

Knowledge Diffusion

implications of geography on the diffusion of scientific knowledge, explained by article citations:
the Dutch biotechnology and microbiology case

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Knowledge diffusion and geography

*Why are industries concentrated in cities? (...)
Knowledge spillovers among the firms in an industry
(Marshall, 1920)*

*Intellectual breakthroughs must cross hallways and
streets more easily
than oceans and continents (Grossman & Helpman,
1991)*

*Knowledge flows occur more often between regions
which belong to the same country and which are in
geographical proximity (Maurseth & Verspagen, 2002)*

GEOGRAPHY MATTERS



Measuring knowledge diffusion

Scientific vs. industrial knowledge

| | <i>scientific</i> | <i>industrial</i> |
|------------------------|-------------------|-------------------|
| - Codification: | publication | patent |
| - Tacitness: | low | high |
| - Specificity: | low | high |
| - Incentive structure: | diffusion | appropriation |

Diffusion \approx represented by citations

- Geographic information
- Institutional information
- Time



Patent citations

Jaffe, A.B., Trajtenberg, M. and R. Henderson (1993) Geographic localization of knowledge spillovers as evidenced by patent citations, *Quarterly Journal of Economics*, 108, pp. 577-598.



"Metaphorically speaking, citations are frozen footprints on the landscape of scholarly achievement; footprints which bear witness to the passage of ideas" (Cronin, 1984)

In which way is in the Netherlands produced scientific knowledge diffused and which mechanisms underlie this diffusion?

- Direction?
- Speed?
- Quantity?



Hypotheses

Direction

H1: Knowledge is diffused by a process of hierarchical and contagious diffusion

Speed

H2: The speed of knowledge diffusion is characterized by a S-curve

Quantity

H3a: Academic knowledge producers generate more diffusion than other institutes

H3b: Research collaboration enhances the amount of knowledge diffusion



Data

Web of Science (Science Citation Index)

- Biotechnology and applied microbiology
- 1988-2002
- 35 leading journals

Database diffusion

- 66 publications with at least one Dutch address
- 1312 citations
- 2367 citing institutions



source' publication

1988
at least one NL-address
acad/ non-acad
top/ non-top
author(s)
at least one citation



'goal' publication 1(citation

- national/ EU/ internat.
- top/ non-top
- year (1988-2002)

'goal' publication 2(citation

- national/ EU/ internat.
- top/ non-top
- year (1988-2002)

'goal' publication n(citatio

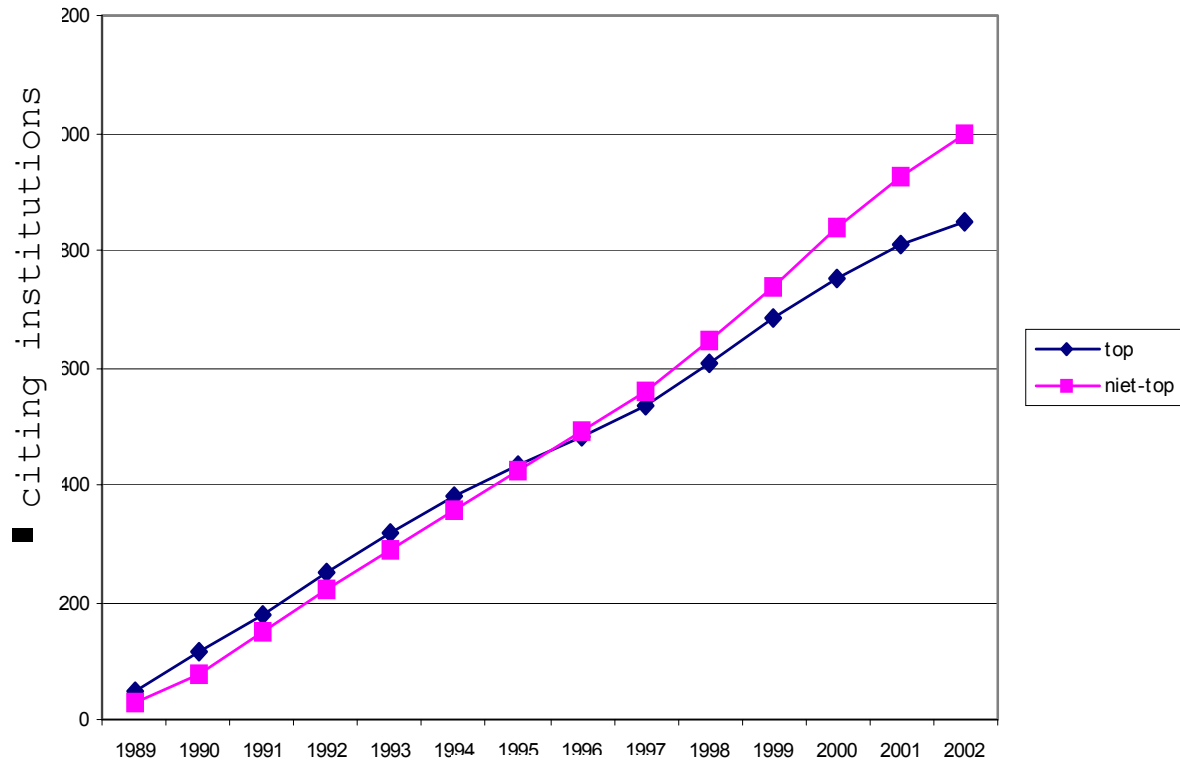
- national/ EU/ internat.
- top/ non-top
- year (1988-2002)



