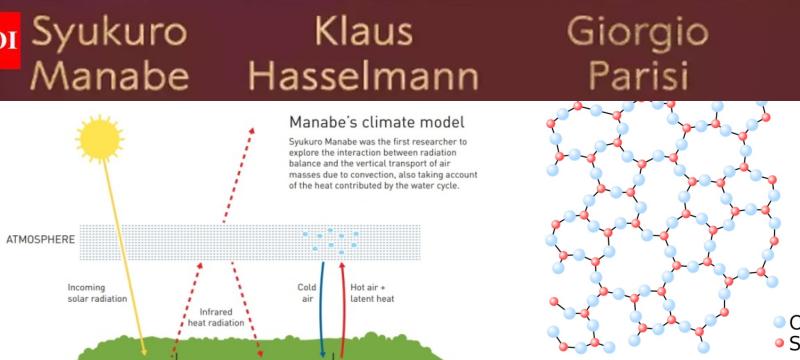


# **The Geography of Complex Knowledge**

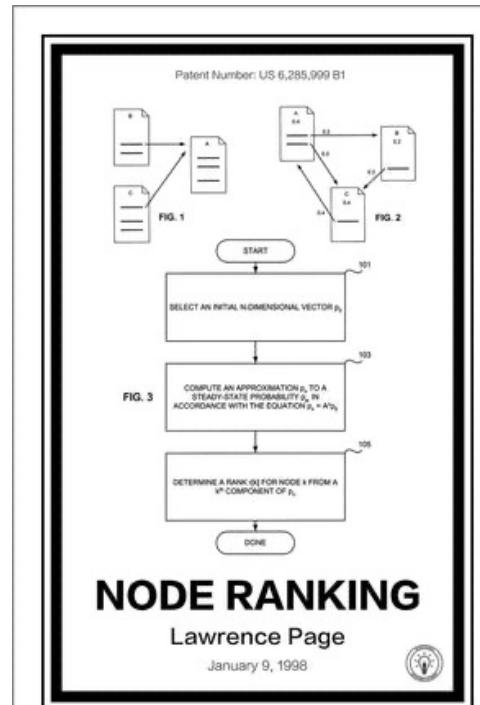
**Pierre-Alexandre Balland**

# The Century of Complexity

2021's Physics Nobel Prize is about  
Complexity Science



AI applications extract information from  
complex network structures



# 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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# What is Economic Complexity?

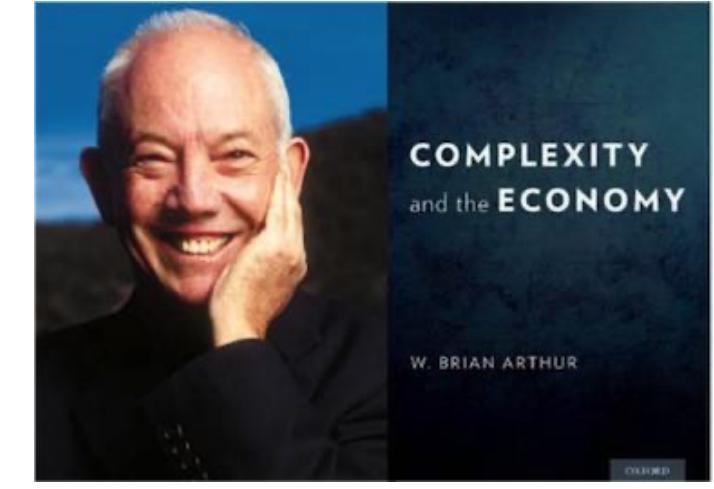
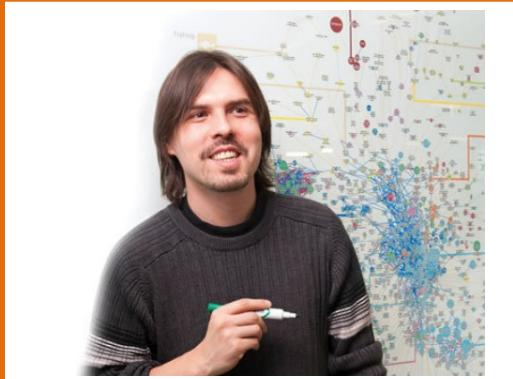
Economic complexity is the application of **complex systems** and **network thinking** to economics

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



# Recent reads



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

European Commission

INNOVATION POLICY FOR A COMPLEX WORLD

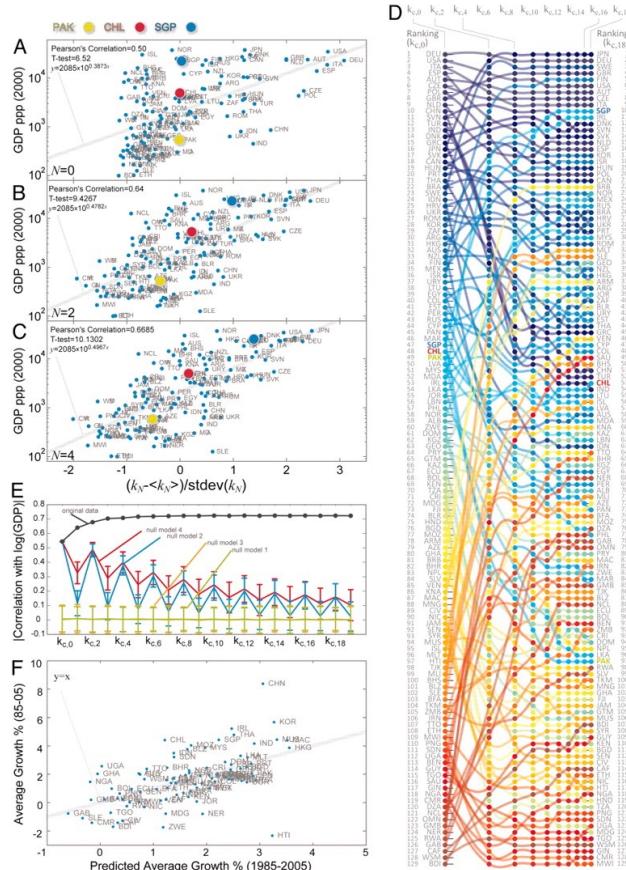
Pierre-Alexandre Balland

SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2022

Building a sustainable future in uncertain times

Research and Innovation

# Complexity is a wealth generator



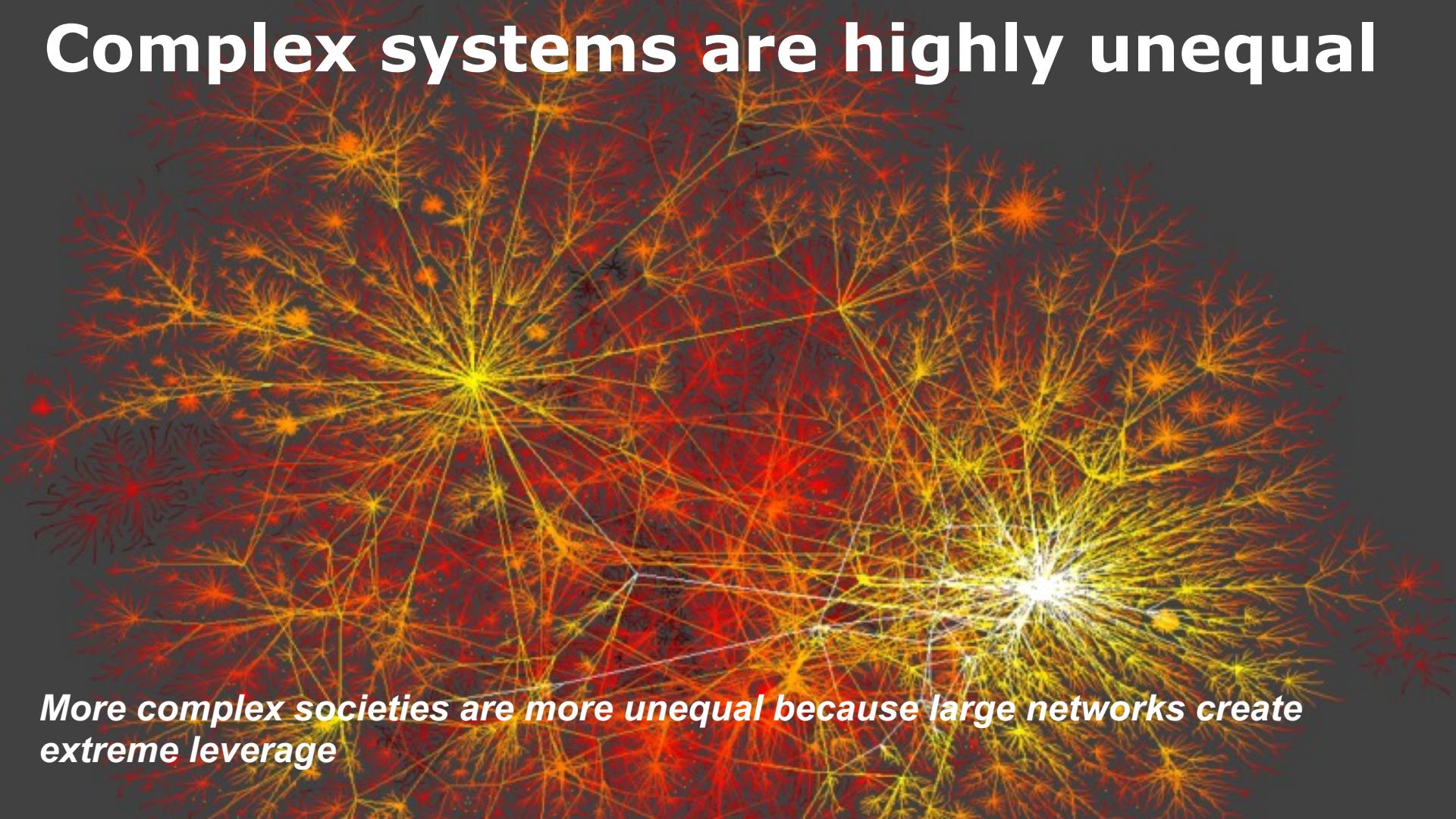
Economic complexity of a country/city is a strong predictor of its future growth

