

# The economy as a Complex system

**Pierre-Alexandre Balland**

Utrecht University

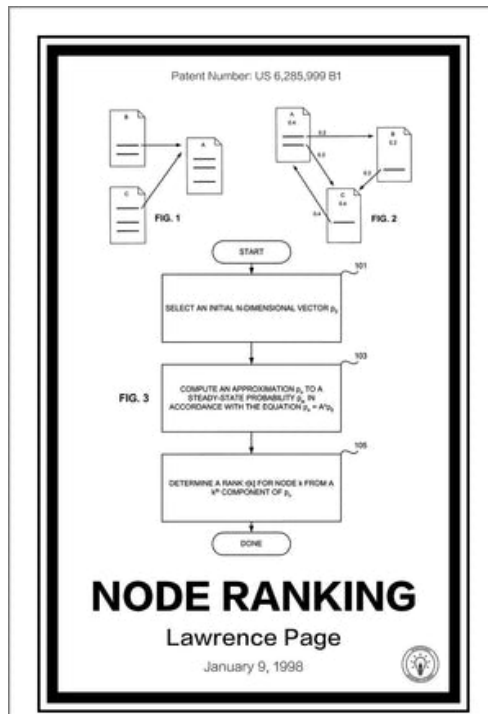
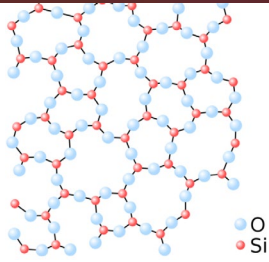
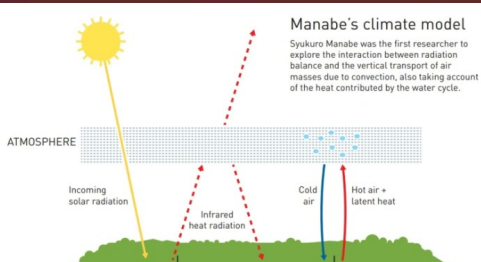
Toulouse Artificial Intelligence Institute

ESIR Group, European Commission

# The Century of Complexity

2021's Physics Nobel Prize is about Complexity Science

AI applications extract information from complex network structures



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# What is Economic Complexity?

Economic complexity is the application of **complex systems** and **network thinking** to economics

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Paradigm shift from *isolated characteristics* to **systemic interactions**

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-> To understand emerging patterns of growth, regional evolution, technological change, inequality, sustainability...

# What is Economic Complexity?

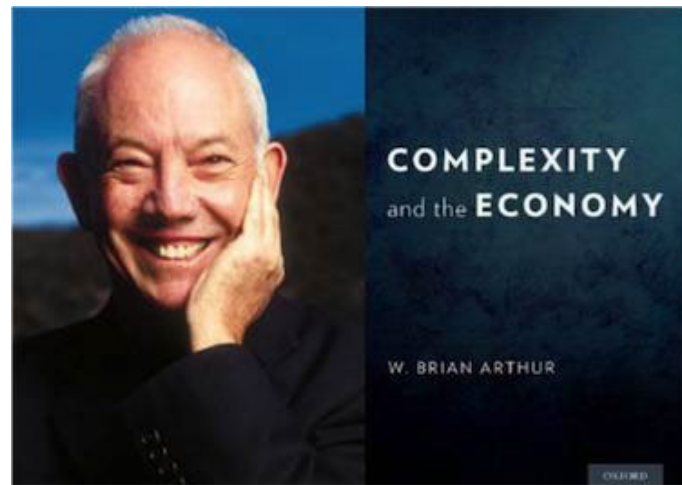
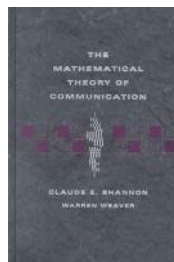
Economic complexity is the application of **complex systems** and **network thinking** to economics

Paradigm shift from *isolated characteristics* to **systemic interactions**

-> To understand emerging patterns of growth, regional evolution, technological change, inequality, sustainability...

Economic complexity produces useful **heuristics** and **metrics** to make better business and policy decisions

# Founding parents





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## Research Policy

Volume 51, Issue 3, April 2022, 104450



### The new paradigm of economic complexity ☆

Pierre-Alexandre Balland <sup>a, b</sup>, Tom Broekel <sup>c</sup>, Dario Diodato <sup>d, #</sup> , Elisa Giuliani <sup>e</sup>, Ricardo Hausmann <sup>f</sup>, Neave O'Clery <sup>g</sup>, David Rigby <sup>h</sup>



## Research Policy

Supports open access

### Special Issue on Economic Complexity

Edited by Pierre-Alexandre Balland, Tom Broekel, Dario Diodato, Ricardo Hausmann, Neave O'Clery, David Rigby

Last update 17 January 2022



## INNOVATION POLICY FOR A COMPLEX WORLD

Pierre-Alexandre Balland

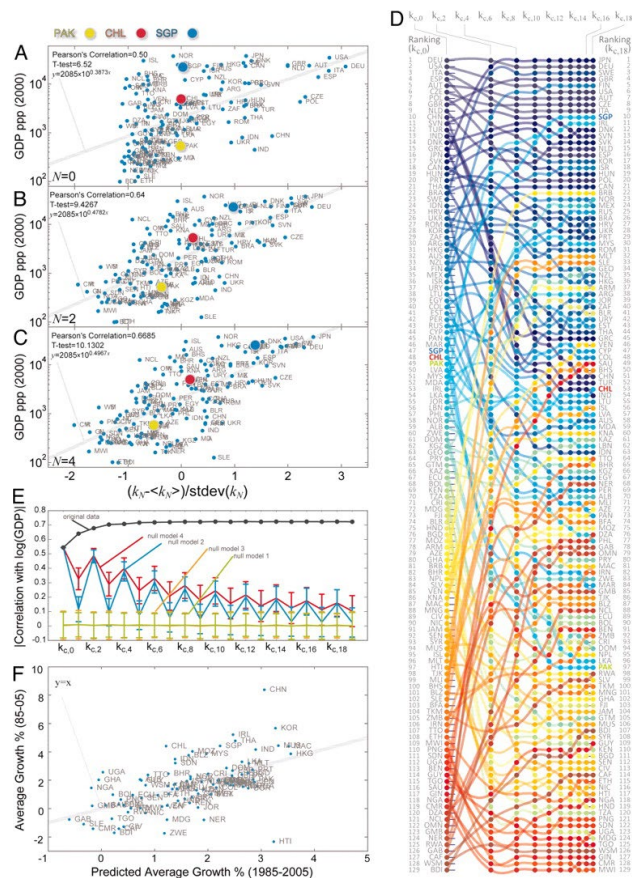
## SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2022

Building  
a sustainable future  
in uncertain times





# Complexity is a wealth generator



Economic complexity of a country/city is a strong predictor of its future growth

Adam Smith outlined the power of connections and the fact that they were hidden ('invisible hand')

