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Patterns of technological diffusion: Evidence from patent data

Workshop on Key Enabling and Emerging Technologies for Competitiveness
- KeyTEC project -

Brussels, 8th June 2016

WHERE,WHO

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Unit
KfG - Knowledge for Growth

NEW - Unit
Territorial Development

Work Package: IRI-TEC
Industrial Research, Innovation and Technology Analysis

Project: KeyTEC
Key Enabling and Emerging Technologies for Competitiveness

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WHY

- Shed new light on the technological development process
- Understand how technical solutions emerge and spread across technologies and strategic industries

- Detecting the rise of new technological paradigms
- Designing effective Industrial and Innovation policies and anticipate future knowledge needs

WHY

Schumpeter, 1939 -> Business cycles related to the occurrence of innovations. These appear in clusters and shape technological development and economy.

Weitzman, 1996 -> Innovation as an endogenous combinatoric process. The capacity of exploring and realizing new combinations constrain the knowledge generation process (and growth).

The probability for a technology to emerge could be related to its diffusion in the technological development process

Recent contributions recognize the importance of looking at the co-occurences of technologies (e.g. Dernis *et al.*, 2015; Verhoeven *et al.*, 2016)

HOW

- We use patent applications at USPTO over the 1972-2012 period.

- We analyse the combinations of technological fields.

HOW

Interconnection of technologies are built from the co-occurrences of technical fields within patent documents.

Fields of technology	Patent A	Patent B	Patent C
→	H01G	**B29G**	**B29G**
	B29G	B32H	B32H
		C01A	

B29G is the most interconnected technology of the example

HOW

The degree of B29G is $d(n_i) = \sum_j x_{ij} = 3$

For each year we can compute the average degree of the "technical knowledge network" as: $\bar{d} = \frac{\sum_{i=1}^{g} d(n_i)}{g}$

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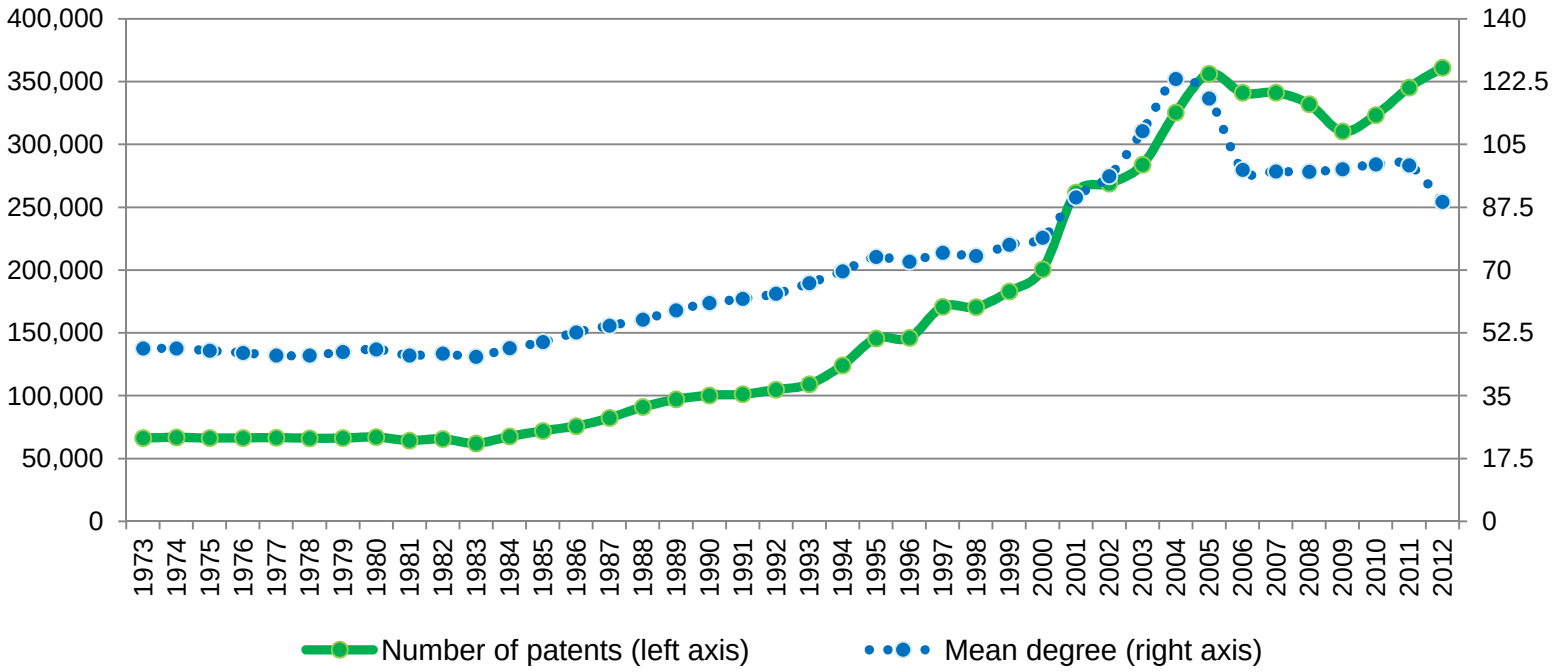
Patent filings and average degree at the USPTO (1972-2012)