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

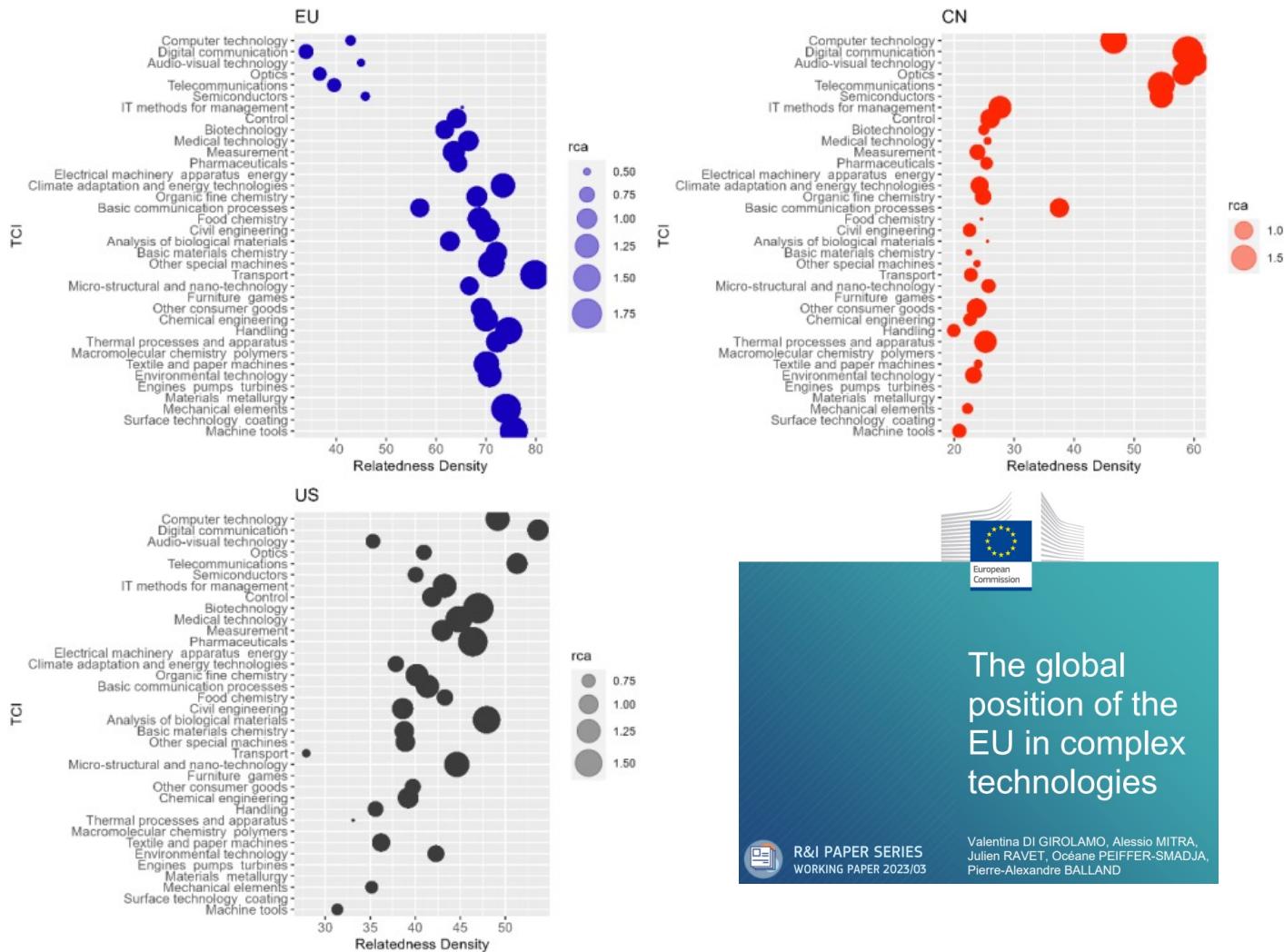
Trade and division of labor are very efficient ways to organize the economy

New technologies and globalization allow for a deeper division of knowledge

# Complex systems are highly unequal



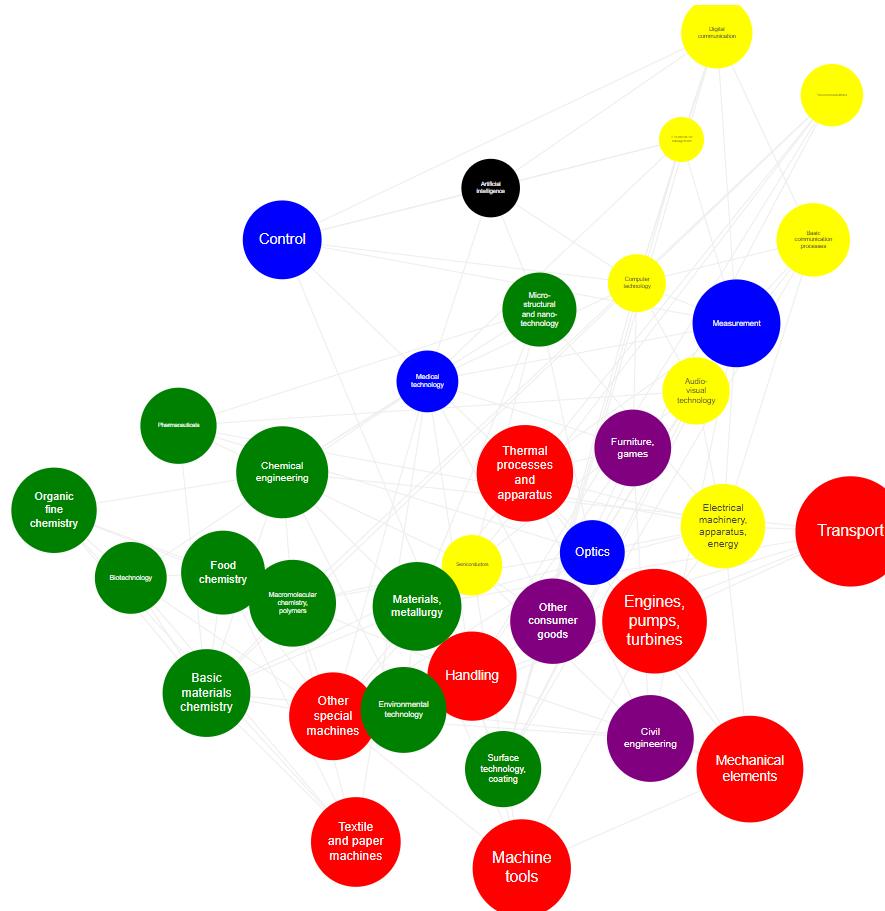
*More complex societies are more unequal because large networks create extreme leverage*



# US knowledge space prior to the AI revolution



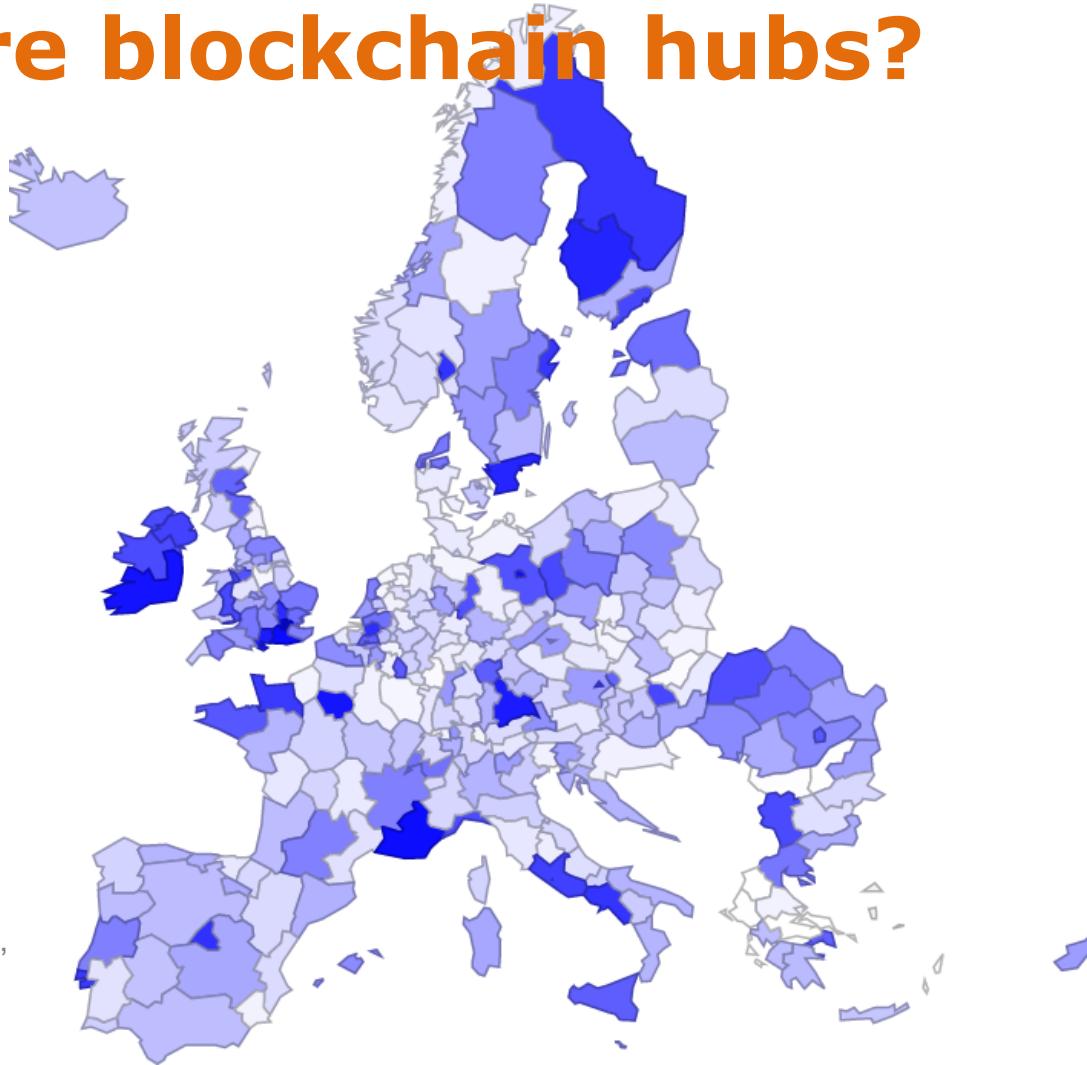
# EU knowledge space prior to the AI revolution