Trade and division of labor are very efficient ways to organize the economy

New technologies and globalization allow for a deeper division of knowledge

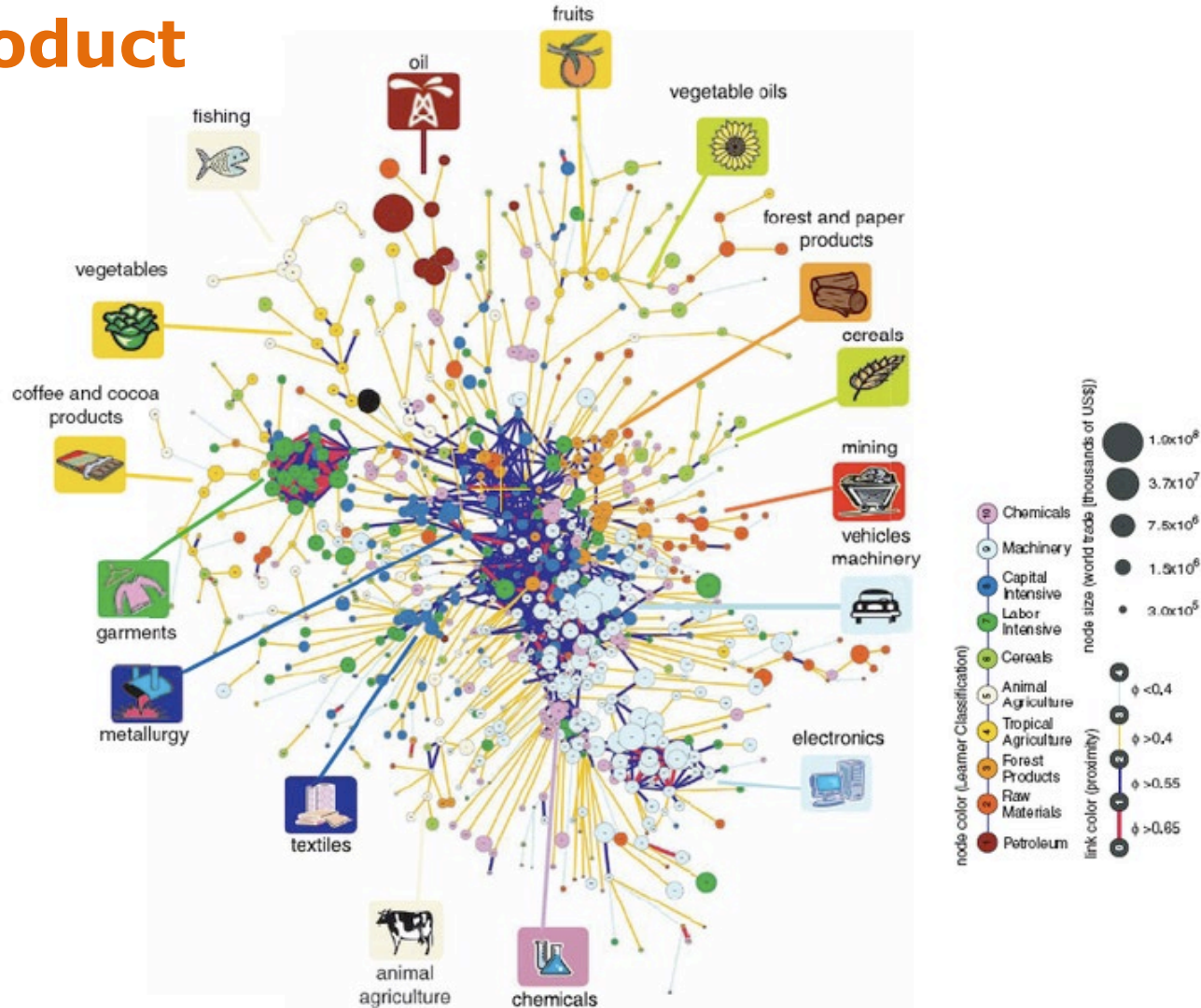
# Complex systems are highly unequal



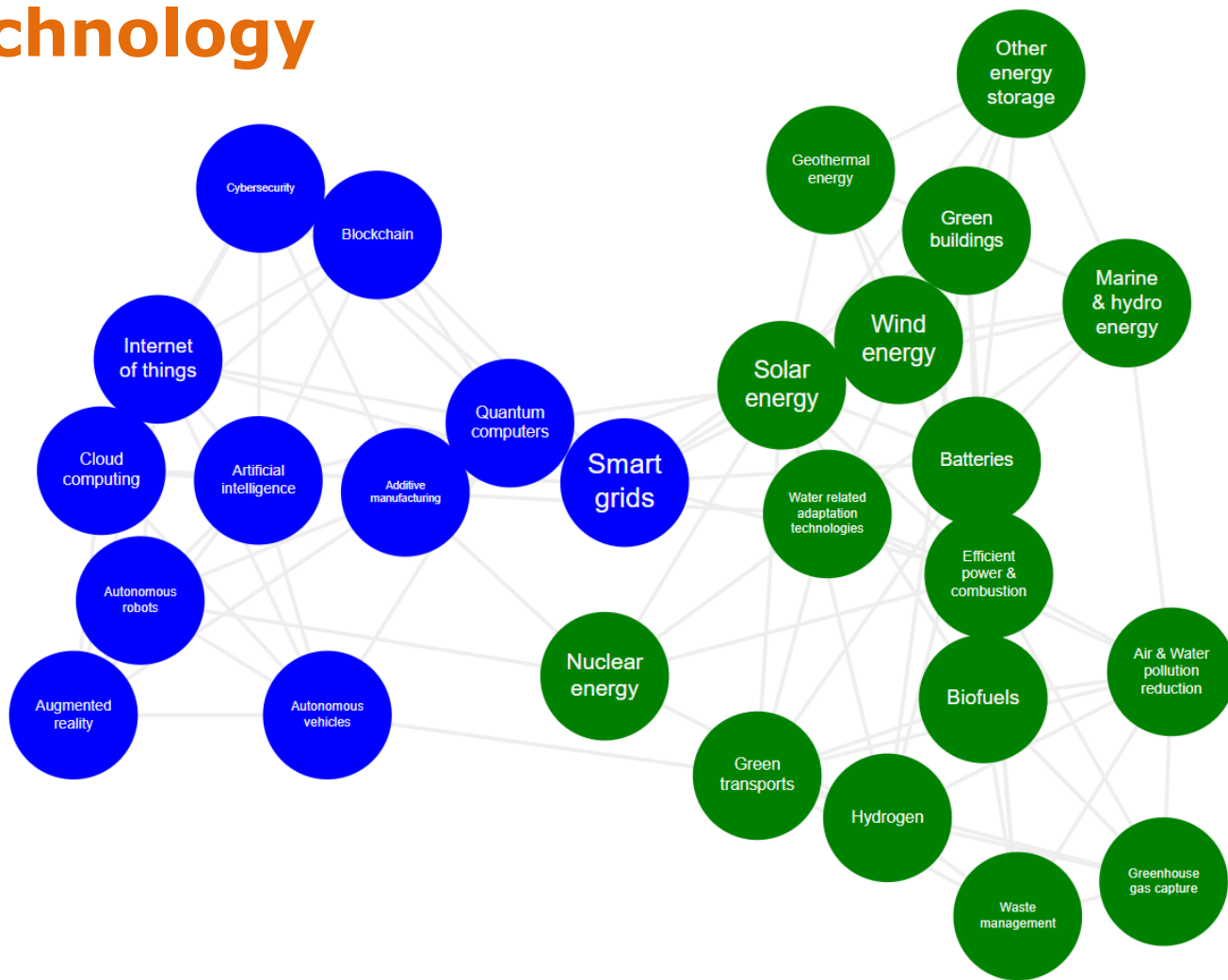
*More complex societies are more unequal because large networks create extreme leverage*



