).

Suggestions for the empirical specification – part 2

- It could be nice to have descriptive statistics for explanatory variables. As an example, which is the geographical localization of the top departments? Apparently the dummy for geographical proximity is highly correlated with regional dummies
- Why geographical proximity defined as 10km (or the average distance)? Minimum distance may be preferable. It is defined between what headquarter? That has implications on the idea of endogeneity of the geographical proximity
- Many explanatory variables, possibly collinear, hide the relevance of “economic” motivations: for example, dummy for purchase of software and share of investment in software
- Which is the information content of the importance of universities as innovation source in explaining the probability of academic collaborations? Why do not include, instead, the use of tax subsidies and public funding? Or the percentage of internal funds in the corporate capital structure?

Suggestions for the empirical specification – part 3

- In order to facilitate the understanding and comparability of the various determinants, the estimated marginal effects (i.e. the variations of the probability to have an academic relationship to an infinitesimal variation of the continuous nature regressors, or to a passage from value 0 to value 1 of the dummy variables) should be reported
- Many explanatory variables are possibly endogenous: firm's dimension (workforce); incidence of software expenditure over investments. They are measured in 2006; maybe it is better to measure them in 2001 because....
- ... since it is possible that there are entry costs for starting a collaboration, may be important to add collaboration in 2002-04 period as explanatory variable.

The nature of adjustment costs (Doms-Dunne, 1998, RED; Barnett-Sakellaris, 1998, JME; Cooper-Haltiwanger-Power, 1999, AER)

Non-convex (irreversibility) and fixed adjustment costs create lumpy investment: firm's investment alternates between regimes of zero and positive values (Barnett-Sakellaris, 1998, JME).

Of the total SIM observations (more than 26,300) have zero investment rate:

- 5% machinery
- 50% buildings
- 25% software
- 50% R&D

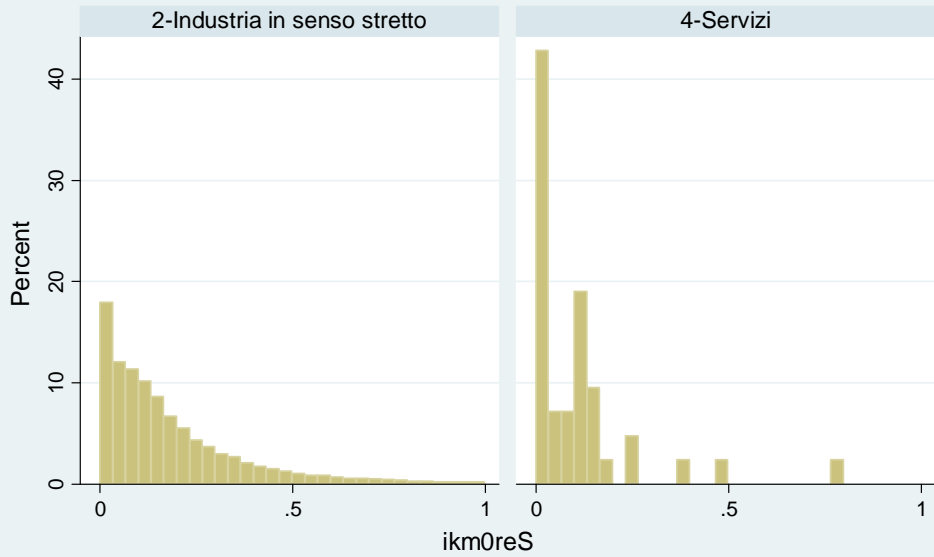
Histograms of the investment-capital ratios show distributions highly skewed to the right, with large percentages of observations having investment rates at or near zero: many company-year observations involve little or no investment.

The long right tails illustrate the fact that a relatively small fraction of companies experience a large investment episode in any given year.

Zeros and sporadicity of investments are typical of buildings and R&D.