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

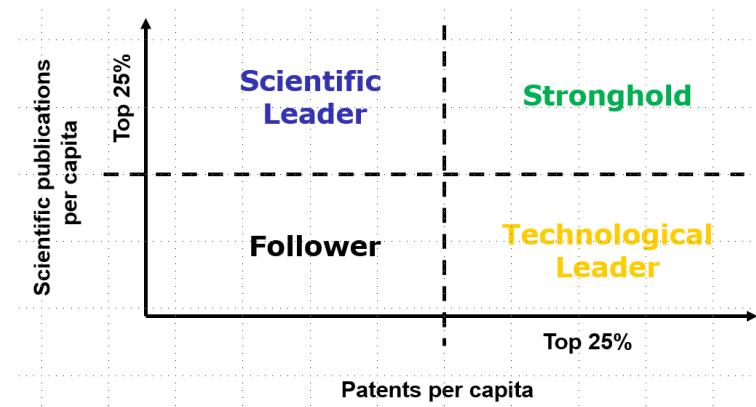
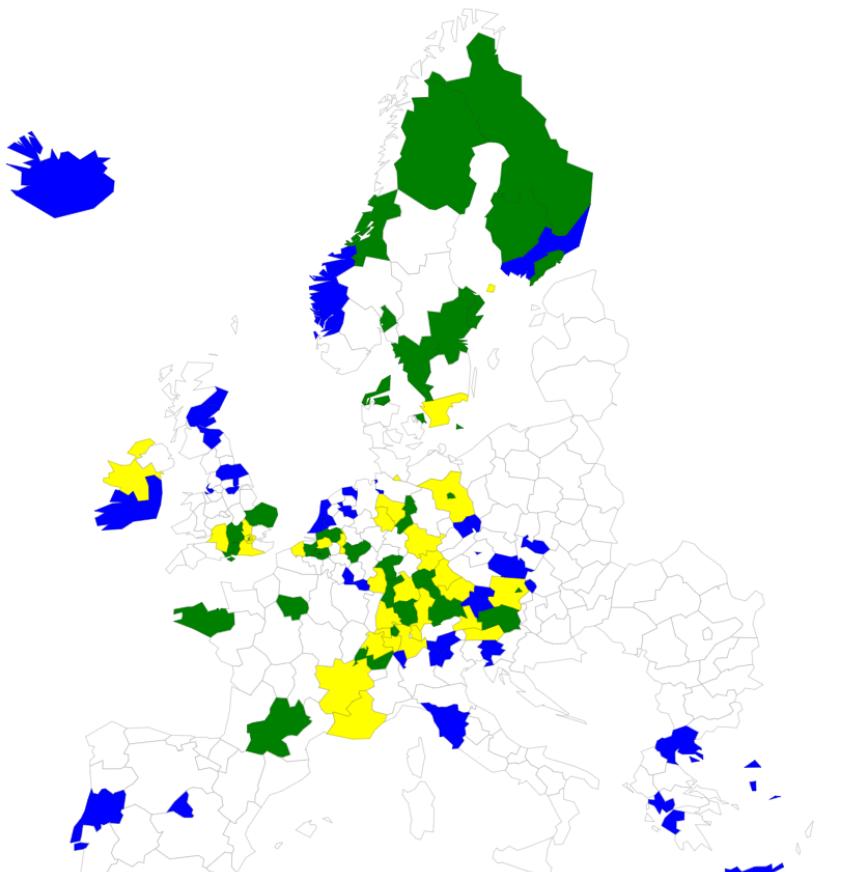


# Where are blockchain hubs?



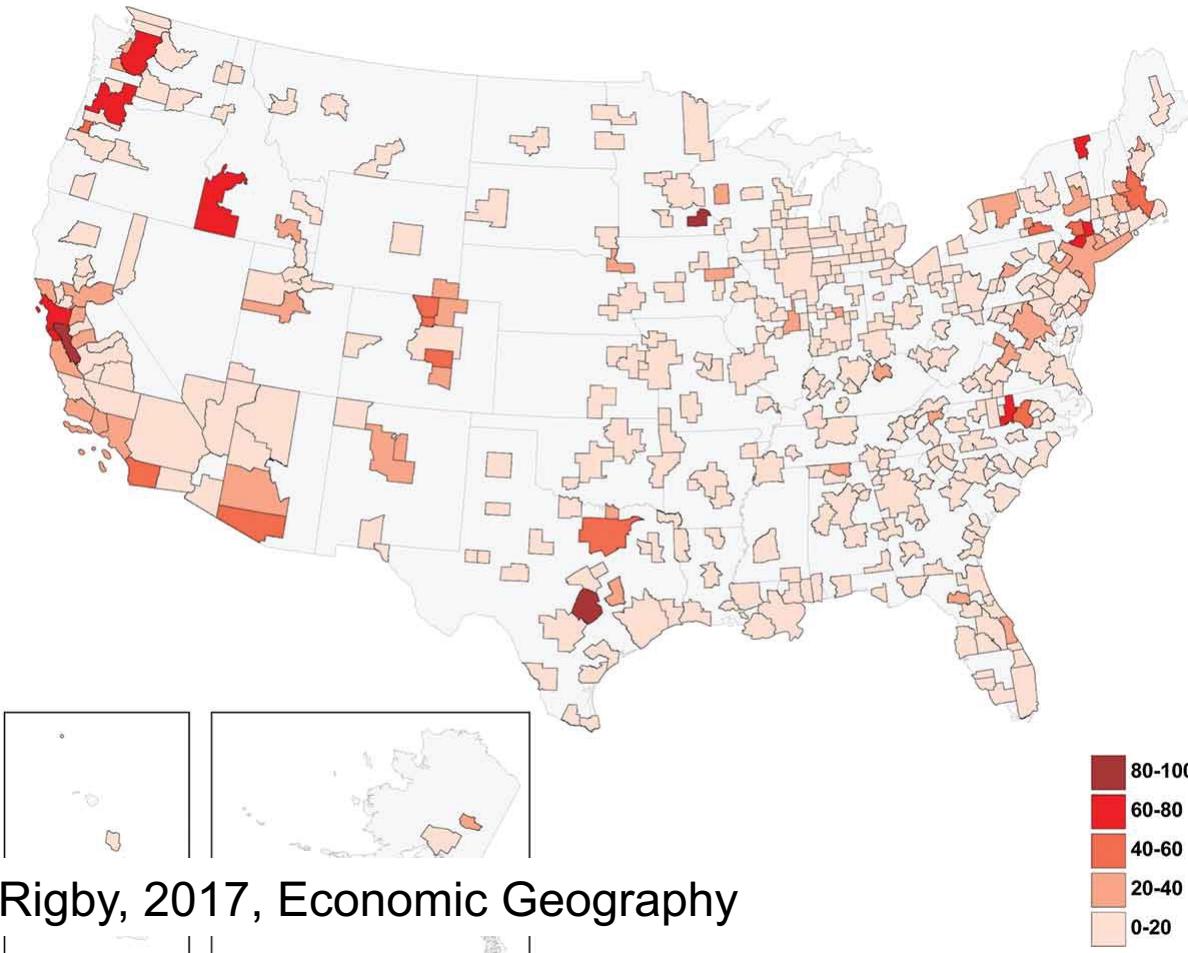
Balland, P.A (2022) – Chapter 14,  
SRIP report of the European  
Commission

# Adding the layer of scientific capabilities

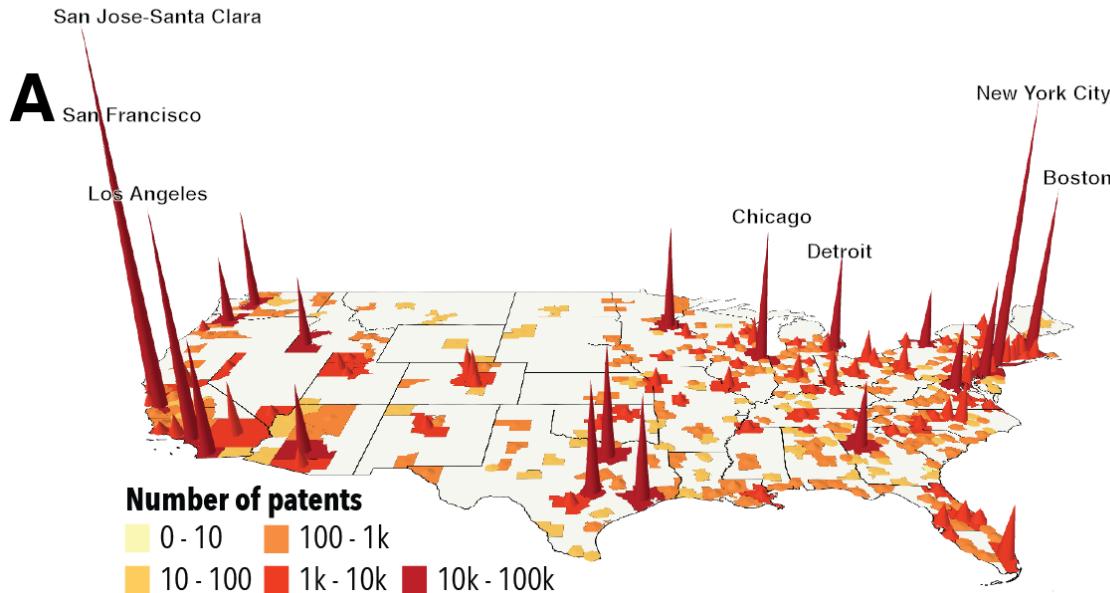


Balland, P.A. & Boschma, R. (2022) Do scientific capabilities in specific domains matter for technological diversification in European regions?, Research Policy