# The product space



# The technology space

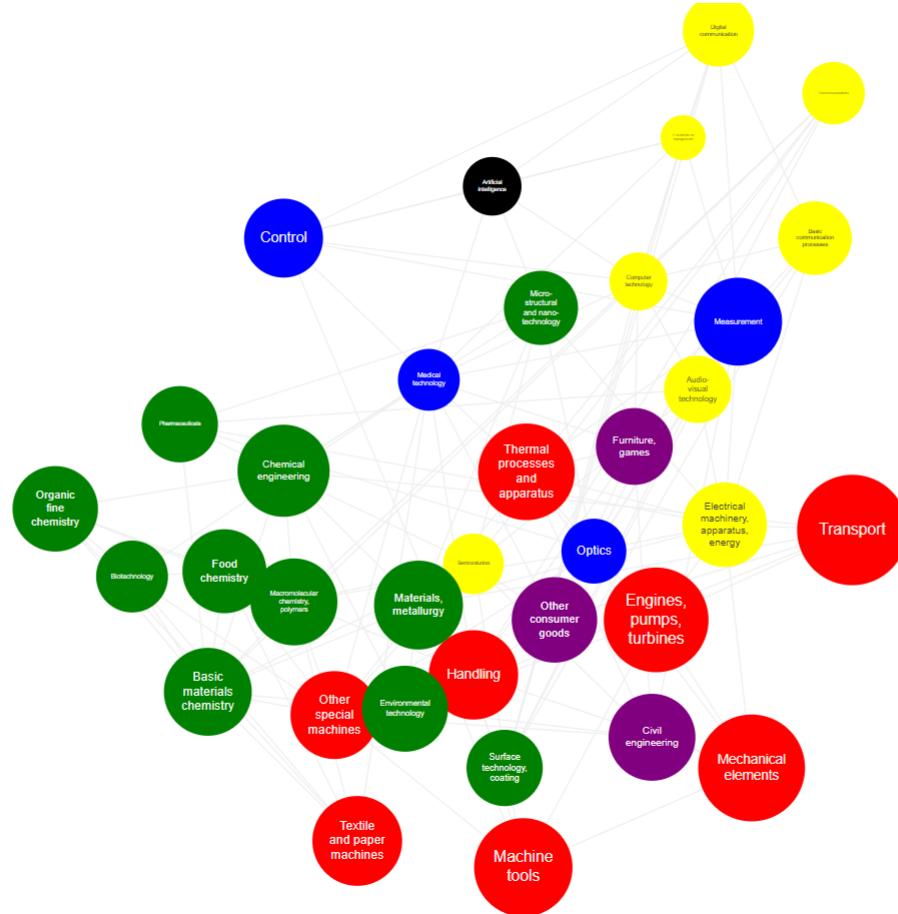


# US knowledge space prior to the AI revolution



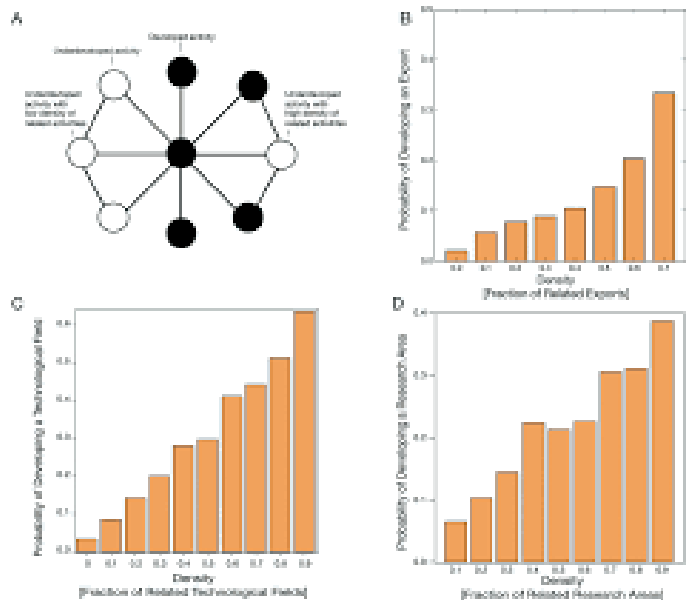
Balland, P.A. (2021)  
Report for DG Grow

# EU knowledge space prior to the AI revolution



Balland, P.A. (2021)  
Report for DG Grow

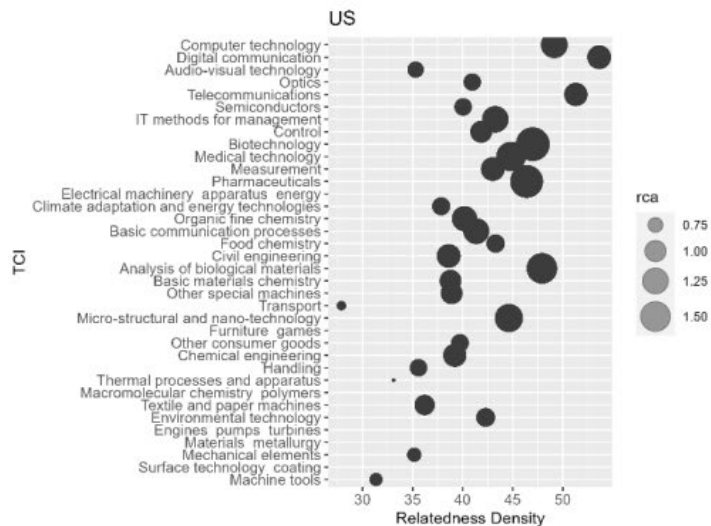
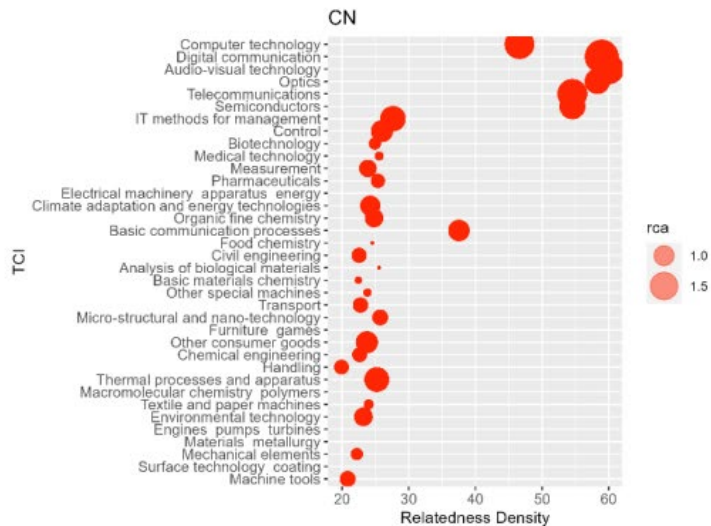
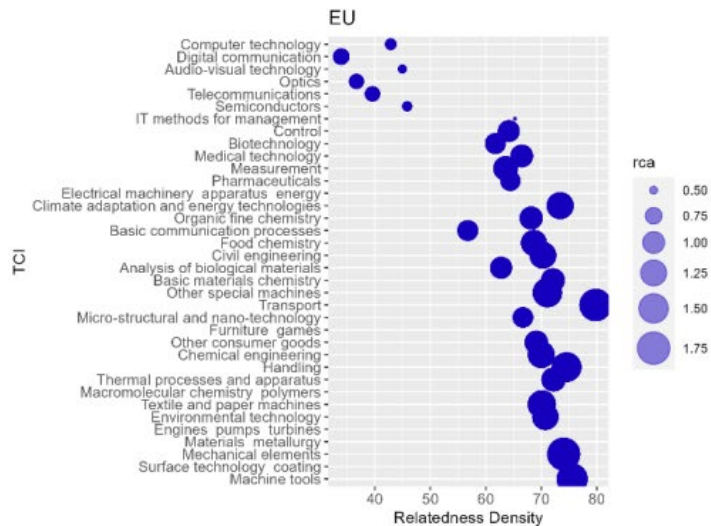
# The principle of relatedness



The structure of the economy allows to predict its further evolution

Hidalgo, C., Balland, P.A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., Glaeser, E., He, C., Kogler, D., Morrison, A., Neffke, F., Rigby, D., Stern, S., Zheng, S., and Zhu, S. (2018) **The Principle of Relatedness**, *Unifying Themes in Complex Systems (IX)*: 451-457





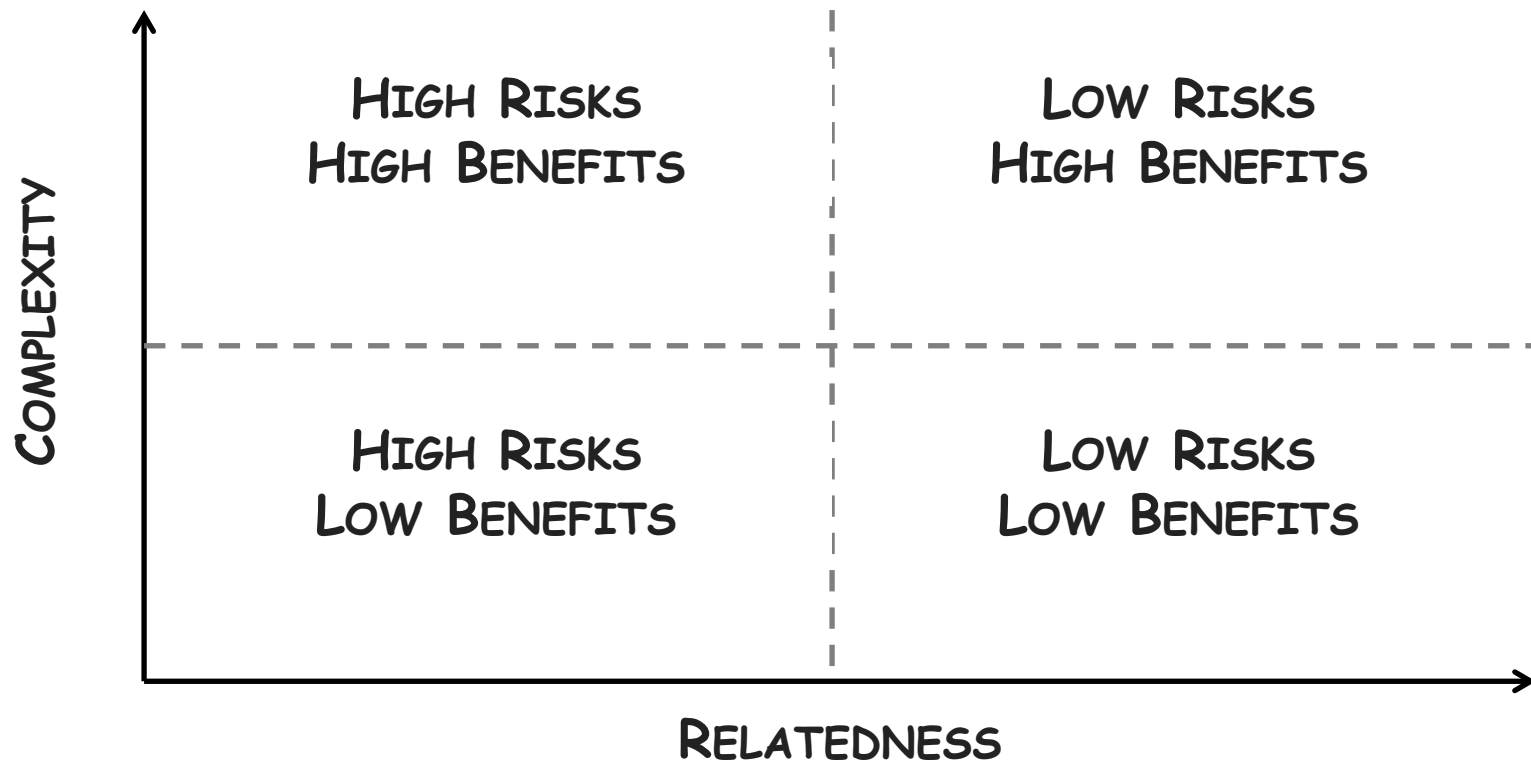
# The global position of the EU in complex technologies