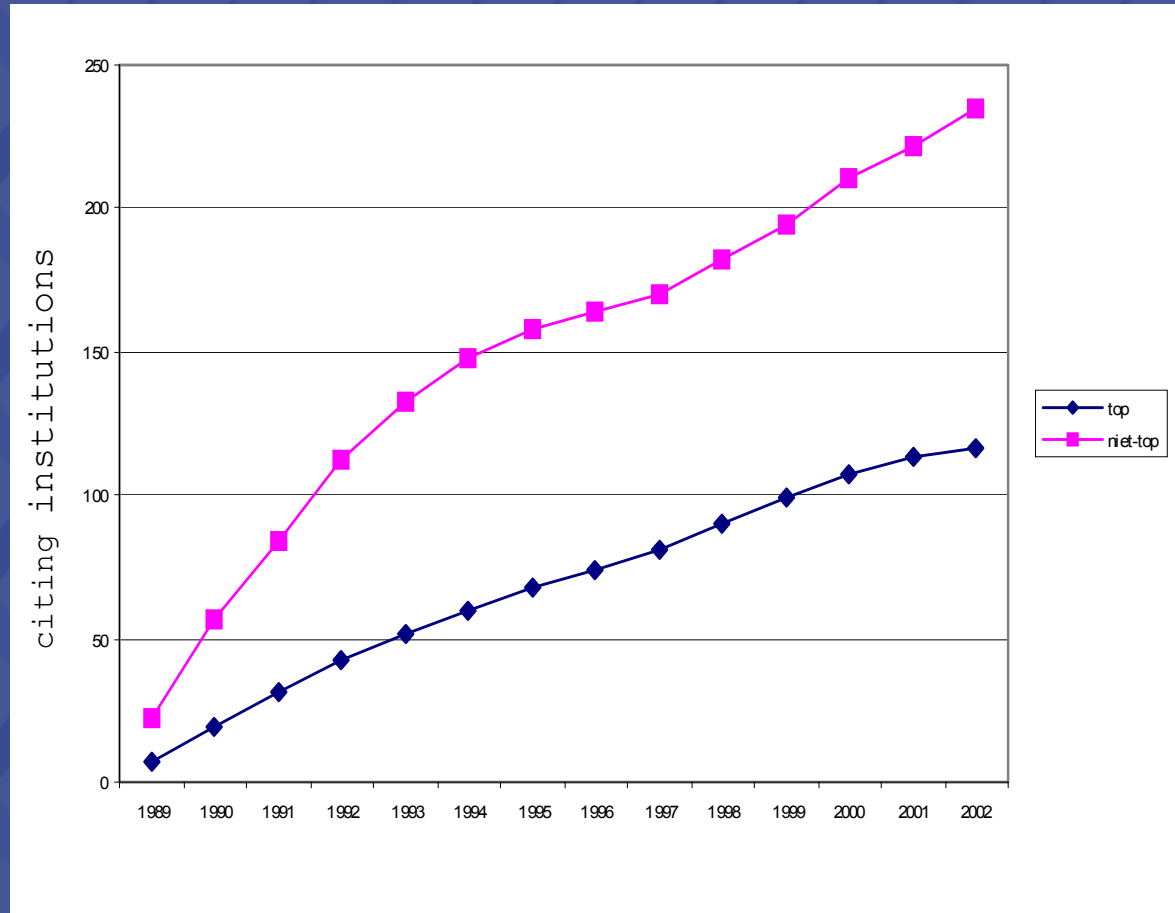
Findings

Direction

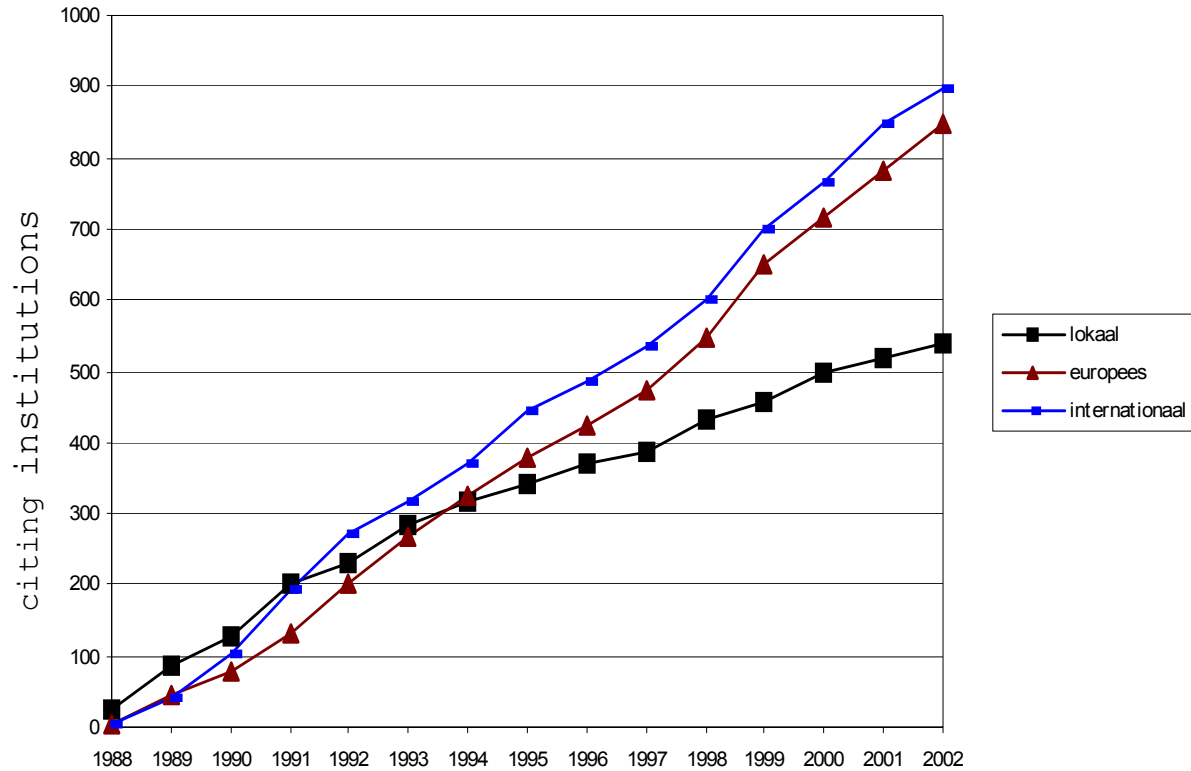