# Knowledge complexity scores

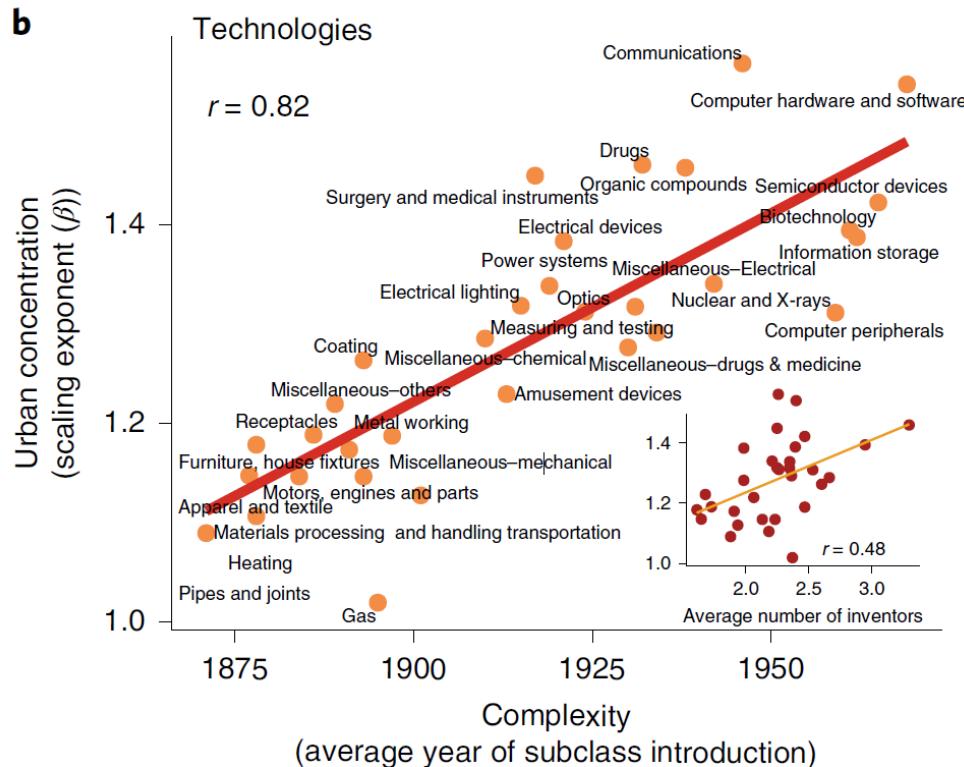


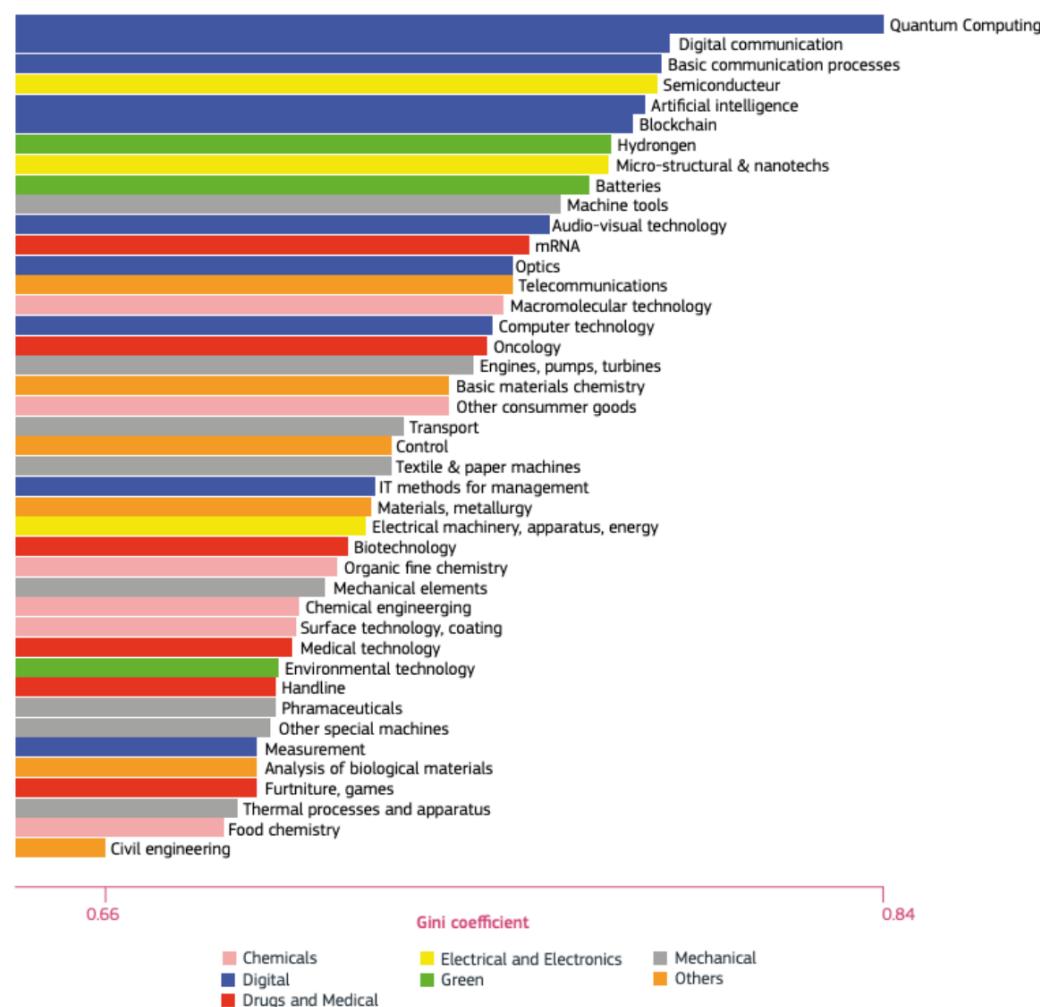
# Complex activities concentrate in large cities



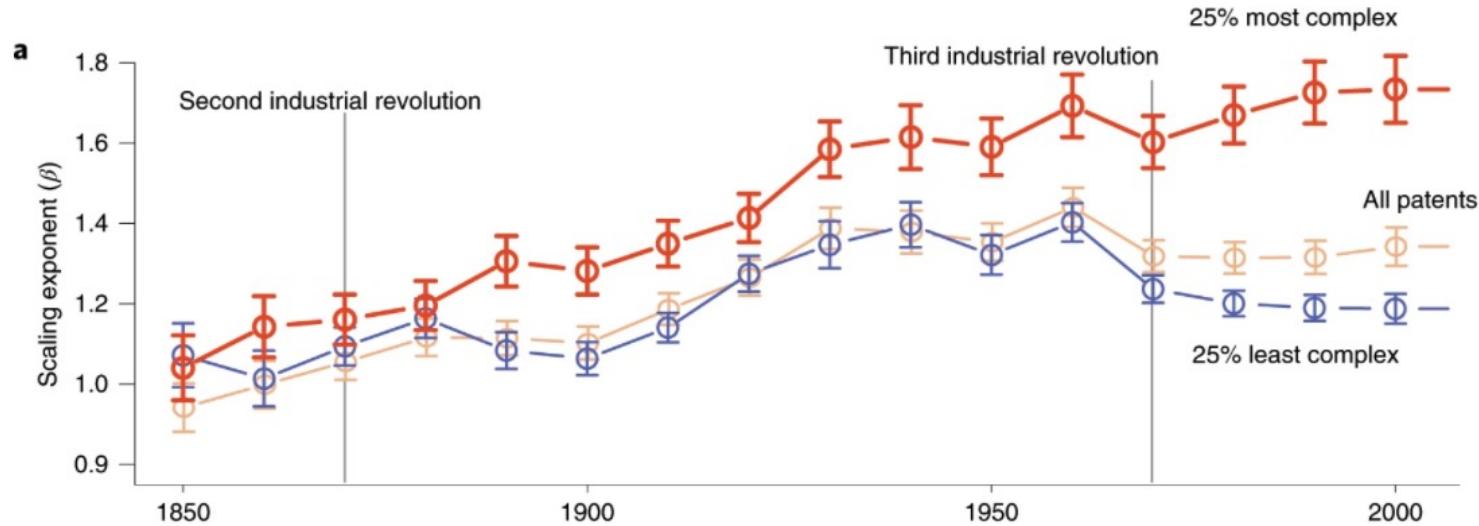
Balland, P.A., Jara-Figueroa, C., Petralia, S., Steijn, M., Rigby, D., and Hidalgo, C. (2020)  
Complex Economic Activities Concentrate in Large Cities, *Nature Human Behavior*

# Complex activities concentrate in large cities



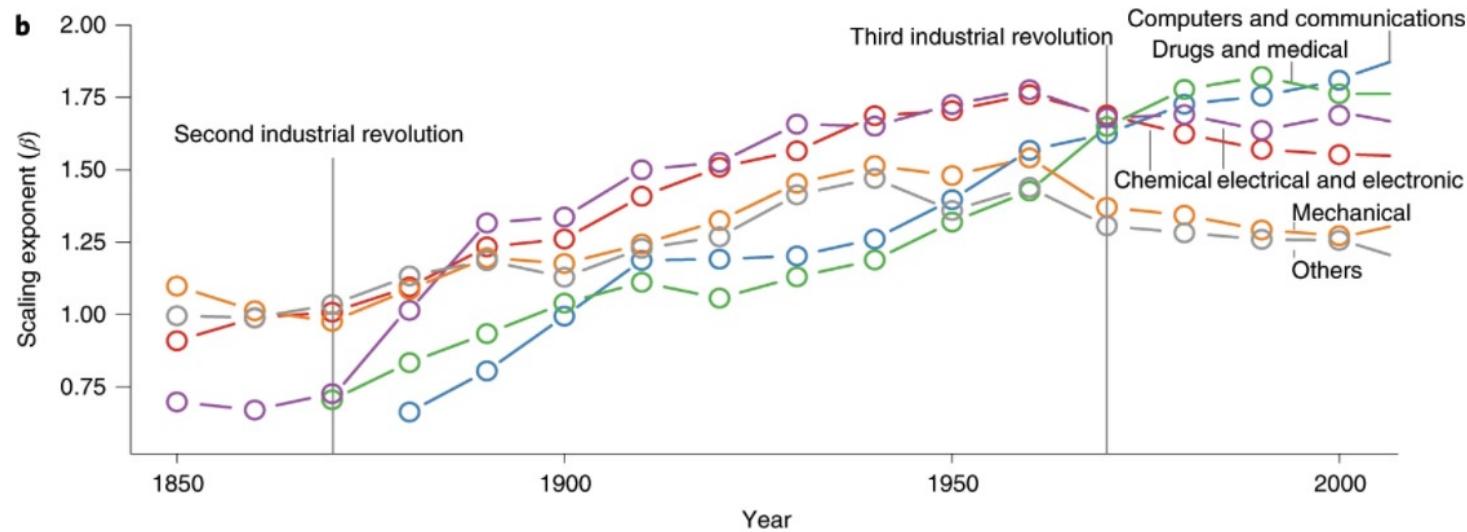


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Balland, P.A., Jara-Figueroa, C., Petralia, S., Steijn, M., Rigby, D., and Hidalgo, C. (2020)  
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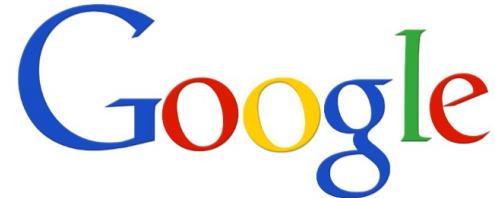


Balland, P.A., Jara-Figueroa, C., Petralia, S., Steijn, M., Rigby, D., and Hidalgo, C. (2020)  
Complex Economic Activities Concentrate in Large Cities, *Nature Human Behavior*

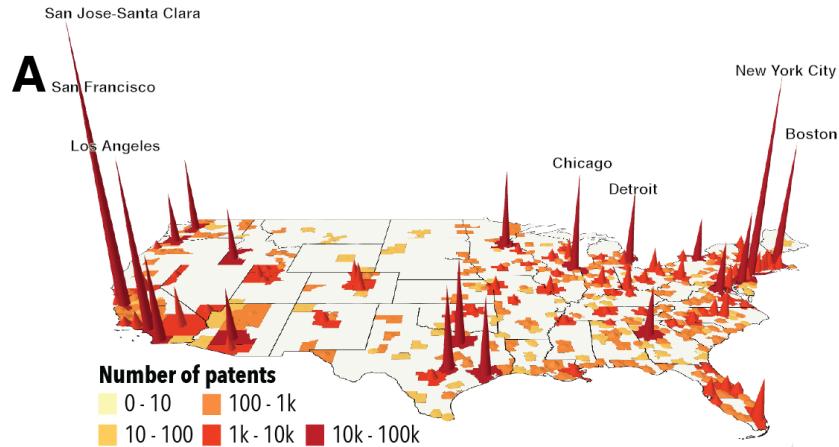
**WINNER TAKES-  
ALL ECONOMY**

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

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



**WINNER TAKES-  
ALL ECONOMY**



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

*Knowledge increasingly  
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more complex*