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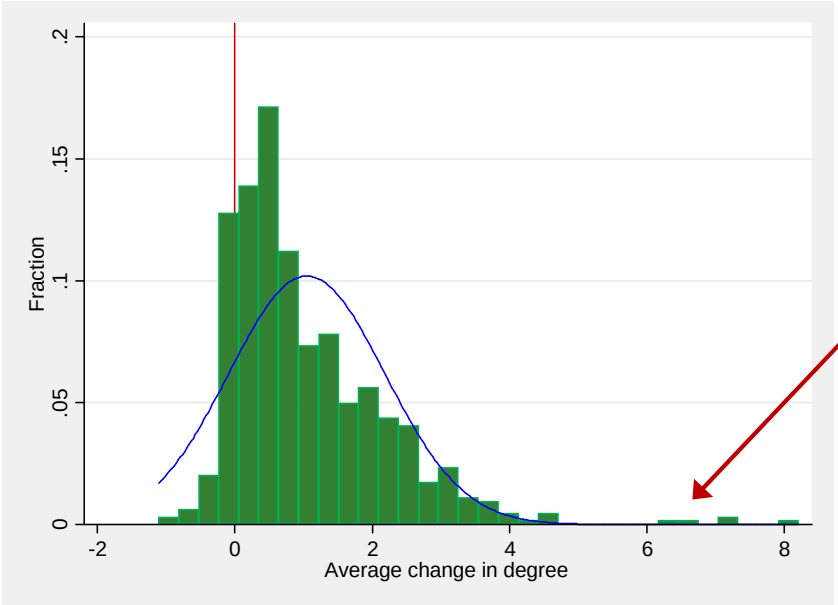
The majority of IPC codes have increased in degree over the period considered (avg. 1.084, median 0.718)

Increased complexity of technologies during the period

Average degree changes of IPC codes (1972-2012)



Few technologies experiencing a very high diffusion with respect to the others

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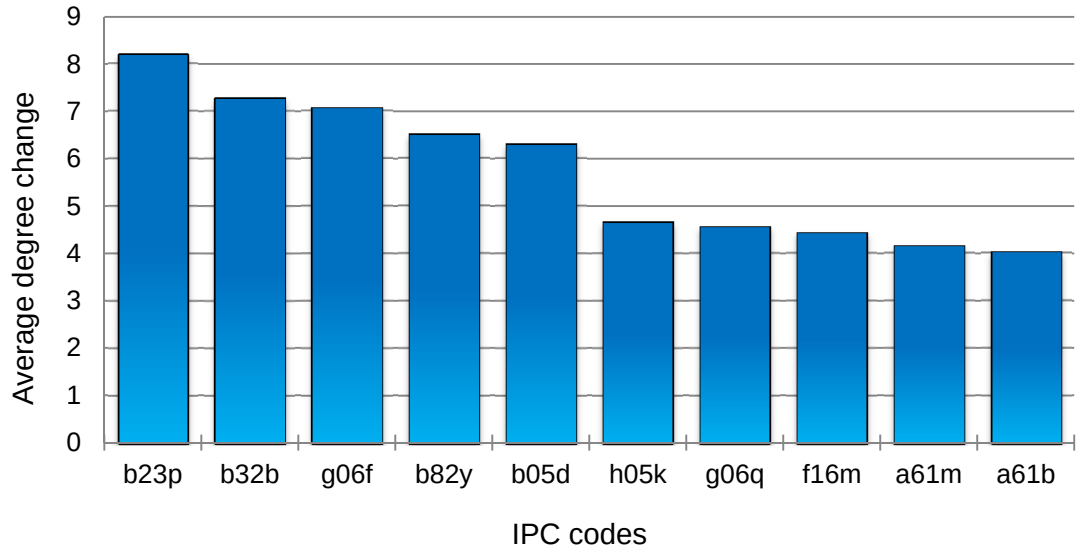
Top 10 IPC codes by mean degree change (1972-2012)



-> 5 among the 10 technologies with the highest average increase in degree are related to machinery and material development and testing
(b23p, b32b, b82y-nanotechnology, b05d, f16m)