Diffusion of 'top' knowledge



Diffusion of 'non top' knowledge

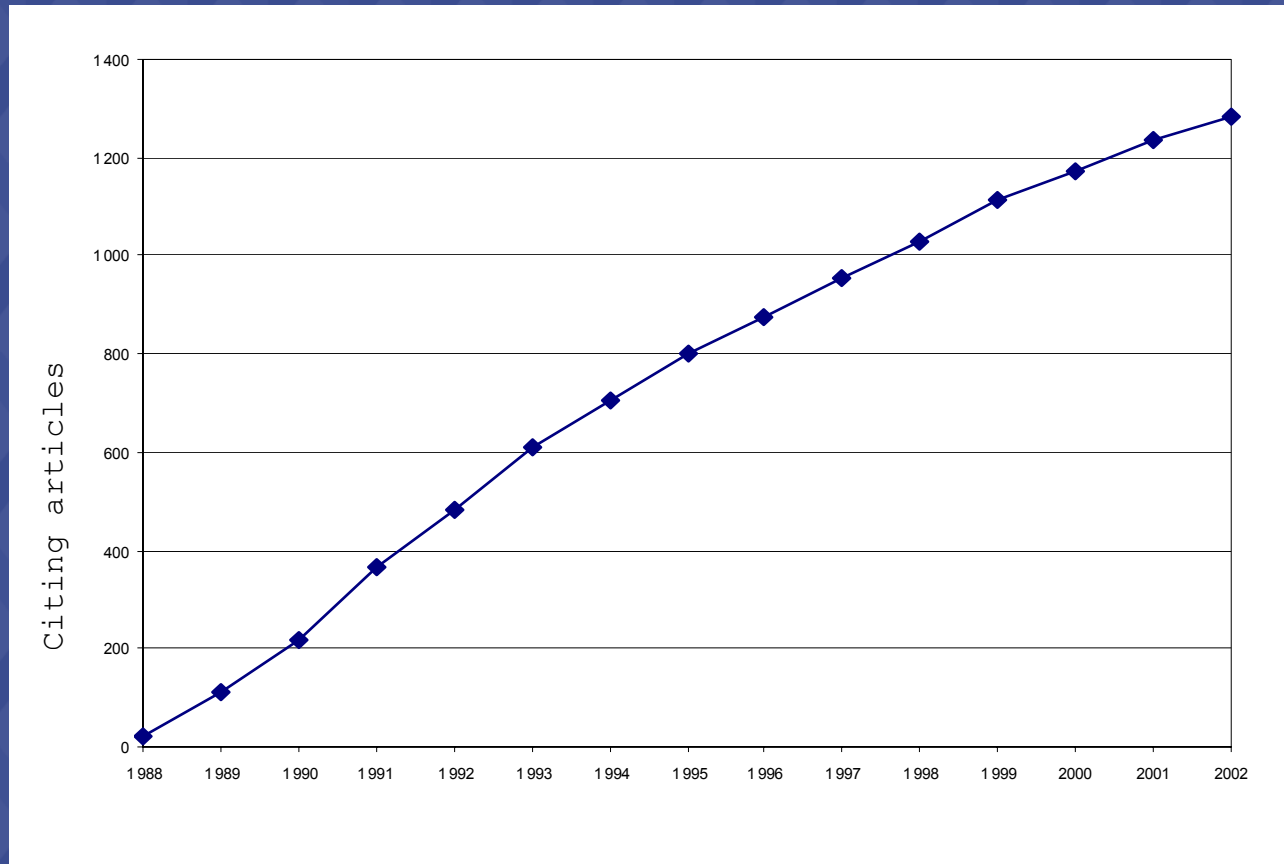