**WINNER TAKES-  
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THE WORLD OF  
KNOWLEDGE  
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**WINNER TAKES-  
ALL ECONOMY**

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

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

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

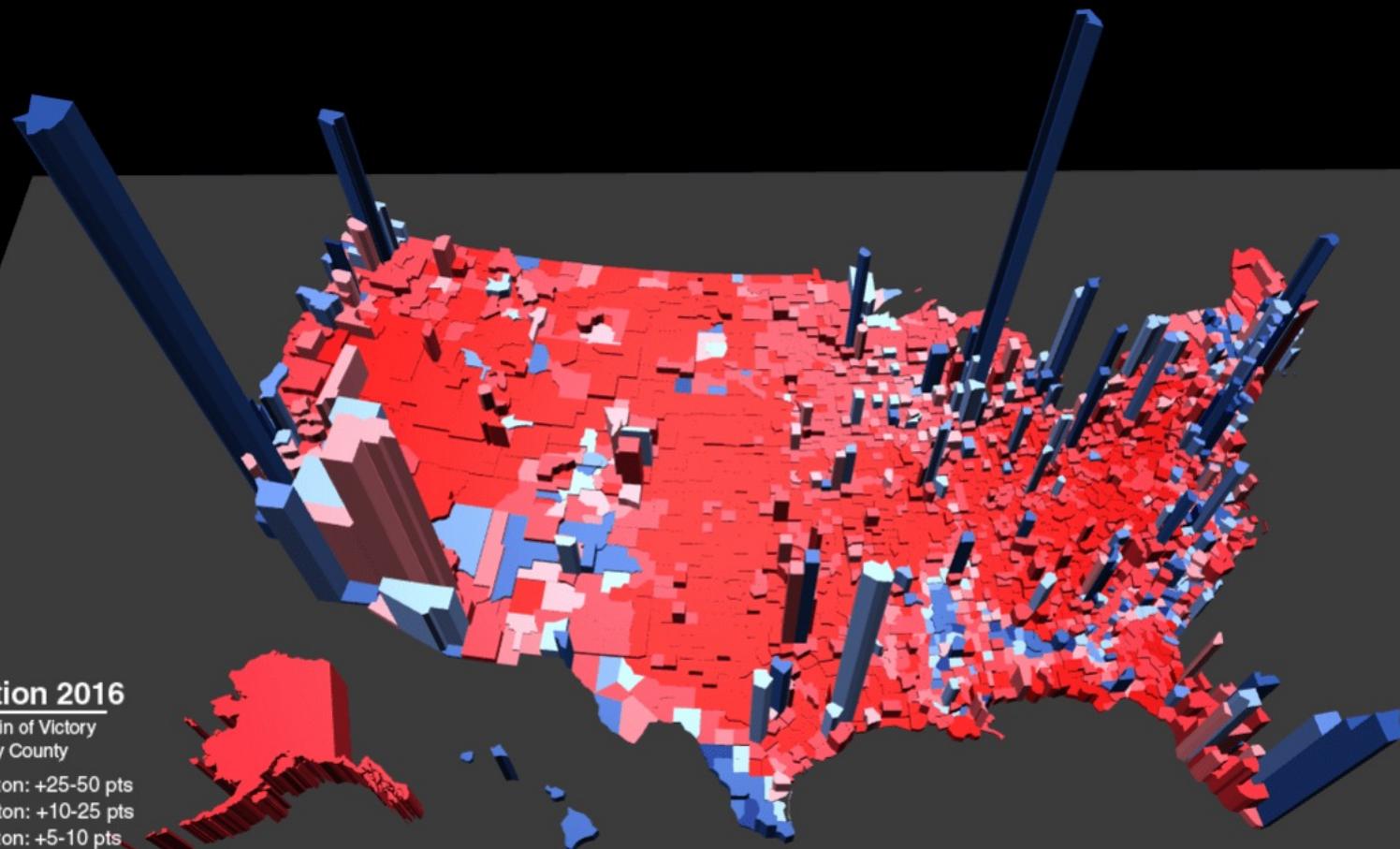
*Knowledge increasingly concentrates as it becomes more complex*

**WINNER TAKES-  
ALL ECONOMY**

+

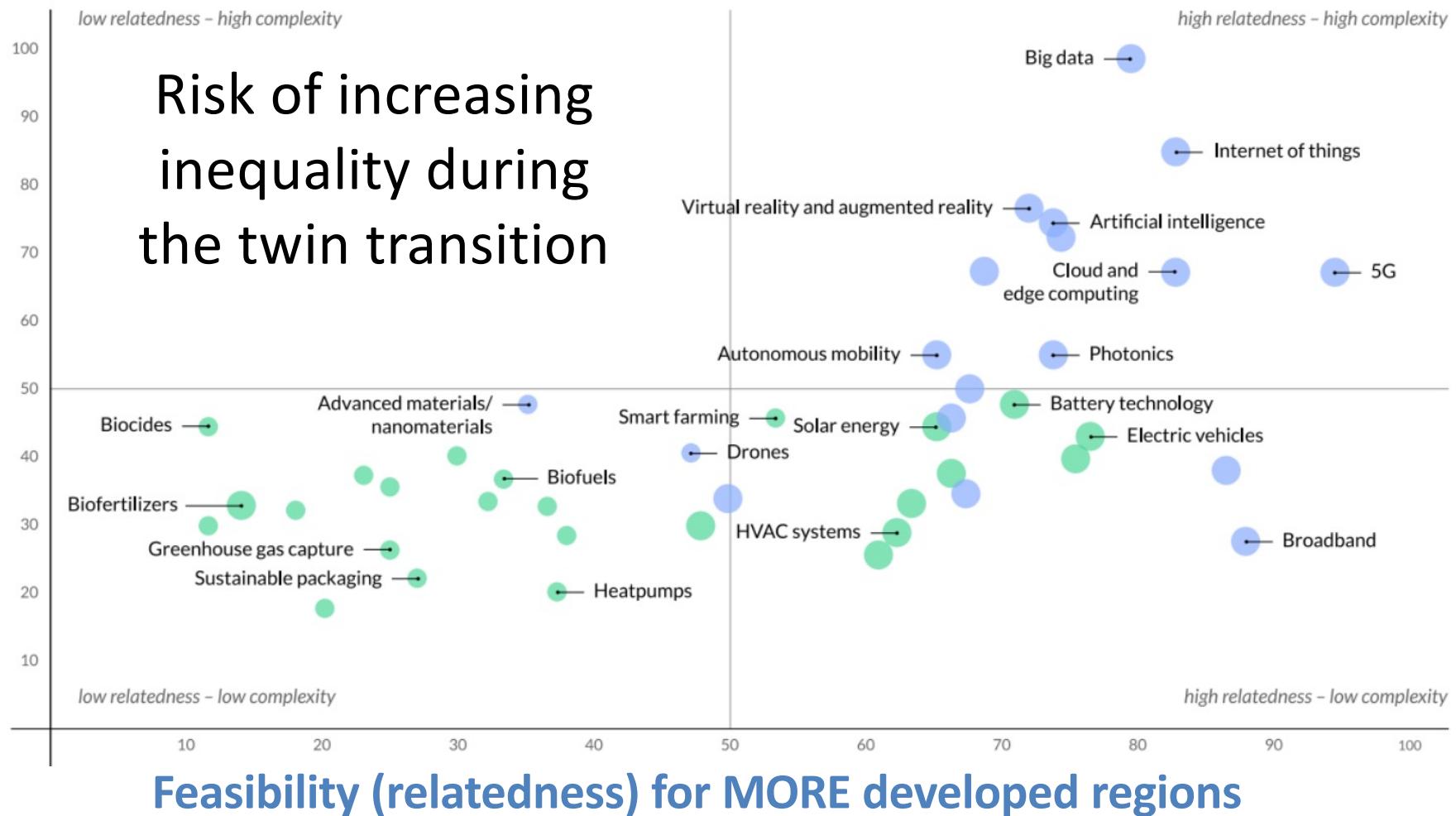
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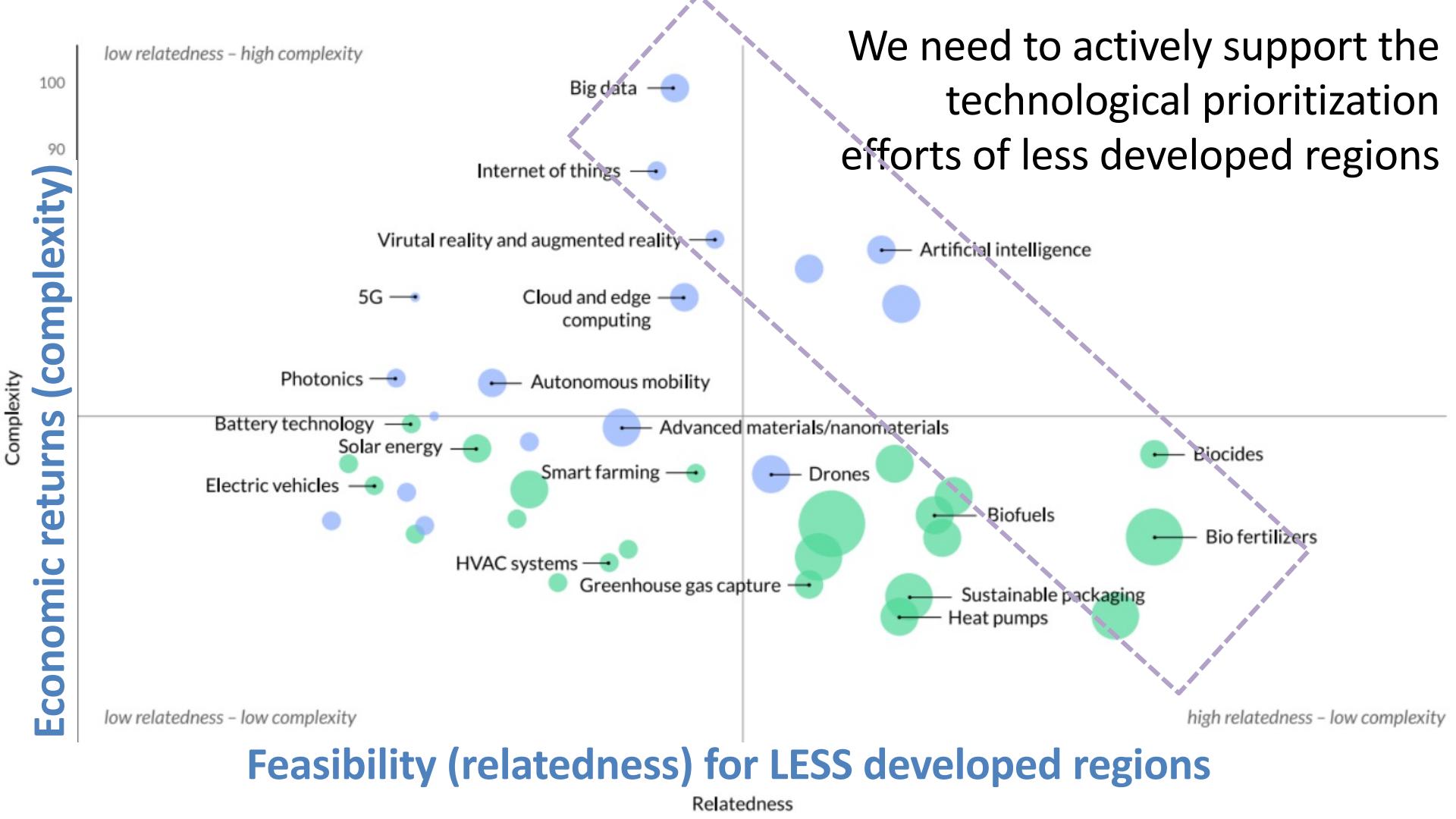
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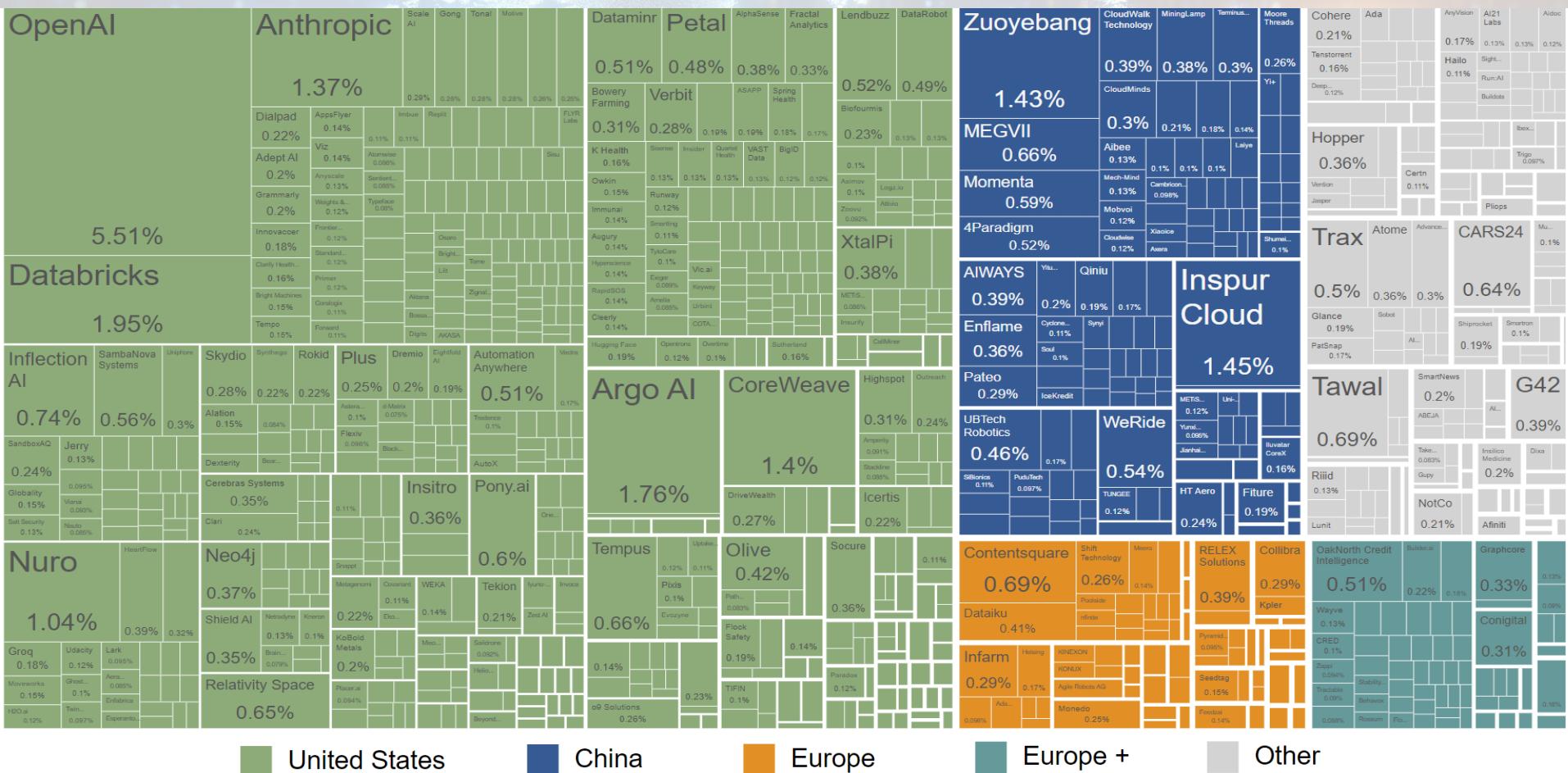
# Risk of increasing inequality during the twin transition