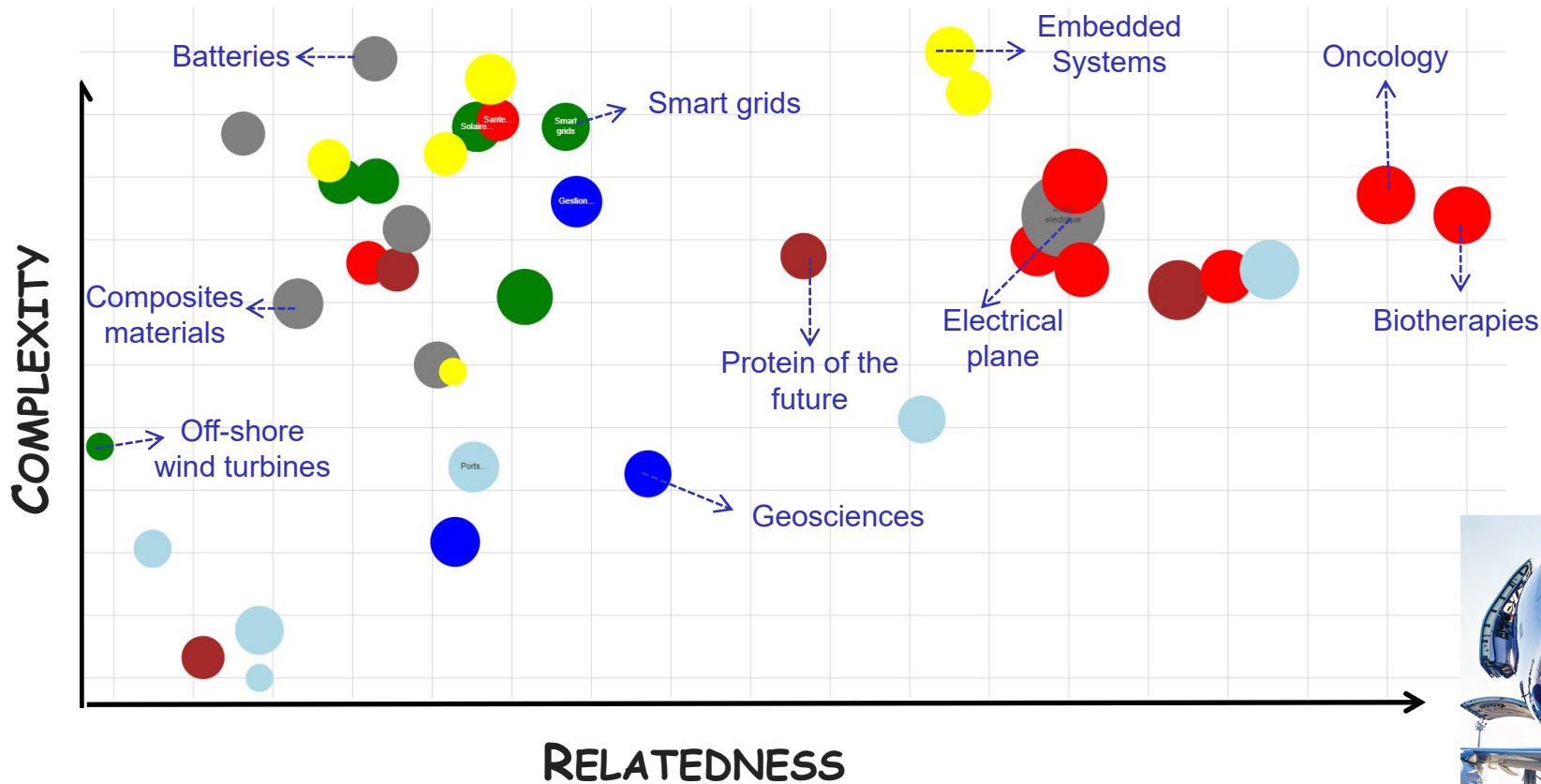
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Valentina DI GIROLAMO, Alessio MITRA,  
Julien RAVET, Océane PEIFFER-SMADJA,  
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# Smart Investment Framework



