Proximity and Knowledge flows.

The case of university-industry research collaborations in the UK

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Background of the study (I)

- Universities as key actors in the generation of knowledge and innovation and at the centre of academic and policy attention. Knowledge flows and spillovers believed to require intense interactions, favouring local and regional levels over others (Universities as spillovers' creators and components of innovation systems)
- Large empirical literature finding localised knowledge spillovers (LKS) from university research to industrial innovation (e.g. Jaffe, 1989; Acs et al., 1994; Feldman, 1994; Mansfield & Lee, 1996; Audretsch & Feldman, 1996, 1999; Anselin et al., 1997, 2000; Henderson et al., 1998; Varga, 1998; Fritsch & Schwirten, 1999; Autant-Bernard, 2001; Arundel & Geuna, 2004; Abramovsky et al., 2007; Fritsch & Slavtchev, 2007; Laursen et al., 2008)

Background of the study (II)

- However: literature on LKS generally vague about the mechanisms channelling knowledge (e.g. Breschi & Lissoni, 2001a,b, 2003, 2004; Breschi et al. 2005)

  "[...] more research efforts should be placed on finding out how knowledge is transmitted, among whom, at what distance, and on the basis of which codebooks" (Breschi &Lissoni, 2001a, 270)

- And: direct role of geographical proximity on knowledge flows put in question (e.g. Fisher, 2001; Boschma, 2005; Torre & Rallet, 2005)

  "Geographical proximity can be considered a *necessary, but not sufficient* precondition for the existence of a territorially based system of innovation [...] " (Fisher, 2001, 210)

  "[...] geographical proximity per se is neither a necessary nor a sufficient condition for learning to take place" (Boschma, 2005, 62)

Background of the study (III)

In short, the study of university-industry (U-I) linkages has shown various limitations, among which:

1. Scarce attention to the specific **“transfer” mechanism** of knowledge flows between U and I: tendency to concentrate on **spatial co-location** of U and I, more than on actual interactions
2. Focus on **geographical proximity** (often based on somewhat ‘arbitrary’ and partial measures): **other dimensions of proximity** (i.e. cognitive, organisational, social, institutional, relational), and their interaction with space, mostly neglected

Our previous work (D’Este & Iammarino, 2010) addressed particularly point 1, investigating research quality & geographical proximity in U-I research collaborations in the UK

Research questions

- What different dimensions of proximity contribute to the establishment of U-I research collaboration (formal, intentional, bi-directional knowledge flows)?
- Which factors favour spatially bounded knowledge flows and (potential) spillovers, as opposed to geographically unbounded, or distant, knowledge flows and (potential) spillovers?

In short:

What are the factors driving the *formation* and the *spatial distribution* of U-I knowledge flows (in the form of research collaborations)?

Proximity in U-I collaborations (I)

Based on the literature of proximity (e.g. Kirat and Lung, 1999; Nooteboom, 1999; Torre and Gilly, 2000; Boschma, 2005; Bouba Olga and Grossetti, 2005; Torre and Rallet, 2005; Moodysson and Jonsson, 2007; Ponds et al., 2007; Vicente et al. 2007)

Geographical proximity: limited spatial or physical distance among the actors (U-I, U-U, I-I)

Organisational proximity: capacity to coordinate and integrate new and old complementary knowledge *between different* organisations (U-I, I-I)

Proximity in U-I collaborations (II)