Economic returns (complexity)

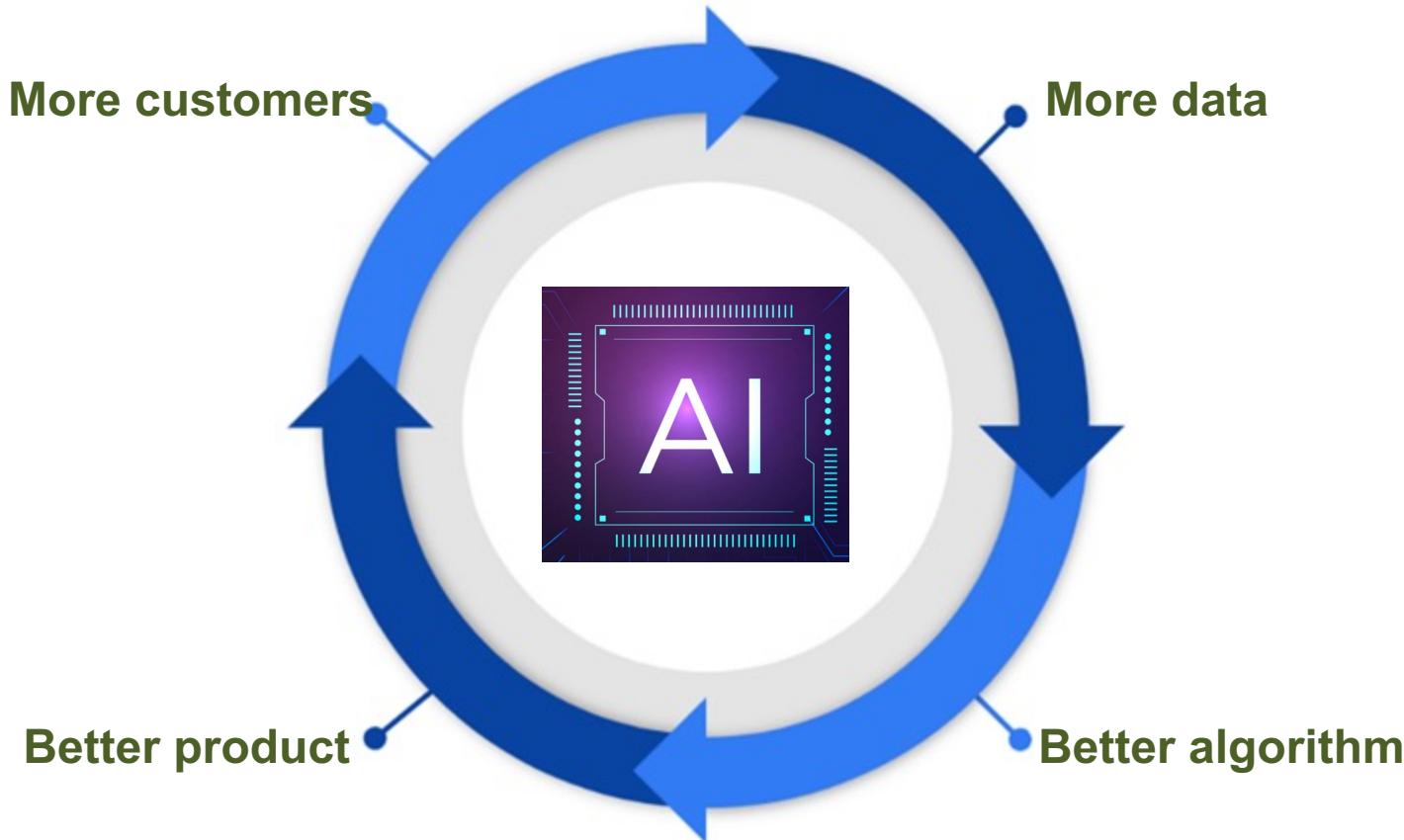


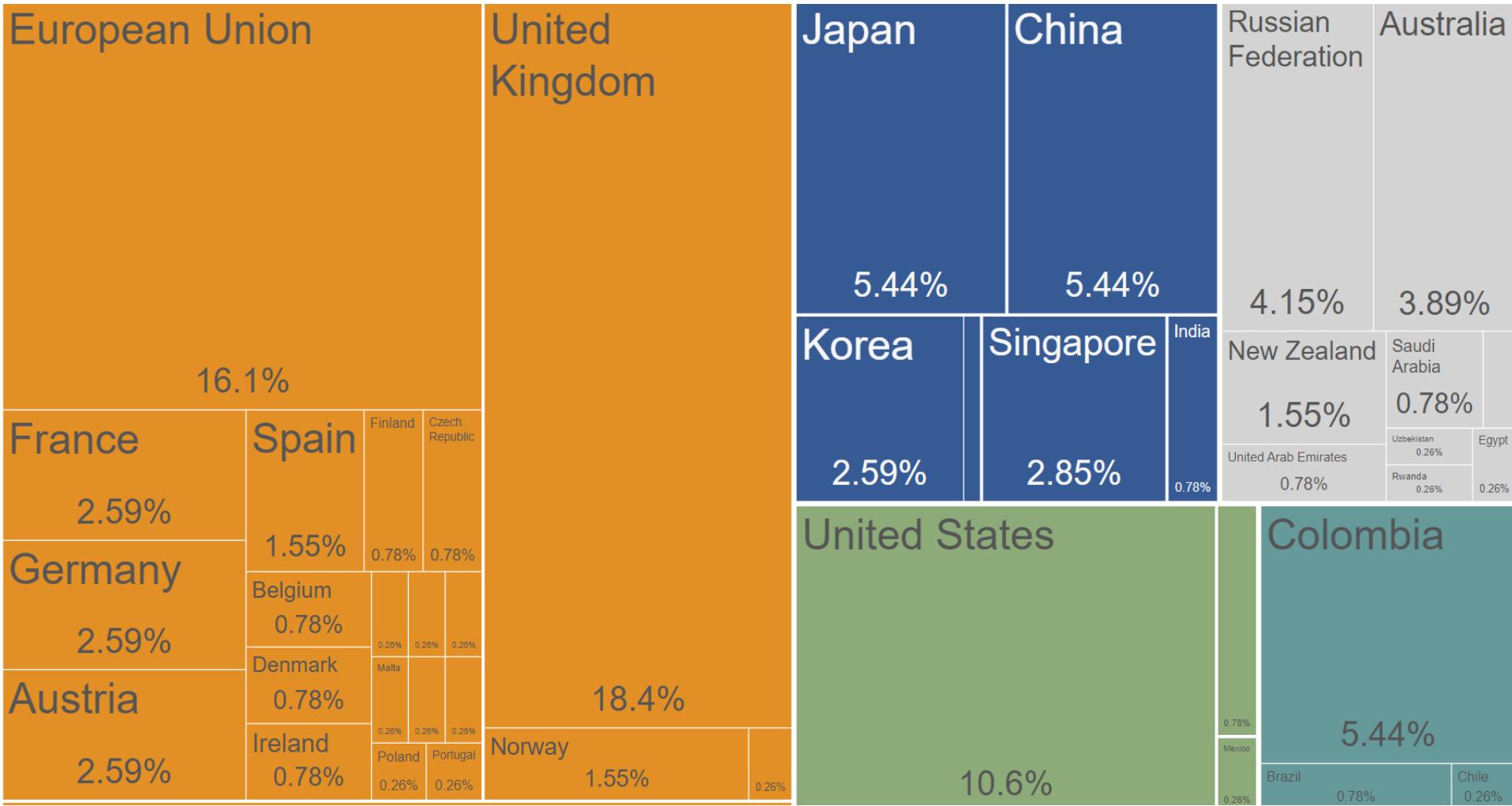


# Top AI start-ups (\$)



# Feedback (big) Data Loops

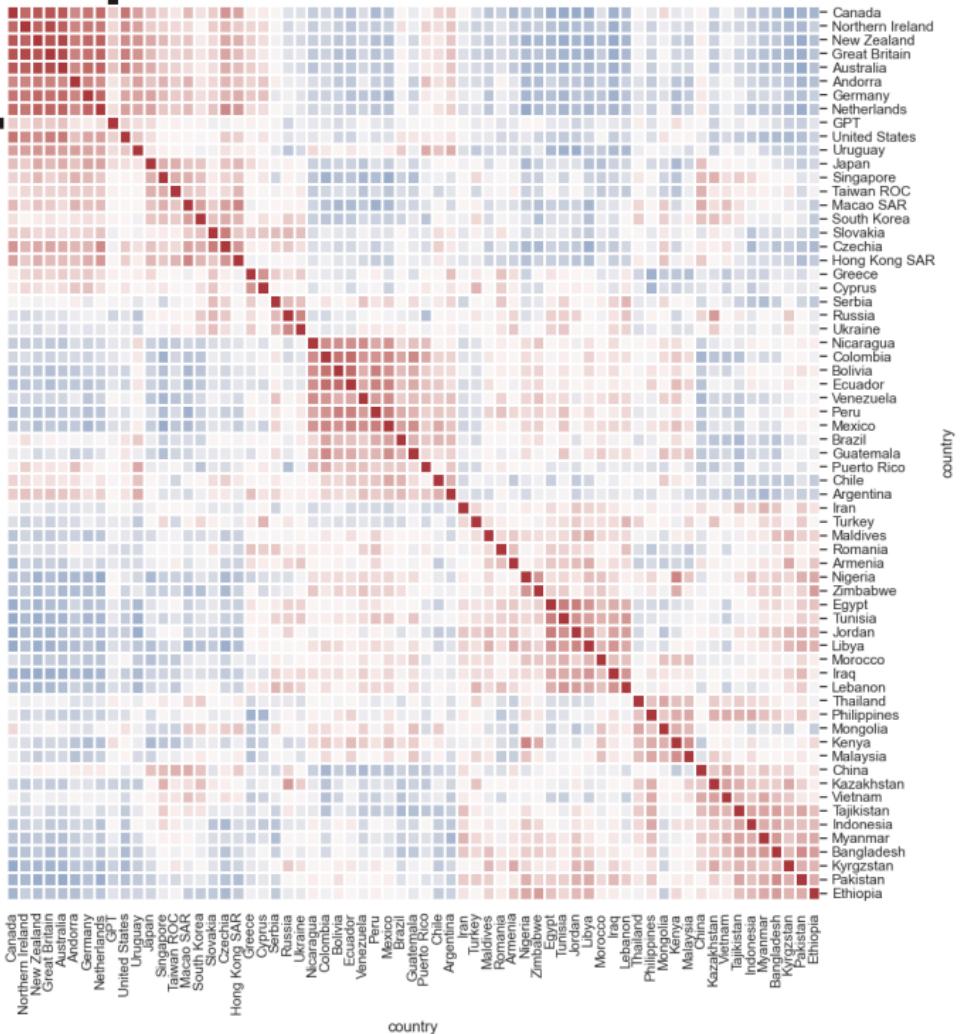




Source: Utrecht Students from the Economics of Networks Class (SGPL/USE)

# AI & the new geography of jobs





# LLMs and human performance. Which humans?

Biased towards WEIRD countries (Western, Educated, Industrialized, Rich and Democratic)