Spatial diffusion of knowledge



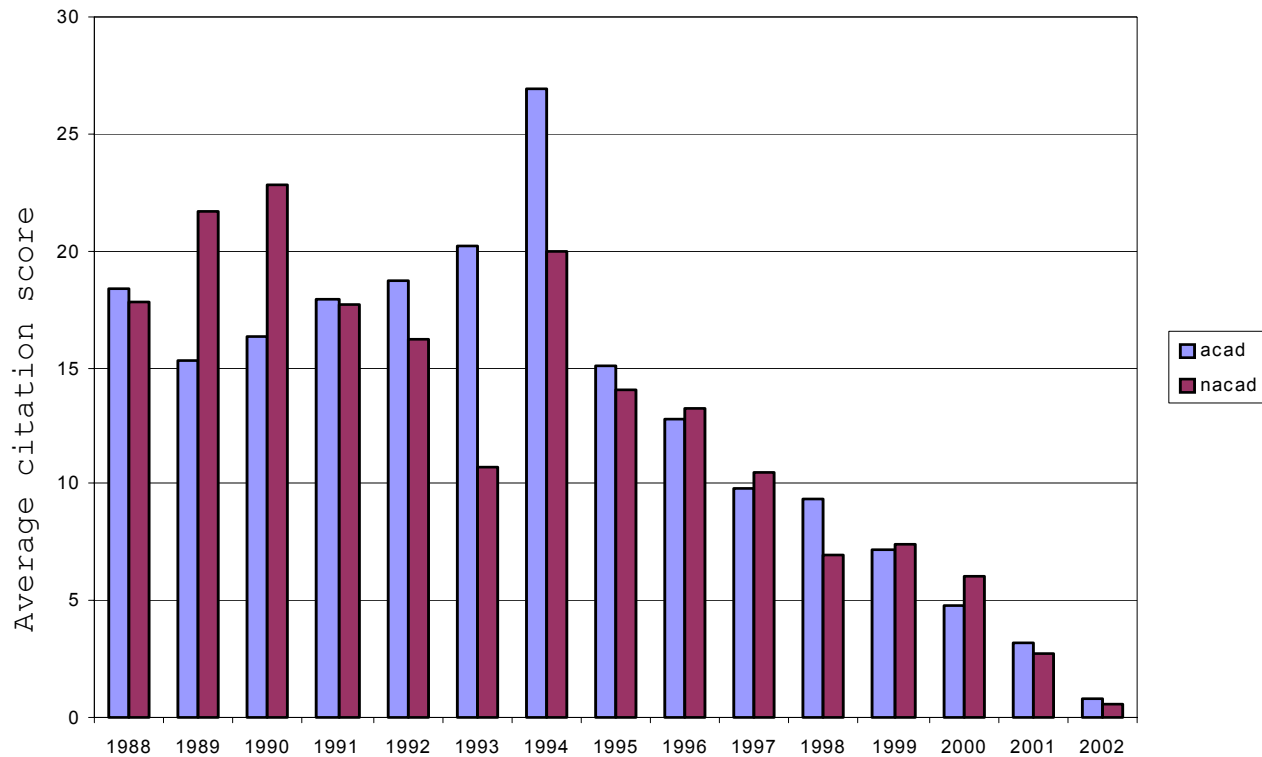
Speed