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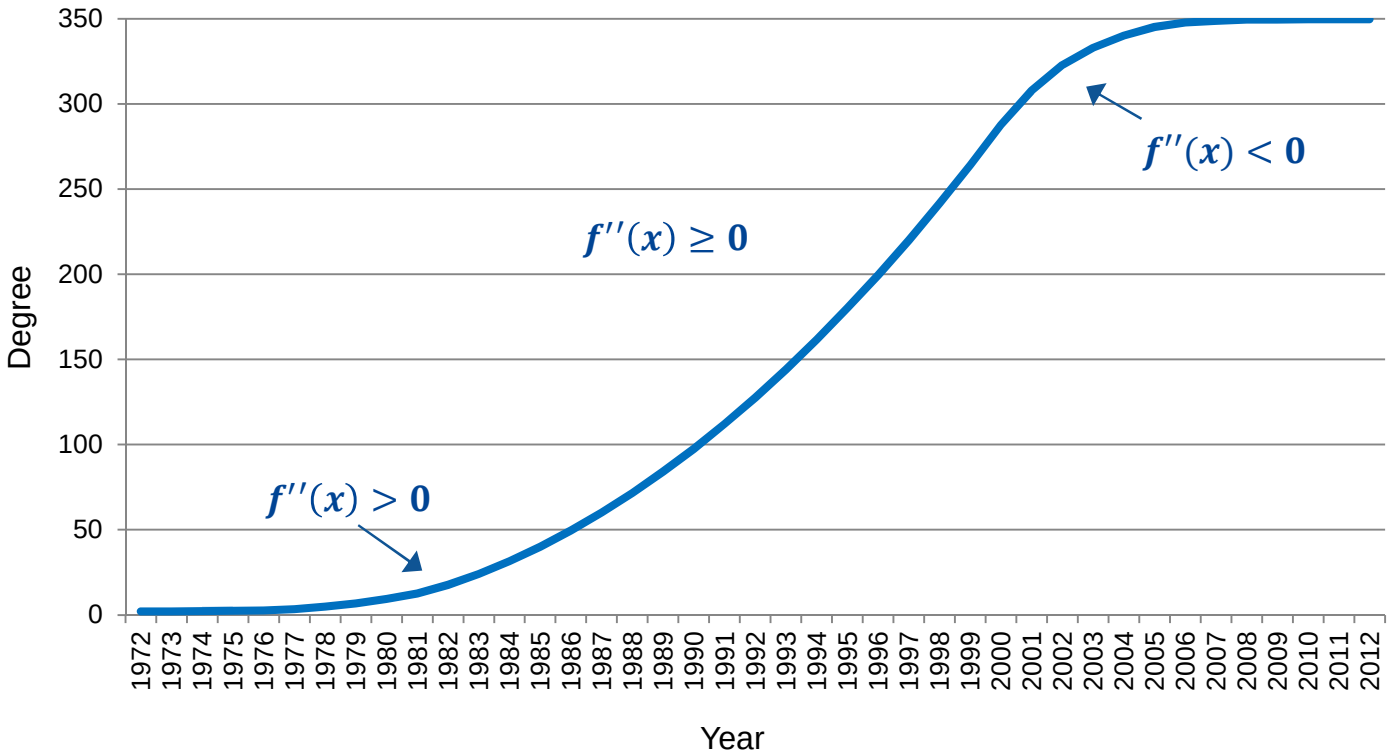
Looking for the 'maturity' of technologies