*Atari et al. (2023) Which humans?*



MISTRAL  
AI\_

Noord-Brabant

Inner London

Oberbayern

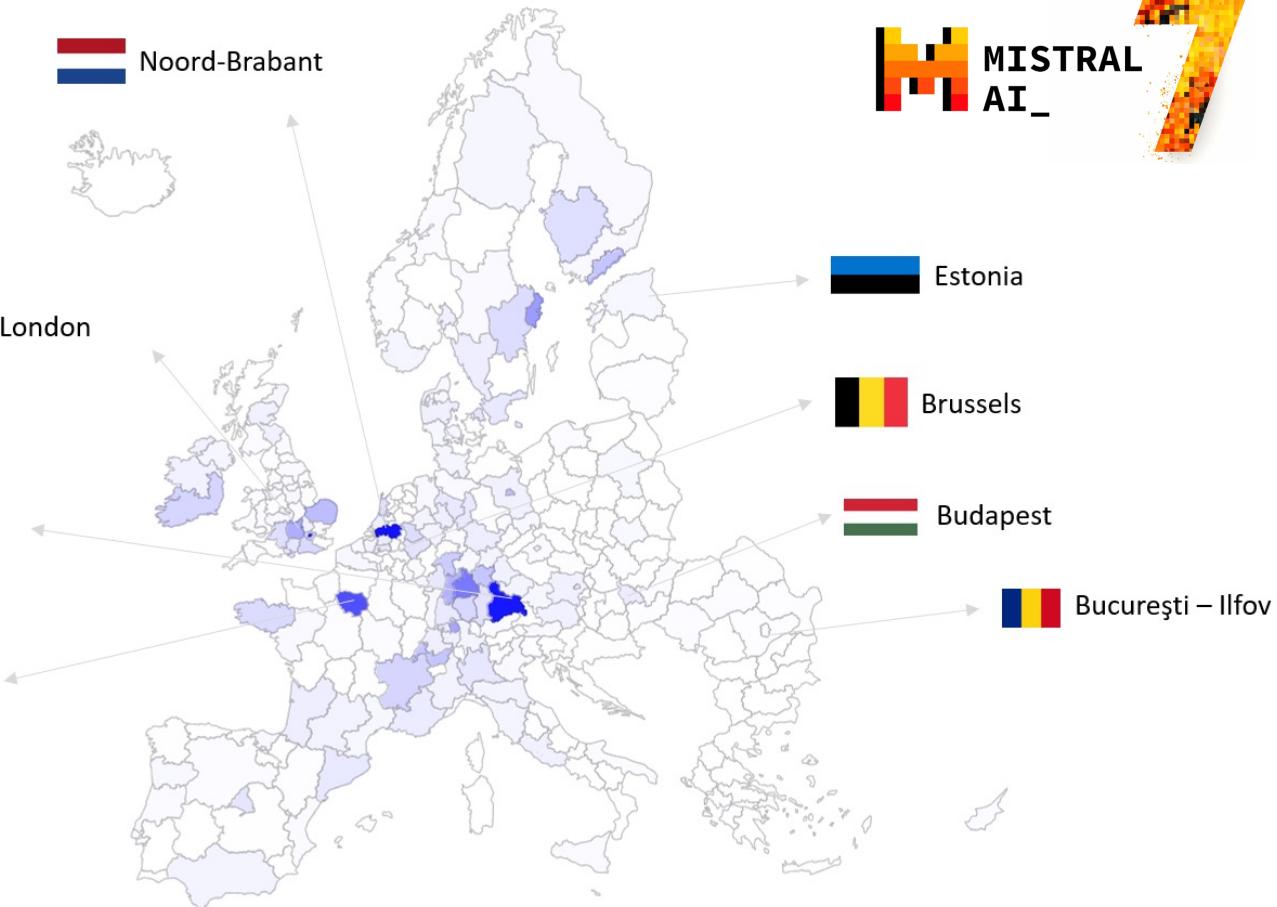
Ile de France

Estonia

Brussels

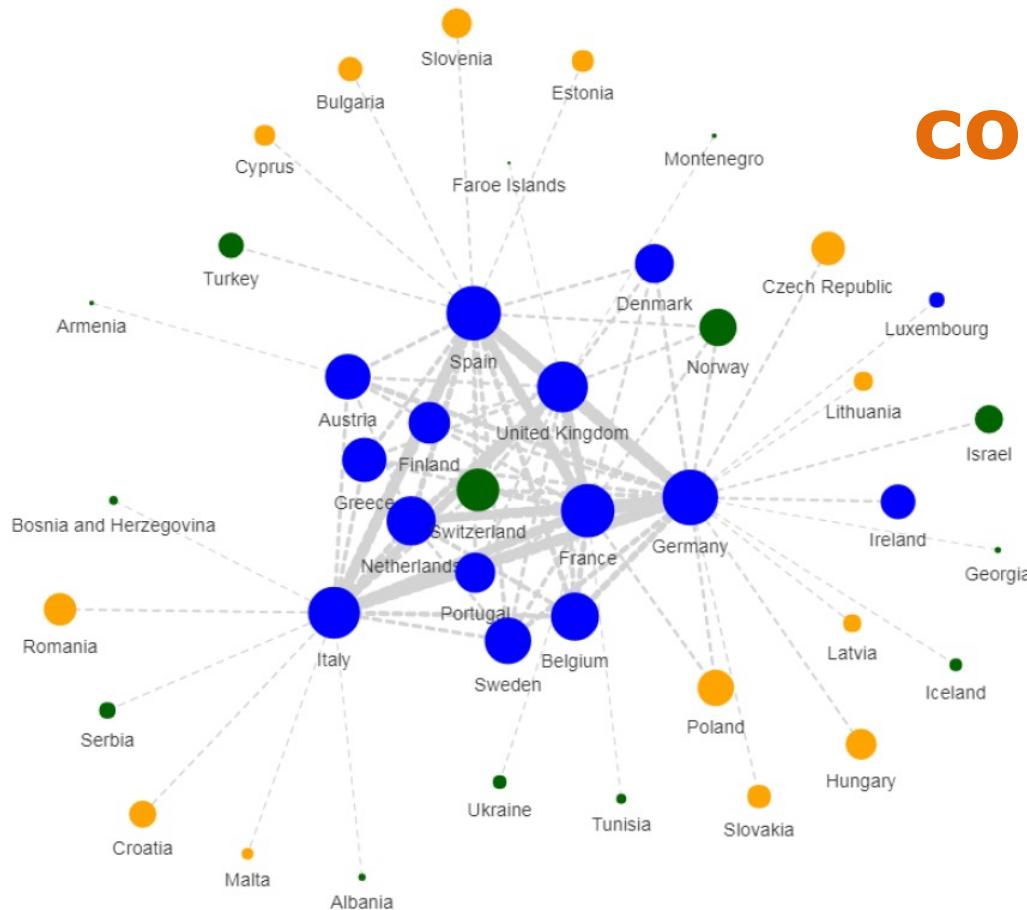
Budapest

Bucureşti – Ilfov



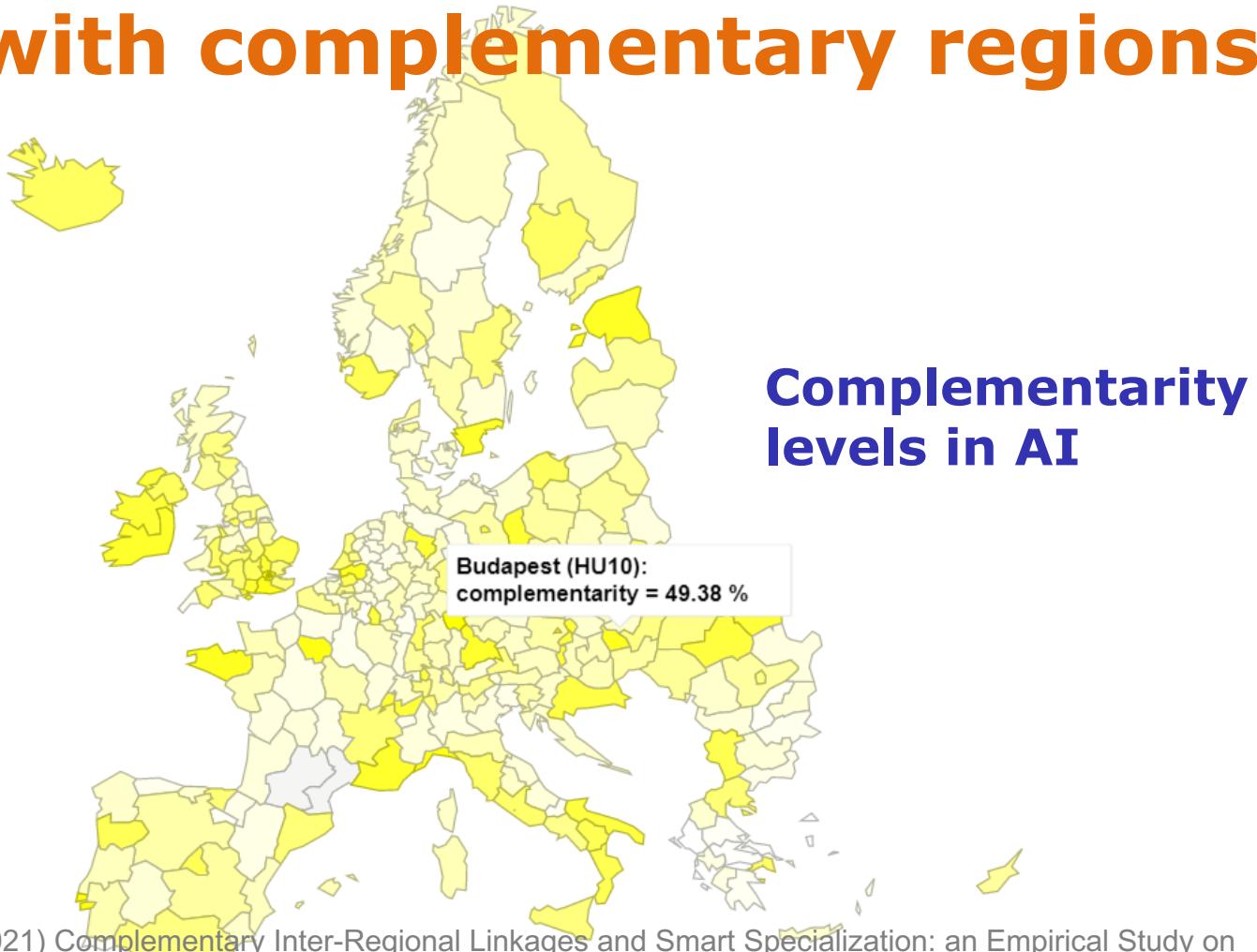
Share of AI patents in Europe

# H2020 collaborations



Oberbayern - Mittelfranken		Oberbayern - Niederbayern	Düsseldorf - Köln	Karlsruhe - Rheinhessen-Pfalz	Oberfranken - Mittelfranken	Oberbayern - Berlin	Stuttgart - Oberbayern	Île de France - Rhône-Alpes	Île de France - Nord - Pas-de-Calais	Île de France - ...	Île de France - Alsace	Stockholm - Östra Mellansverige	Zürich - Stuttgart	Espace...	Zürich - Inner London	Région...	
2.08%		1.01%	0.95%	0.95%	0.95%	0.88%	0.88%	1.01%	0.38%	0.38%	0.38%	2.46%	0.38%	0.32%	0.38%	0.19%	0.19%
Stuttgart - Tübingen	0.69%	Berlin - Düsseldorf	Oberbayern - Thüringen	Berlin - Darmstadt	Berlin - ...	Freiburg - ...	Stuttgart - Schwaben	...	Tübingen - Schwaben	...	...	2.46%	0.25%	0.25%	0.25%	0.19%	0.19%
1.64%		Tübingen - Oberbayern	0.63%	Oberbayern - ...	0.32%	0.38%	0.38%	0.38%	0.38%	0.38%	0.38%	0.57%	0.25%	0.25%	0.19%	0.13%	0.13%
Stuttgart - Karlsruhe	1.39%	Oberpfalz - Mittelfranken	0.63%	Darmstadt - Köln	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.57%	0.25%	0.25%	0.19%	0.19%	0.19%
Karlsruhe - Darmstadt	1.32%	Stuttgart - Freiburg	0.57%	Oberbayern - ...	0.25%	0.10%	0.10%	0.19%	0.10%	0.10%	0.10%	0.57%	0.25%	0.25%	0.19%	0.19%	0.19%
Oberbayern - Schwaben	1.13%	Düsseldorf - Amsberg	0.44%	Weser-Ems - ...	0.32%	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.44%	0.25%	0.25%	0.19%	0.19%	0.19%
Berlin - Brandenburg	1.01%	Tübingen - Detmold	0.44%	Trier - Saarland	0.32%	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.44%	0.25%	0.25%	0.19%	0.19%	0.19%
Inner London - Outer London	1.77%	Karlsruhe - Oberbayern	0.44%	Stuttgart - ...	0.32%	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.38%	0.25%	0.25%	0.19%	0.19%	0.19%
Inner London - Berkshire, Buckinghamshire and Oxfordshire	1.13%	Freiburg - ...	0.32%	Mittelfranken - ...	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.38%	0.25%	0.25%	0.19%	0.19%	0.19%
East Anglia - Inner London	0.76%	Berlin - ...	0.25%	Berlin - Köln	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.88%	0.25%	0.25%	0.19%	0.19%	0.19%