Cumulative number of citations

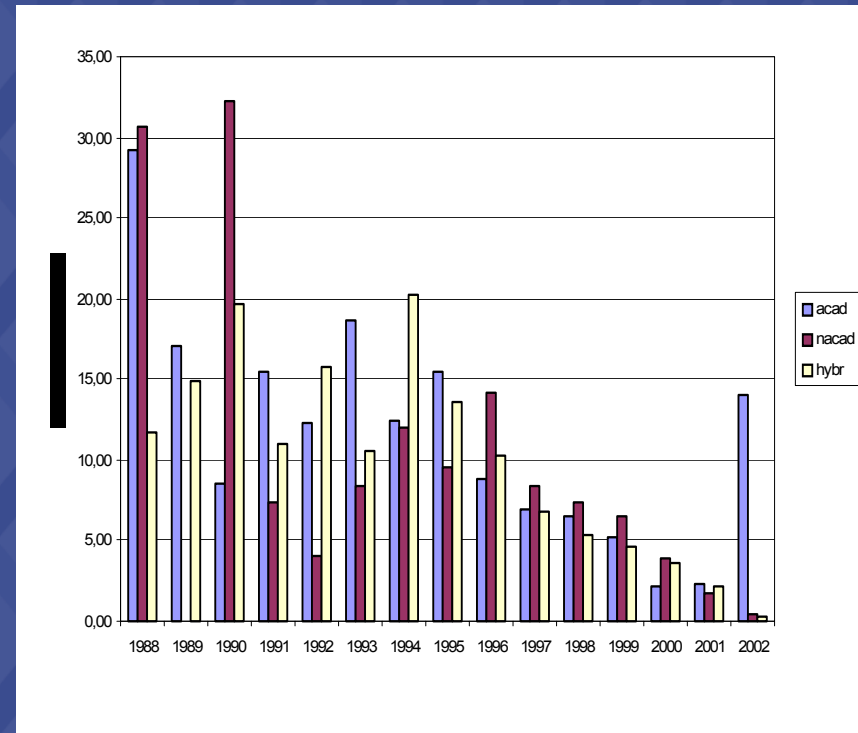
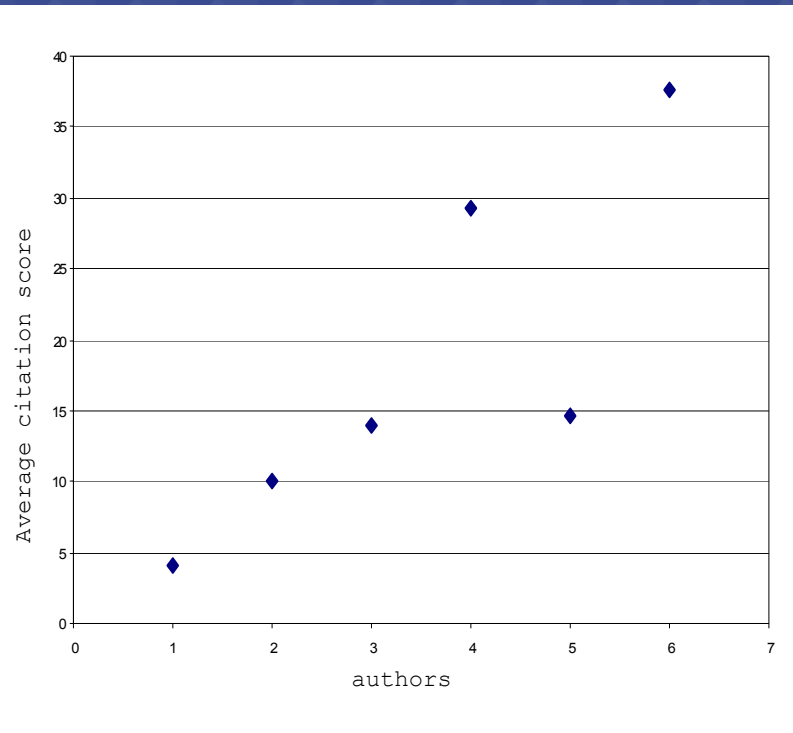