Firms' investment-capital ratios - machinery

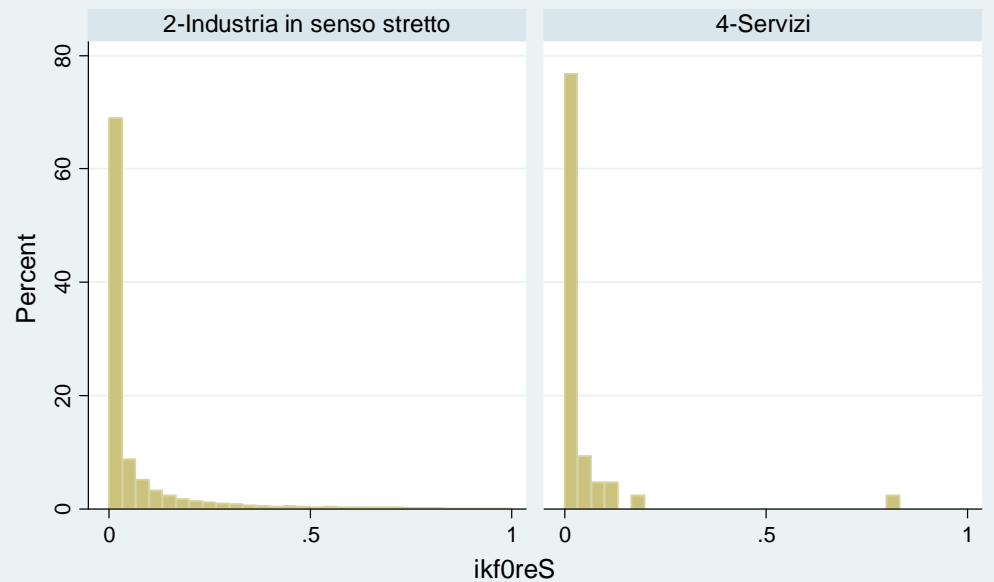
The vertical axis shows the relative frequency of the observations in percent



Graphs by settoria

Firms' investment-capital ratios - buildings

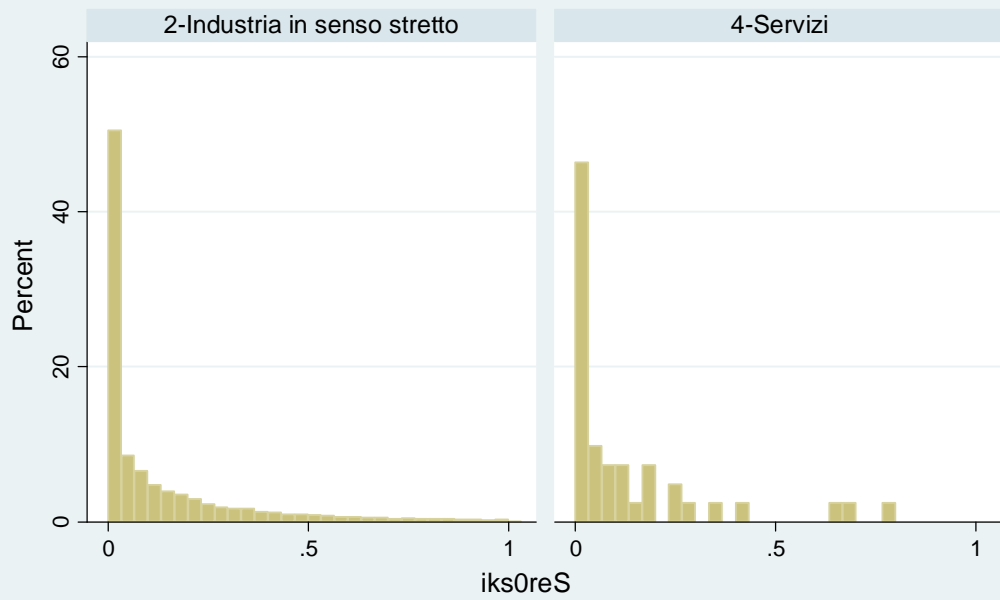
The vertical axis shows the relative frequency of the observations in percent