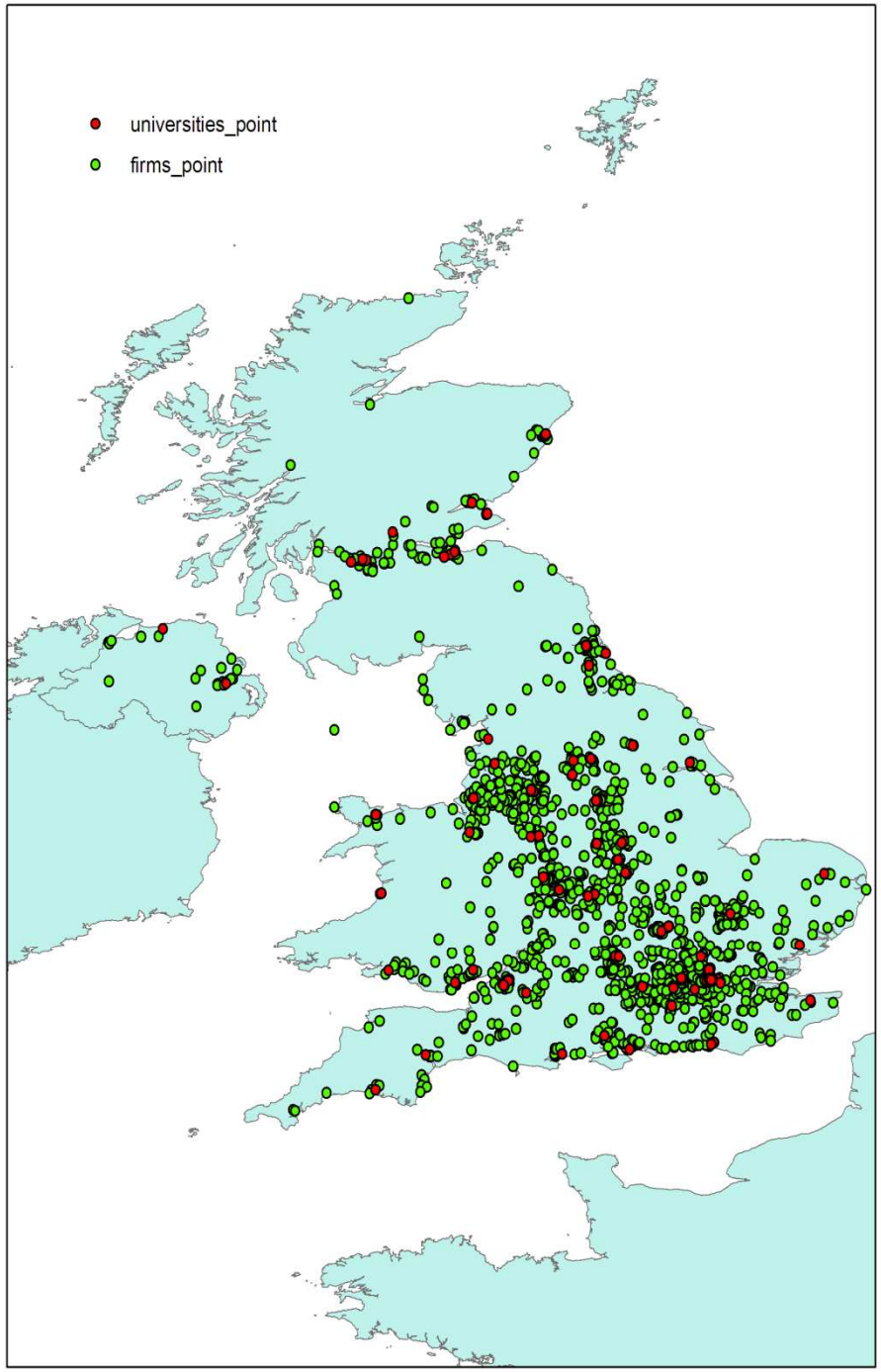
Social proximity: socially embedded relations between actors (from U and I) at the micro-level, that involve trust based on friendship, commitment and experience

Cognitive proximity: shared knowledge bases, similar and complementary bodies of knowledge (I-I)
Technological complementarity (which is NOT necessarily Cognitive proximity): degree of relatedness between industrial sectors (I-I) that rely on the same scientific disciplines (U)

Institutional proximity: shared formal and informal institutions (laws, rules, norms, incentives, values, habits): U-I traditionally rather low; I-I generally high

Dataset (I)

- Collaborative research grants awarded by the UK Engineering and Physical Sciences Research Council (EPSRC) over 1999–2003:
- 2210 research grants involving 4525 partnerships; 2031 business units and 1566 PIs in 318 university departments (covering 87 UK universities)



Dataset (II)

Main variables included:

- Scientific field of the academic partner
- Industry of the business units (manufacturing & services)
- Geographical distances (crow-flies, in km) for each possible pair U-I, and between all I-I units
- Size of the EPSRC grant
- Research quality of the university department (scores of the UK Research Assessment Exercise – RAE 2001)
- Size of the university department (number of research active staff)
- Total volume of income for research received by the department (distinguished by private- and public-funding)

Methodology

- Building indicators of different proximity (and related) dimensions
- Exploring the likelihood of U-I collaborations' formation by adopting a case-control approach. That is, we pair each focal relationship (i.e. each instance of actual research collaboration) with a critical number (e.g. 10 cases) of U-I pairs that could have happened but did not
- Rare Events Logit model to estimate the likelihood of the formation of U-I research collaborations (King and Zeng, 1999a,b)

Measures of proximity

- **Geographical proximity:** distance in km between ALL partners: U-I, I-I and U-U
- **Organisational/Social proximity:** collaborative experience gained with different partners or through repeated interaction with the same partner could produce organizational skills and trust-based social bonds that make geographically distant U-I collaboration more likely. No. of U-I collaborations by firm; Dummy multiple-firms collaboration
- **Technological relatedness:** match between (up to 5-digit) industrial sectors and scientific fields. Index of relatedness (following Cohen et al., 2002; Nesta and Saviotti, 2005; Sorenson et al., 2006). E.g.:

$$R_{ij} = \frac{J_{ij} - \mu_{ij}}{\sigma_{ij}}$$

Other related measures

Firm clustering: I-I knowledge flows may be associated with specialized spatial concentrations of firms. Experience gained by firms within clusters may reduce the importance of geographical proximity for U-I collaborations

$$di\_f = \left(\sum_{j=1}^{N_i} \frac{1}{d_{ij}} * r_{ij} \right) * w_i$$

I distance from Universities: all universities enter into this index

$$di\_u = \sum_{j=1}^{T_i} \frac{1}{d_{ij}}$$

U scientific reputation: Scientific reputation in U-I collaborations differs by discipline and by industry, and interact with geographical proximity and technological complementarity. RAE score.