Quantity

Citation output by institution type



Citation output and collaboration



Direction

- Hierarchy effect: absorptive capacity
- Contagious effect: geographical proximity

Speed

- Maximum level of diffusion (citation intensity):
after 5 years

Quantity

- Positive relation between collaboration (co-authorship) and citation output
- Independent on type of institution



Performance of EU scientific knowledge

Data:

- 19769 publications (only EU)
- 181297 generated citations
- 1988-2002

Independent variable:

- Impact (citation output)

Dependent variable:

- Collaboration (#addresses & #authors)
- Hierarchy (top/ non top)
- Status (acad/ non acad)
- Age
- Country fixed effect (dummy variable)



| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|------------|-----------------------------|------------|---------------------------|---------|-------|
| | B | Std. Error | Beta | | |
| (Constant) | .083 | .012 | | 7.109 | .000* |
| AUTHOR | .052 | .002 | .163 | 26.460 | .000* |
| ADDRESS | .011 | .002 | .031 | 5.219 | .000* |
| TOP | .056 | .006 | .050 | 8.574 | .000* |
| STATUS | .068 | .007 | .055 | 9.681 | .000* |
| AGE | .053 | .001 | .439 | 78.450 | .000* |
| AUS | -.033 | .019 | -.010 | -1.763 | .078 |
| BEL | -.084 | .017 | -.028 | -4.923 | .000* |
| DEN | .061 | .018 | .019 | 3.376 | .001* |
| FIN | .011 | .018 | .003 | .611 | .541 |
| FRA | -.171 | .009 | -.125 | -19.040 | .000* |
| GER | .029 | .009 | .022 | 3.252 | .001* |
| GRE | -.092 | .024 | -.021 | -3.849 | .000* |
| IRE | -.015 | .026 | -.003 | -.586 | .558 |
| ITA | -.124 | .012 | -.064 | -10.460 | .000* |
| LUX | -.601 | .314 | -.010 | -1.915 | .055 |
| NETH | .041 | .012 | .022 | 3.494 | .000* |
| SPA | -.083 | .011 | -.049 | -7.732 | .000* |
| SWE | .067 | .014 | .029 | 4.839 | .000* |
| POR | -.078 | .017 | -.026 | -4.551 | .000* |

* Significant at the 5% level