Berkshire, Buckinghamshire and...	0.57%	Unterfranken - ...	0.25%	Unterfranken - ...	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.57%	0.25%	0.25%	0.19%	0.19%	0.19%
Berkshire, Buckinghamshire and...	0.5%	Surrey, East and...	0.32%	Surrey, East and...	0.25%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	Syddanmark - Midtjylland	0.32%	0.25%	0.19%	0.19%	0.19%
												Hovedstaden - ...	0.32%	0.25%	0.19%	0.19%	0.19%
												Länsi-Suomi - Helsinki-Uusimaa	0.32%	0.25%	0.19%	0.19%	0.19%
												Niederoesterreich - Wien	0.69%	0.32%	0.32%	0.32%	0.32%
												Noord - ...	0.32%	0.25%	0.19%	0.19%	0.19%
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												Sud-Est - Bucuresti...	0.25%	0.25%	0.19%	0.19%	0.19%
												Sud - ...	0.25%	0.25%	0.19%	0.19%	0.19%
												Aragón... - ...	0.13%	0.13%	0.13%	0.13%	0.13%
												Praha - Střední...	0.25%	0.25%	0.13%	0.13%	0.13%
												Praha - ...	0.25%	0.25%	0.13%	0.13%	0.13%
												Oslo og Akershus...	0.25%	0.25%	0.19%	0.19%	0.19%
												Düsseldorf - ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Köln - ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Région de ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Eesti - ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Toscana - ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Castilla - ...	0.19%	0.19%	0.19%	0.19%	0.19%
												Közép - ...	0.19%	0.19%	0.19%	0.19%	0.19%

# Connect with complementary regions



# 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

The screenshot shows a web browser displaying an article from the journal "scientific data". The URL in the address bar is nature.com/articles/sdata201674. The page header includes links for "Explore content", "About the journal", and "Publish with us". Below the header, the breadcrumb navigation shows: nature > scientific data > data descriptors > article. The main title of the article is "Unveiling the geography of historical patents in the United States from 1836 to 1975". The authors listed are Sergio Petralia, Pierre-Alexandre Balland, and David L. Rigby. The article is categorized under "Scientific Data" volume 3, Article number: 160074 (2016). It has 7585 accesses, 31 citations, 8 Altmetric metrics, and a link to "Cite this article".

Thanks!