Summary statistics

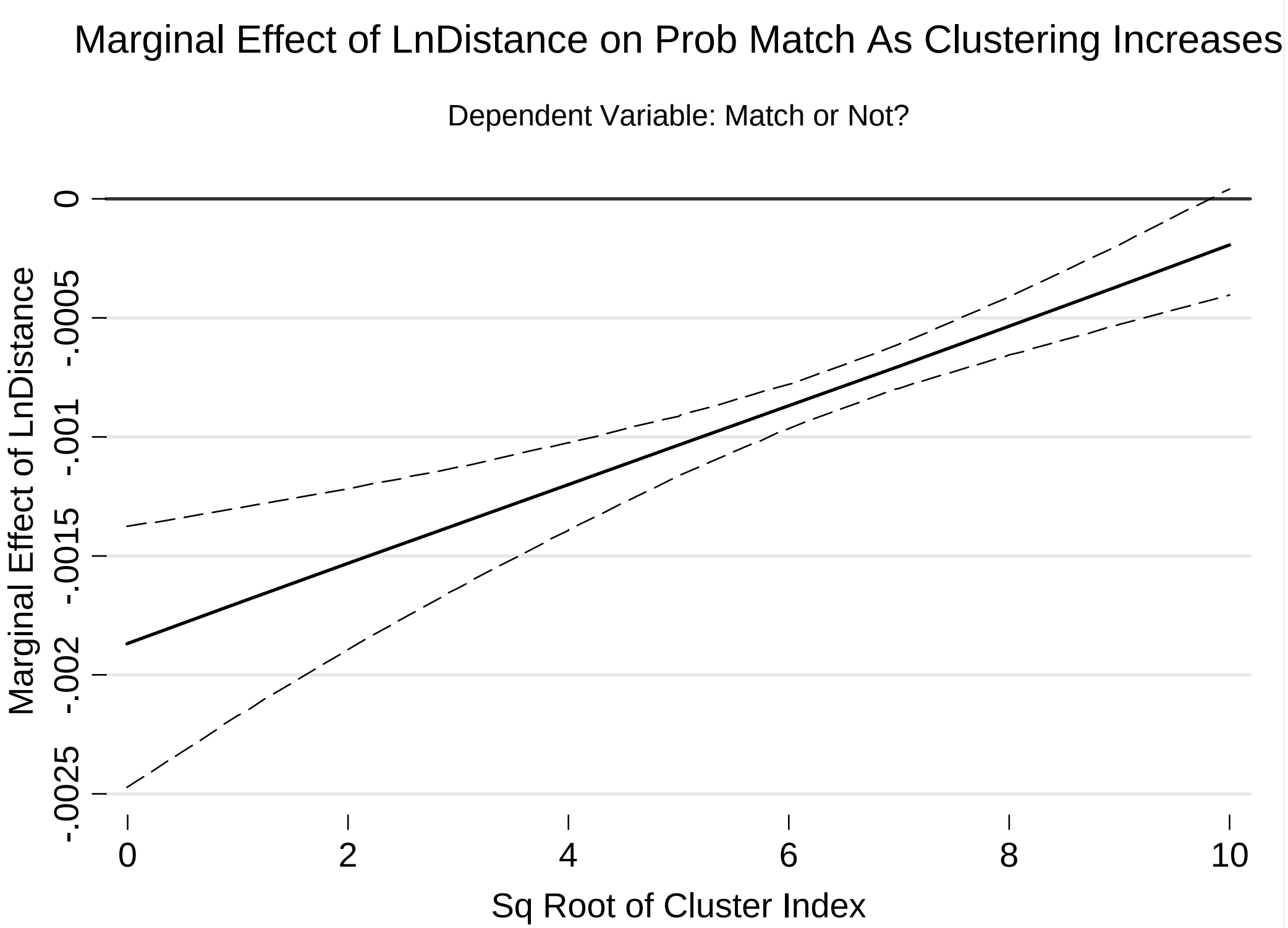
```
. sum lndistance rootcluster dis_cluster rootuni

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
  lndistance |     46761    5.093522    .9718742  -4.558099        9.6
 rootcluster |     46761     4.70963    1.212465   .3484343   9.665967
 dis_cluster |     46761    23.77211    7.390132  -19.79109   61.98301
     rootuni |     46761    1.000437    .3823137   .0758784   3.332118
```

1st Result: geographical proximity and firm clustering.....

Corrected logit estimates N = 46761

occur	Coef.	Robust Std. Err.	z	P>|z|
lndistance	-.9112734	.0603081	-15.11	0.000
rootcluster	-.4509724	.0591956	-7.62	0.000
dis_cluster	.0817544	.011507	7.10	0.000
rootuni	-.1319891	.0663669	-1.99	0.047
_cons	-.8741165	.295768	-2.96	0.003


Marginal Effect of LnDistance on Prob Match As Clustering Increases
Dependent Variable: Match or Not?
Marginal Effect of LnDistance
0
-.0005
-.001
-.0015
-.002
-.0025
0
2
4
6
8
10
Sq Root of Cluster Index

....and multiple steps in progress!

Thank you!