# The case of the Toulouse region



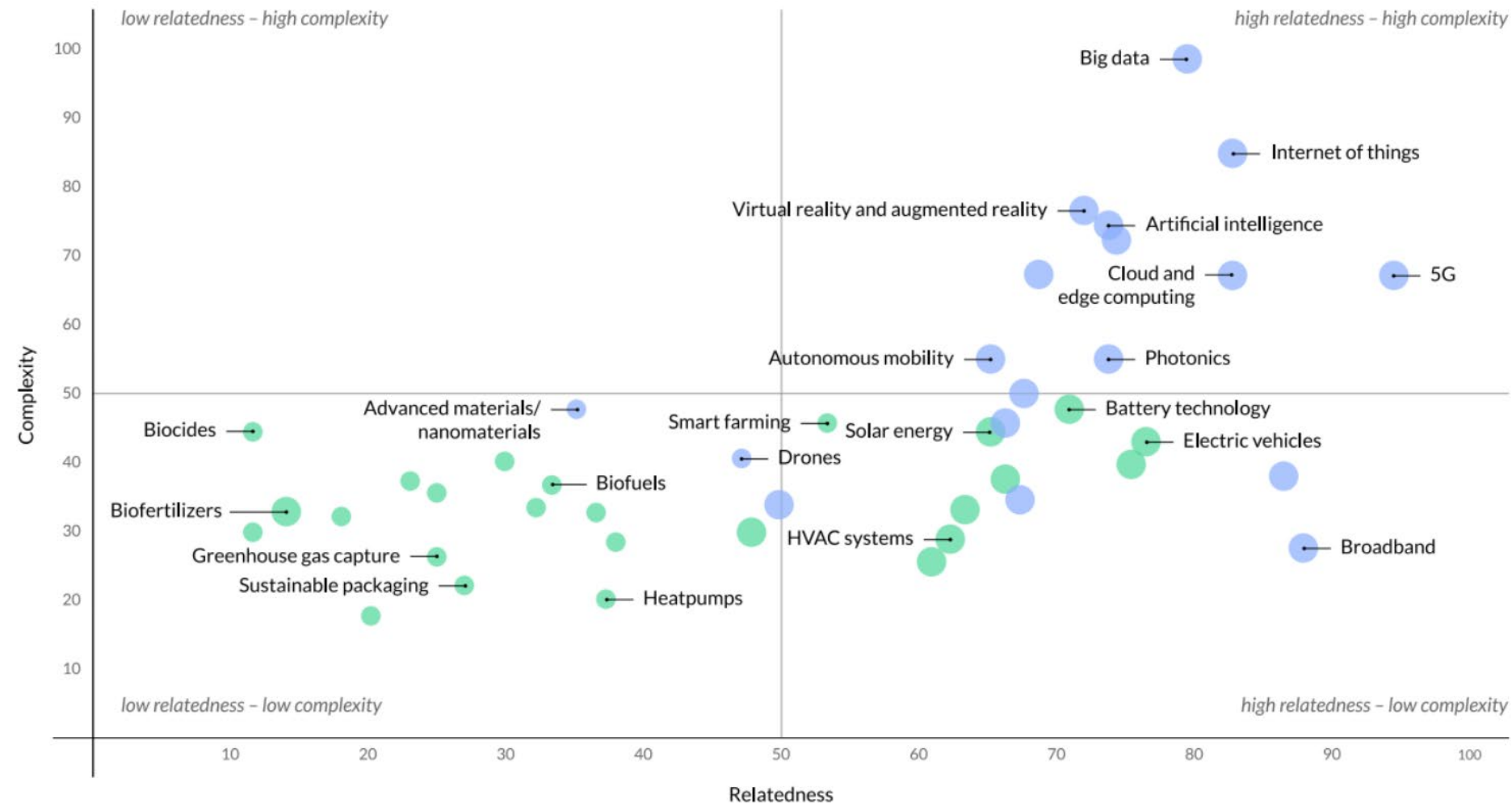
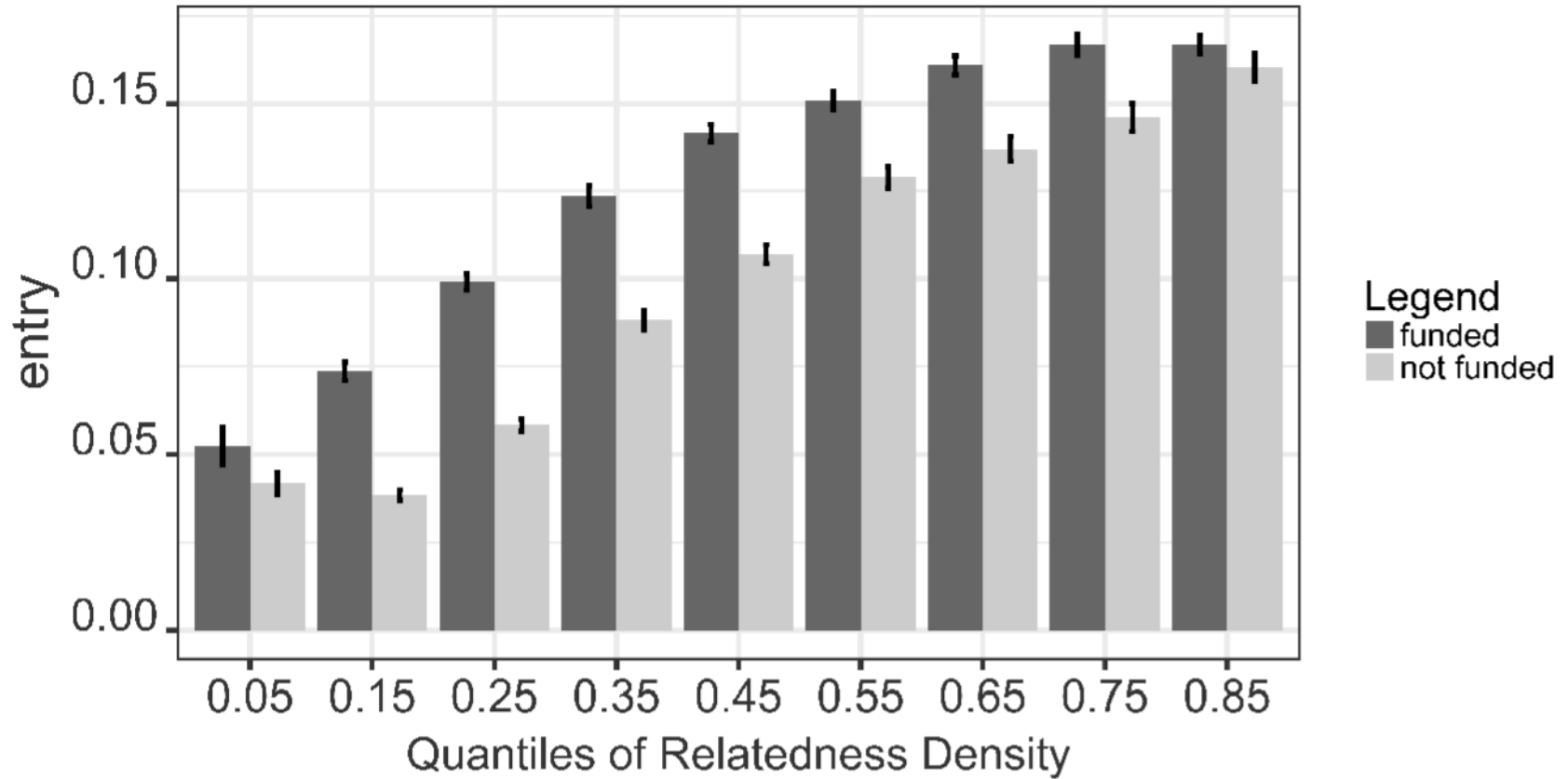
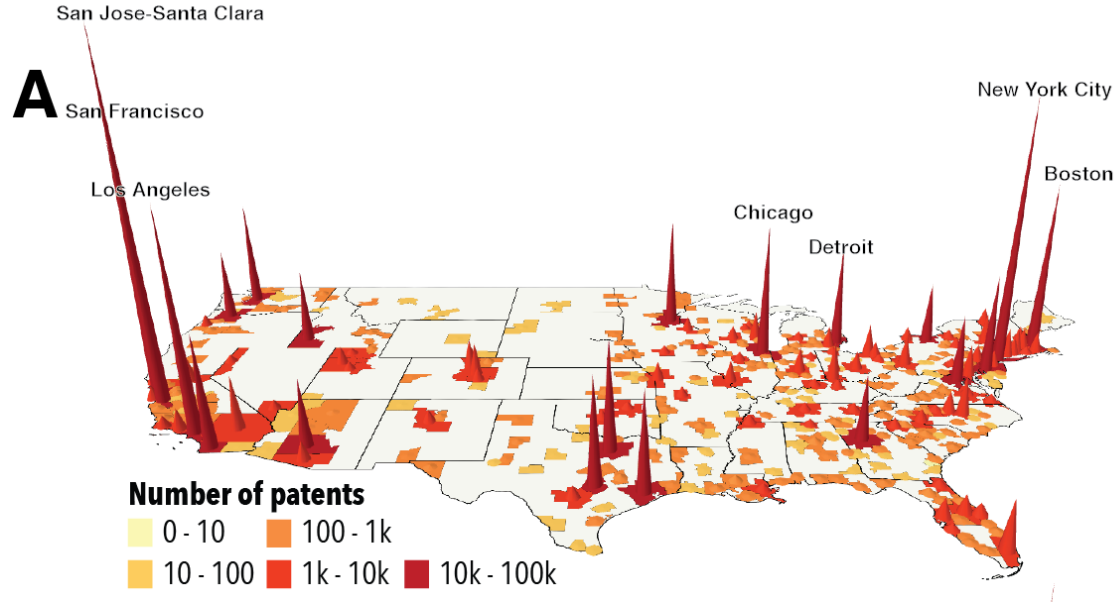