Graphs by settoria

Firms' investment-capital ratios - software

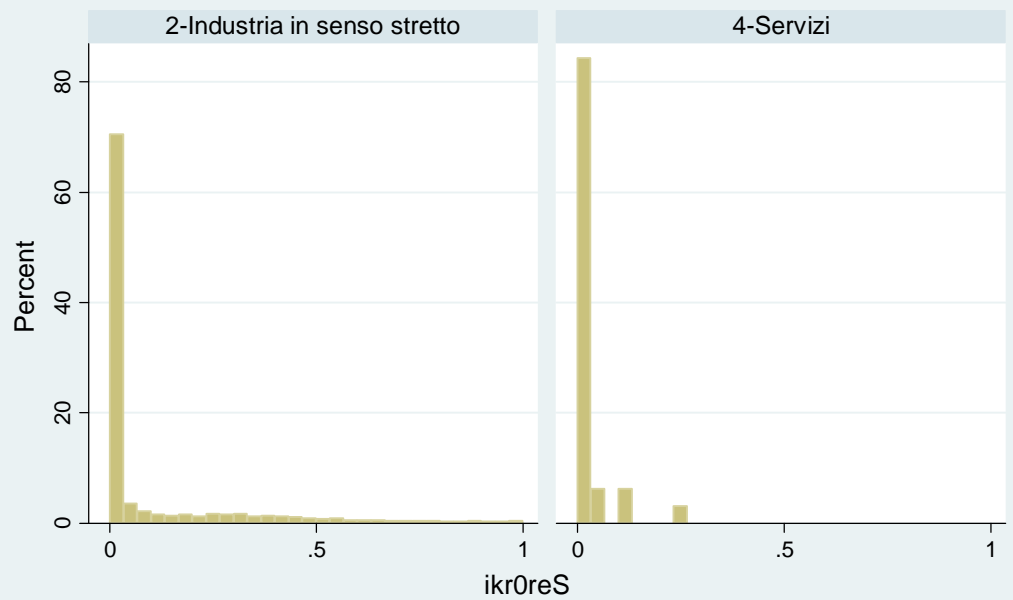
The vertical axis shows the relative frequency of the observations in percent



Graphs by settoria

Firms' investment-capital ratios - R&D

The vertical axis shows the relative frequency of the observations in percent



Graphs by settoria

- The argument is of great interest
- The information provided by the fifteenth round of the Bank of Italy Business Outlook Survey on Industrial and Service Firms is very precious
- The effort in presenting and analysing such a mole of “innovative” information is really inestimable
- Some suggestions may help in reinforcing the empirical evidence

Descriptive tables 1-2

➤ Innovation sources 2005-07:

- 53% purchase of software/innovative machinery
- 25% research centre in Italy
- 10% recruiting postgraduate
- 7% purchase of patents
- 4% research centre abroad

➤ Importance of innovation sources 2005-07:

- 62% inside firms
- 112% sum of relationships with customers, suppliers, trade shows
- 26% private consultants
- 10% universities and public research centres

More in industry than services, more in large than small firms, more in North-West (Center and South for services); software homogeneously distributed.

Descriptive tables 3-4

- **Table 3 is the core table: relationships with universities 2005-07:**
 - 22% yes (25% Industry; 19% Services); mainly (86%) on an individual basis.
- **Which type:**
 - 63% Ind. and 80% Ser. student internships
 - 44% Ind. and 40% Ser. purchase of consulting services
 - 31% Ind. and 15% Ser. financing of research
- **Why no collaborations?**
 - 54% idea never considered
 - 33% academic research unrelated to business requirements
 - 8% other motivations
 - 3% too much bureaucracy/cost too high
 - 0.6% unsatisfactory quality of research