$$L(x) = \frac{max}{1 + a * e^{-b(x-x_0)}}$$

$$G(t) = De^{-b*exp^{-s_2 t}}$$

$f'(x) \geq 0$



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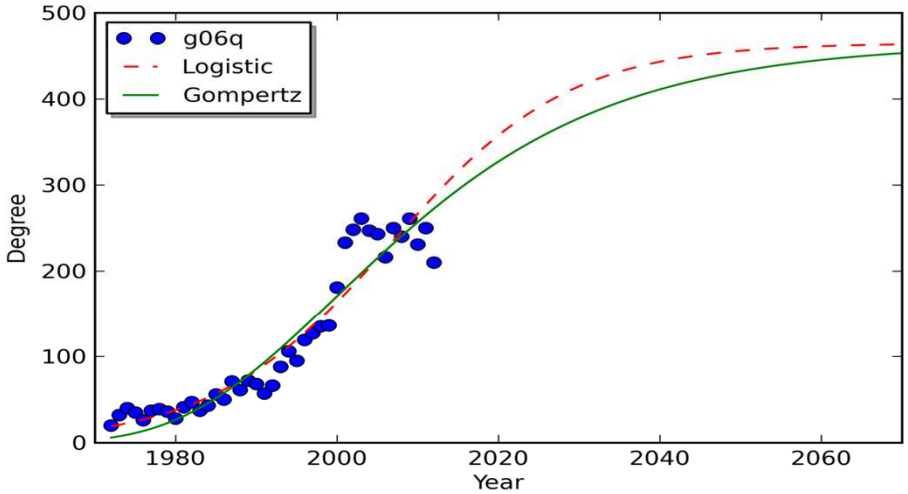
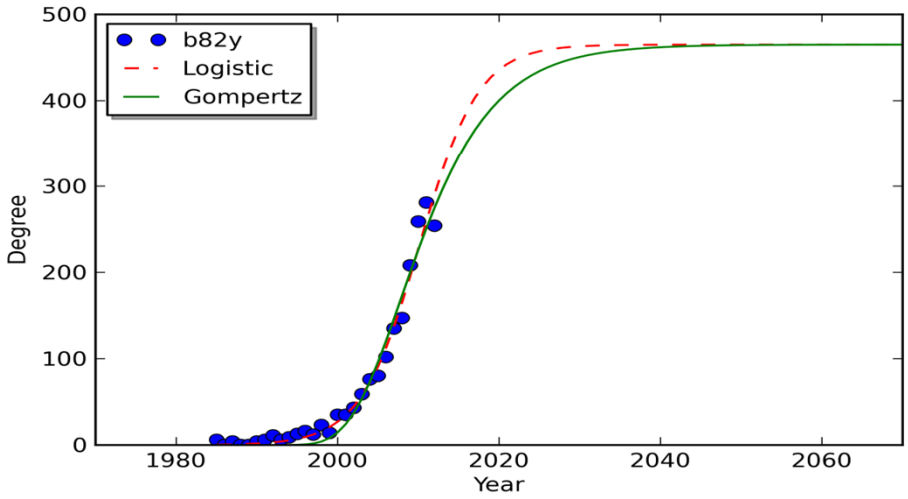


Data processing systems or methods (G06Q)

Nanotechnologies (B82Y)



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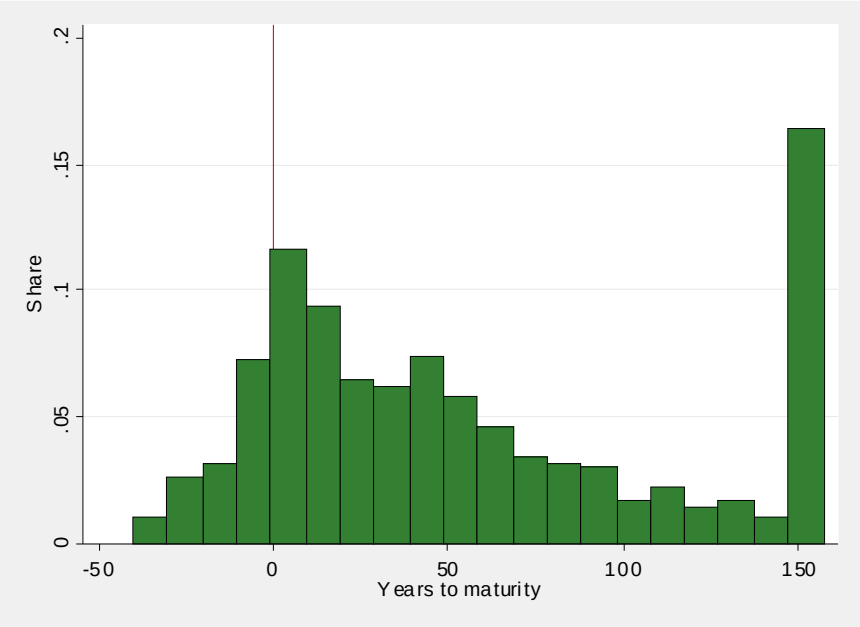

Stage	Share
Mature	15.3%
t <= 10	11.1%
10< t <= 20	9.5%
20 < t <= 30	7.4%
t > 30	56.7%

IPC Code	IPC label
f03d	Wind motors
a01p	Biocidal, pest repellant, pest attractant or plant growth regulatory activity of chemical compounds or preparations
g06g	Analogue computers
c12m	Apparatus for enzymology or microbiology
b60l	Propulsion of electrically-propelled vehicles
b67d	Dispensing, delivering, or transferring liquids, not otherwise provided for
g09g	Arrangements or circuits for control of indicating devices using static means to present variable information
a47b	Tables; desks; office furniture; cabinets; drawers; general details of furniture
b28b	Shaping clay or other ceramic compositions, slag or mixtures containing cementitious material (e.g. plaster)
a62b	Devices, apparatus or methods for life-saving

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- This approach pinpoints a limited set of technologies
- B (Machinery and Materials) category is very important, as G (Instruments and ICT)
- Comparing and 'detecting' KETs (most diffused codes are often KETs)
- KETs, GPTs (General Purpose Technologies)…we miss a label
- Future re-search on the evolution of technologies' networks

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