Figure 2: Differences of Mean Entry Probabilities

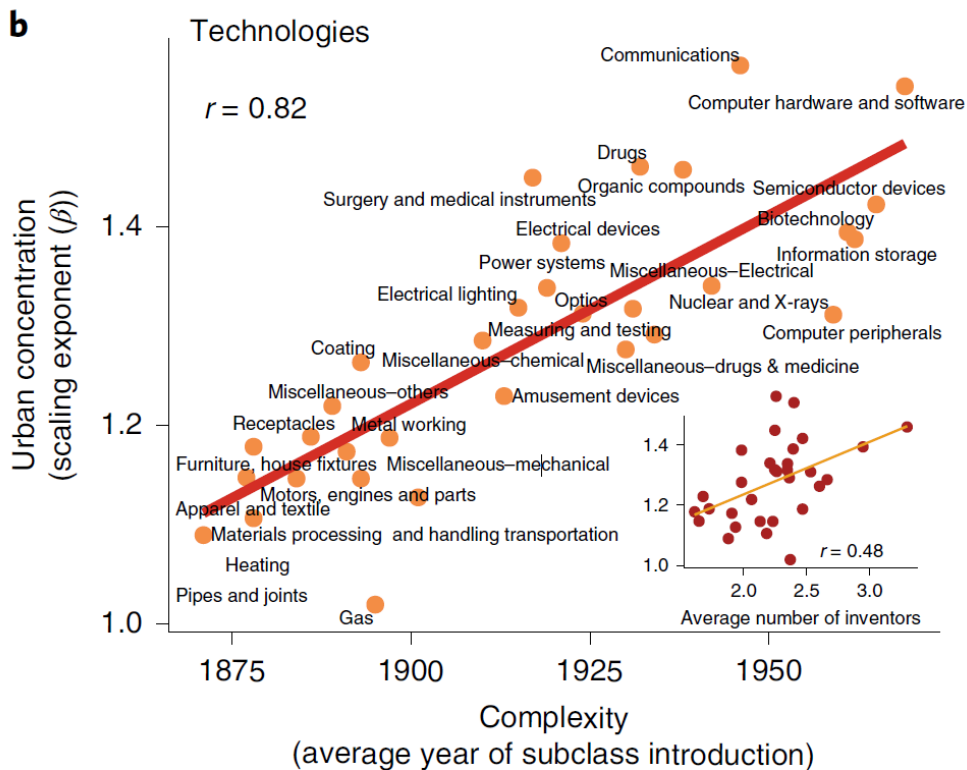


# Complex activities concentrate in large cities



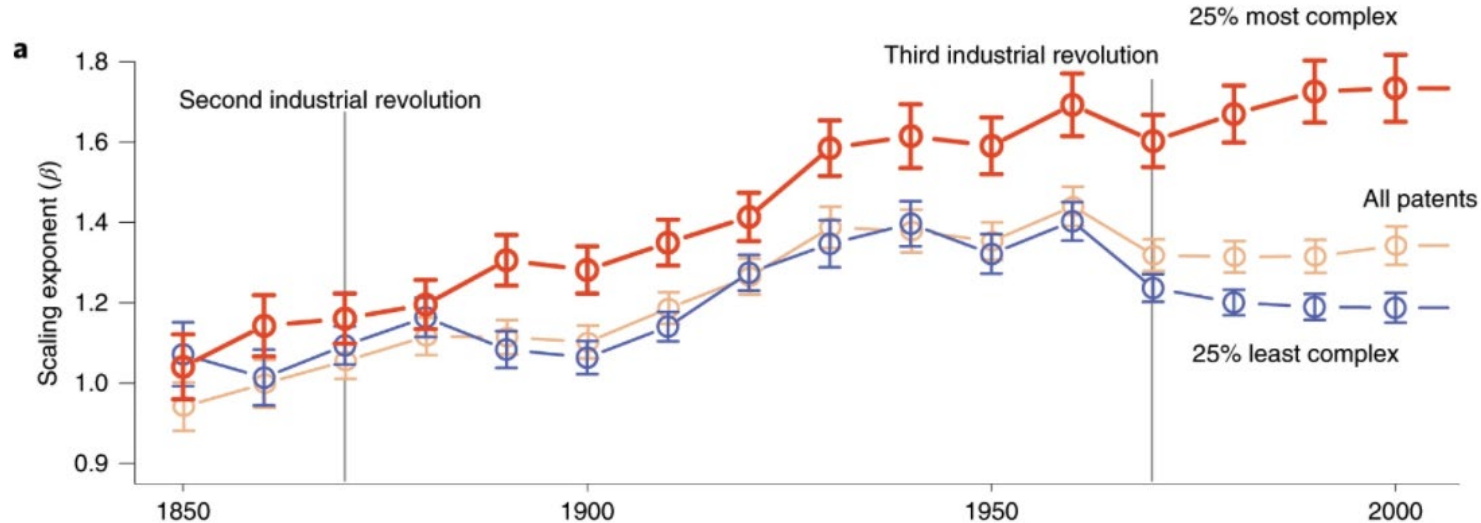
Balland, P.A., Jara-Figueroa, C., Petralia, S., Steijn, M., Rigby, D., and Hidalgo, C. (2020)  
Complex Economic Activities Concentrate in Large Cities, *Nature Human Behavior*

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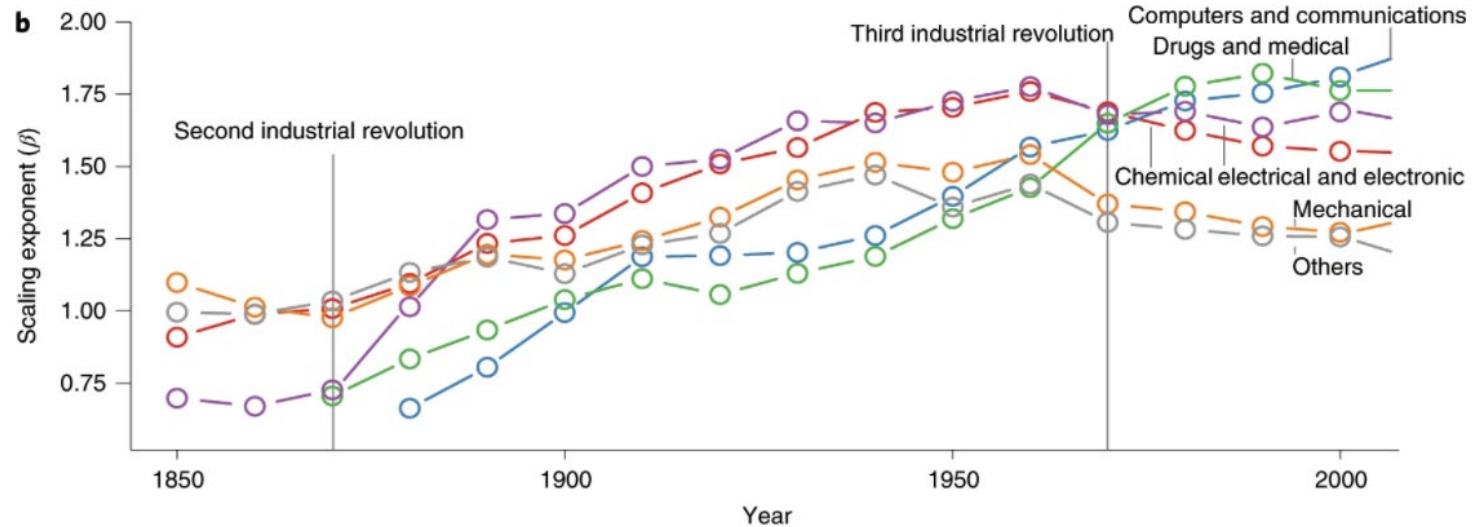


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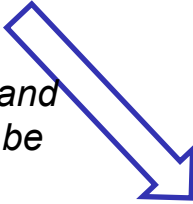
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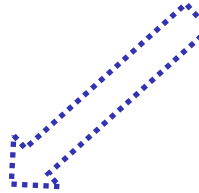
THE WORLD OF  
KNOWLEDGE  
**CONSUMPTION** IS  
GETTING  
**FLATTER**

*Digital technologies, transports and globalization allows products to be widely distributed (leveraged)*



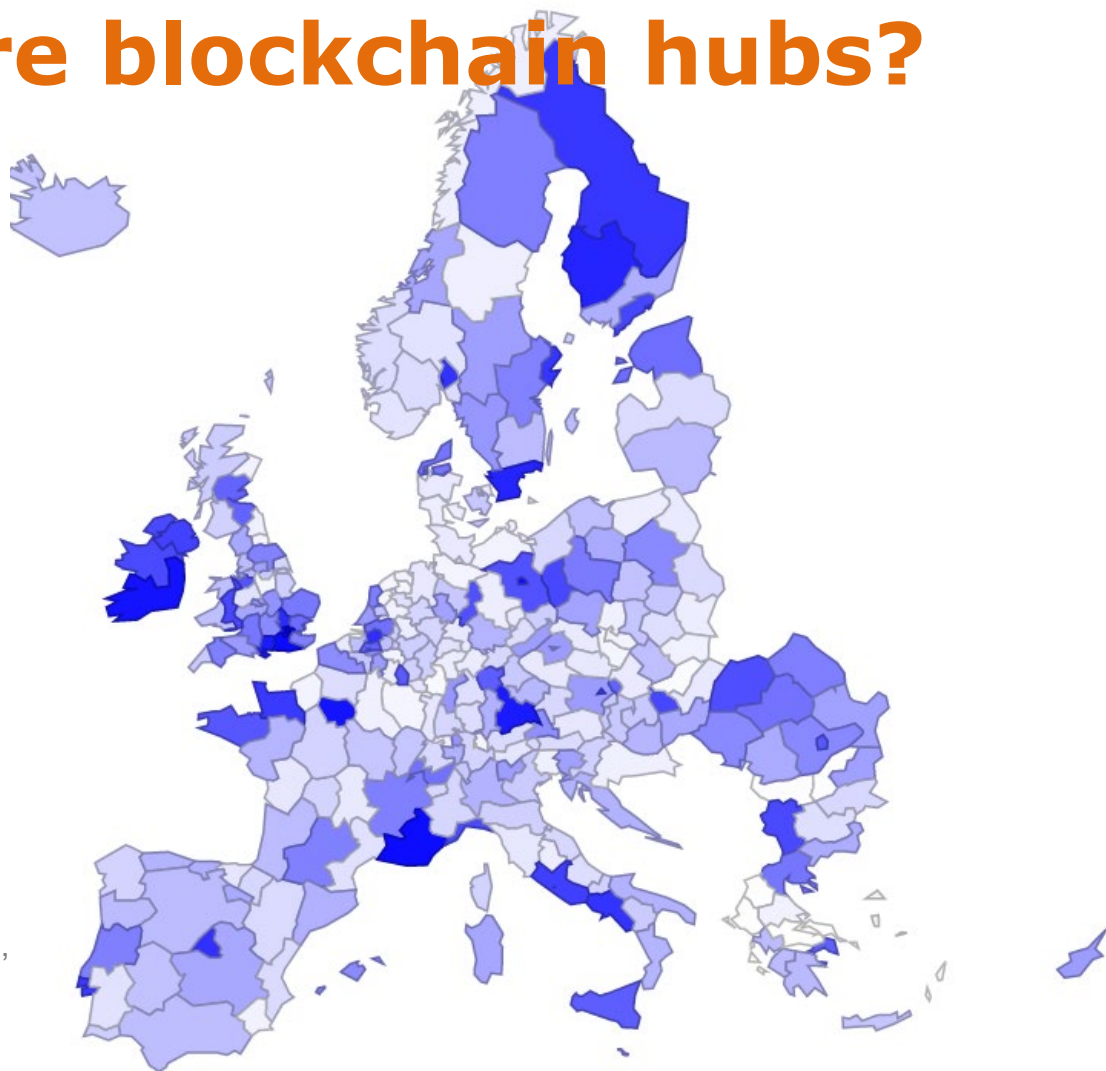
THE WORLD OF  
KNOWLEDGE  
**PRODUCTION** IS  
GETTING  
**SPIKIER**

*Knowledge increasingly concentrates as it becomes more complex*



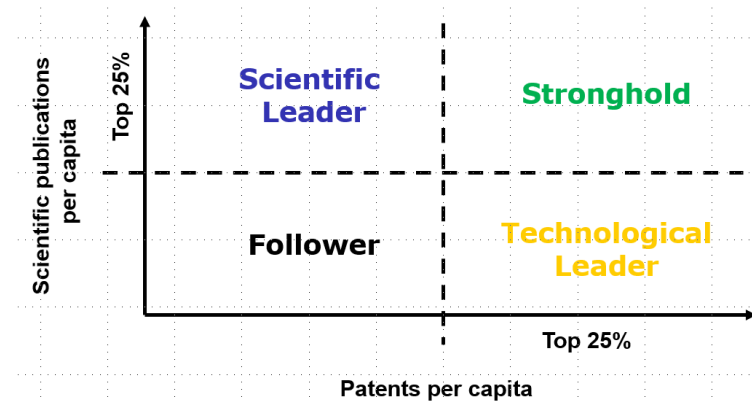
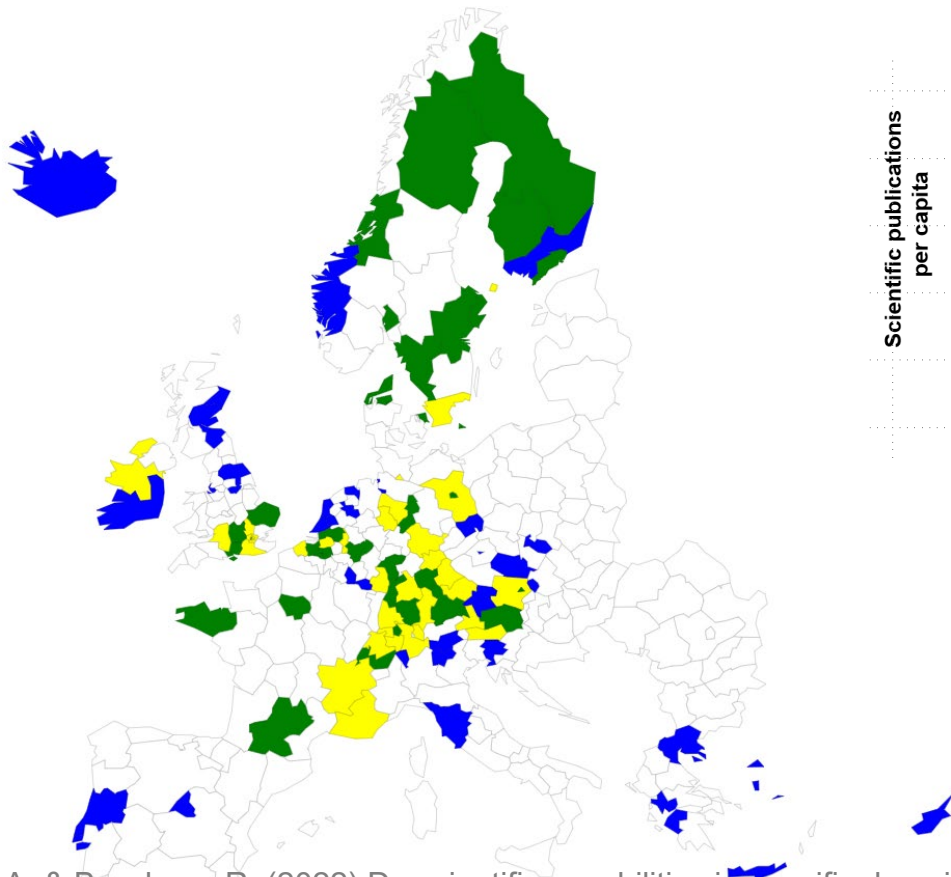
**WINNER TAKES-  
ALL ECONOMY**

# Where are blockchain hubs?



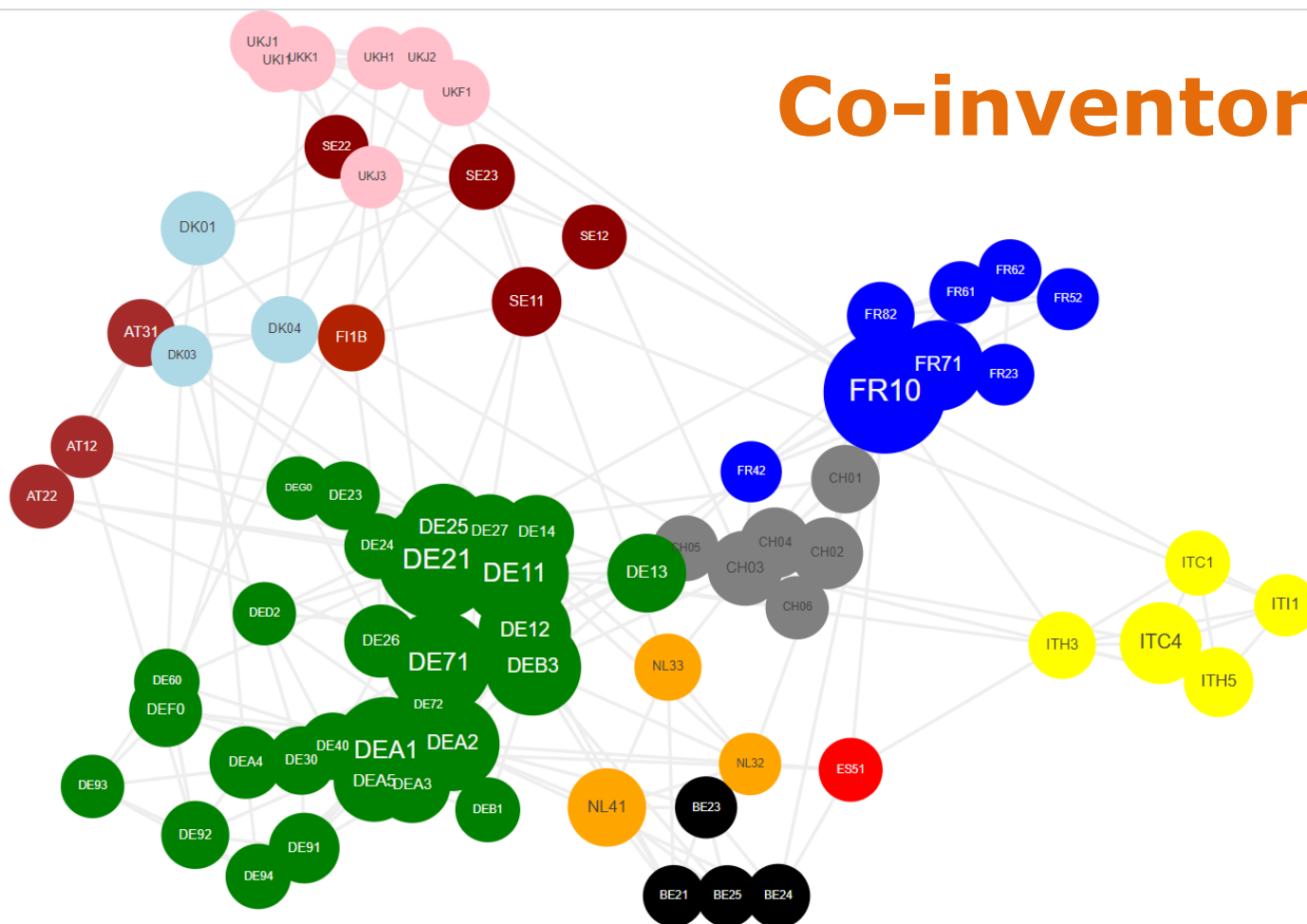
Balland, P.A (2022) – Chapter 14,  
SRIP report of the European  
Commission

# Adding the layer of scientific capabilities



Balland, P.A. & Boschma, R. (2022) Do scientific capabilities in specific domains matter for technological diversification in European regions?, Research Policy

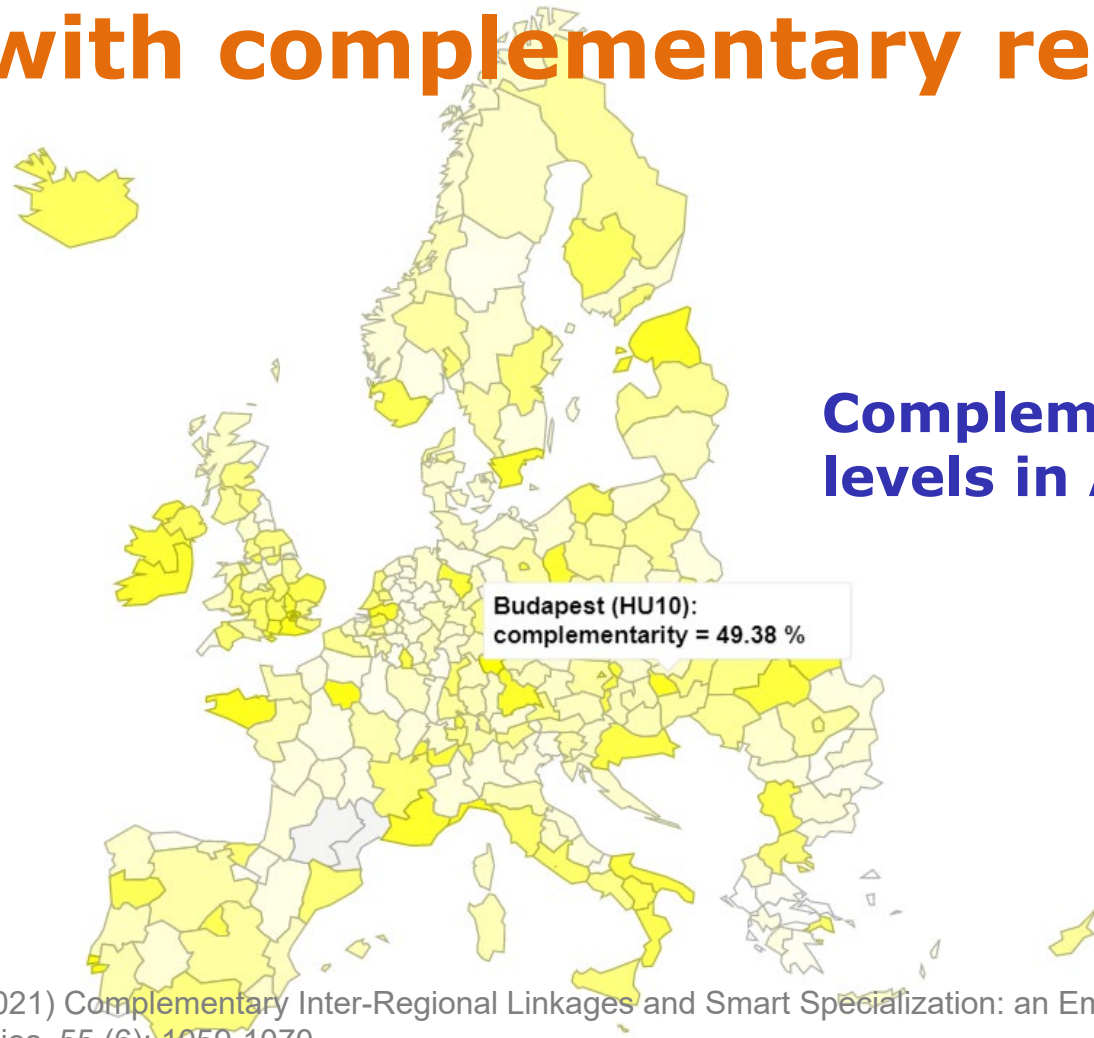
# Co-inventorship





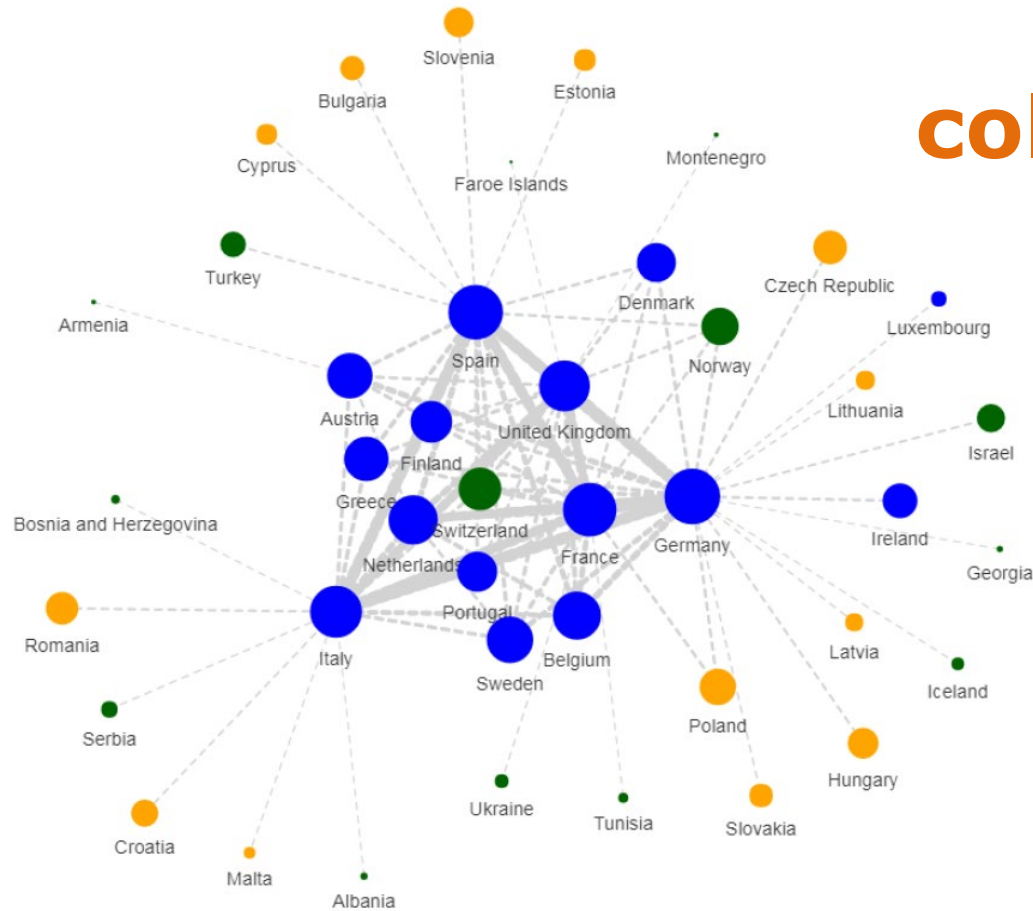


# Connect with complementary regions



**Complementarity  
levels in AI**

# H2020 collaborations



Balland, P.A., Boschma, R., and Ravet, J. (2019) - European Planning Studies, 27 (9)

# System thinking at ESIR

Industry 5.0, a transformative vision for Europe : governing **systemic transformations** towards a sustainable industry

Global value chains : harnessing innovation to protect and transform the **backbone** of global trade

Protect, prepare and transform Europe - Recovery and **resilience** post COVID-19



## Unpacking tensions

# Software & open data

## Economic Geography in R: Introduction to the EconGeo Package

74 Pages • Posted: 4 May 2017

[Pierre Alexandre Balland](#)

Utrecht University - Department of Economic Geography

Date Written: April 27, 2017

### Abstract

The R statistical software is increasingly used to perform analysis on the spatial distribution of economic activities. It contains state-of-the-art statistical and graphical routines not yet available in other software such as SAS, Stata, or SPSS. R is also free and open-source. Many graduate students and researchers, however, find programming in R either too challenging or end up spending a lot of their precious time solving trivial programming tasks. This paper is a simple introduction on how to do economic geography in R using the EconGeo package (Balland, 2017). Users do not need extensive programming skills to use it. EconGeo allows to easily compute a series of indices commonly used in the fields of economic geography, economic complexity, and evolutionary economics to describe the location, distribution, spatial organization, structure, and complexity of economic activities. Functions include basic spatial indicators such as the location quotient, the Krugman specialization index, the Herfindahl or the Shannon entropy indices but also more advanced functions to compute different forms of normalized relatedness between economic activities or network-based measures of economic complexity. By opening and sharing the codes used to compute popular indicators of the spatial distribution of economic activities, one of the goals of this package is to make peer-reviewed empirical studies more reproducible by a large community of researchers.

**Keywords:** Economic Geography, Economic Complexity, Evolutionary Economics, Network Science, R, EconGeo package

**JEL Classification:** B15, B23, D85, P25, O1, O3



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## Unveiling the geography of historical patents in the United States from 1836 to 1975

[Sergio Petralia](#) , [Pierre-Alexandre Balland](#) & [David L. Rigby](#)

[Scientific Data](#) **3**, Article number: 160074 (2016) | [Cite this article](#)

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