



European
University
Institute

ROBERT
SCHUMAN
CENTRE FOR
ADVANCED
STUDIES



The increasing complexity of 5G technology: an issue for global competition?

Pier Luigi Parcu, Niccolò Innocenti and Chiara Carrozza
European University Institute

**9th Conference on the Regulations of Infrastructures: Sector Coupling.
How to regulate convergence?
24 - 26 June 2020**



THE EVOLUTION OF “GENERATIONS” OF TECHNOLOGIES IN MOBILE COMMUNICATION



- The **telecommunication industry** is used to frequent technological "generations" updates arriving almost every decade (Cave, 2018; Oughton et al., 2018; Han and Sohn, 2016).
- However, the fifth generation of mobile telecommunications promises a **much deeper change** than ever previously occurred (Teece, 2018) **going well beyond the telecommunication industry** (Cave, 2018). The 5G is actually expected to drive:
 - IoT that will facilitate the adoption for smart homes and smart cities domain (Aazam et al., 2018).
 - Healthcare, vehicle automation, smart farms (Anwar and Prasad 2018).
 - Augmented reality and virtual reality (Hsieh, 2018; Chang, 2019).
- In this respect **5G may be described as a General-Purpose-Technology (GPT)** almost on the same standing as electricity or the Internet. In fact, **GPTs** are characterized by:
 - pervasiveness across most sectors of the economy;
 - fast evolution;
 - ability to enable further products' or process' innovation.



INTRODUCTION

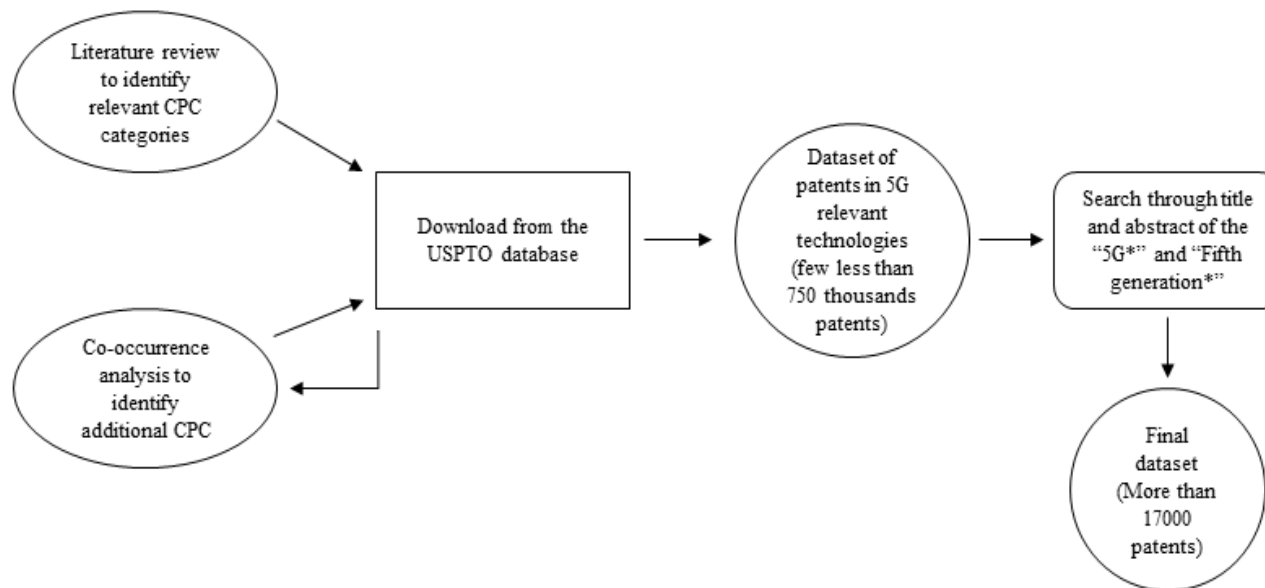
- While the debate regarding 5G development, implementation and disruptiveness is gathering growing attention (Cave, 2018, Campbell et al., 2017; Rao et al., 2018), a key concern emerges: the **growing complexity** of the 5G technology may act as a **barrier to the new entrants**.
- Apparently, only a **handful of companies** lead the **development of the 5G standards** (Huawei, Qualcomm, Intel, Samsung, LG, Nokia, Sharp and NTT DOCOMO). **The crucial question is: will this become a factor hampering global competition?**
- This paper addresses the **technological and business environment's complexity of the 5G ecosystem** and the related **implication for competition and innovation**, following the growing literature on economic and technological complexity (Hidalgo and Hausmann, 2009; Balland and Rigby, 2017).



- The concept of **complexity** following Hidalgo's seminal work (2009) is based on two main characteristics:
 - **Diversity** how many different technological specialisations are present in a country.
 - **Ubiquity** how rare are these technological specialisations.
- The idea is that if **many different technological specialisations** are needed to advance in a particular technology and if these **specialisations are also rare**, the complexity of the technology will be high.
- There is a lack of studies connecting complexity to access to technologies and market competition. **More complexity** leads to global "oligopolies", with **few actors around the globe developing and holding crucial technologies, such as the 5G**, and this is a matter of research and policy concern. We explore the issue for 5G.



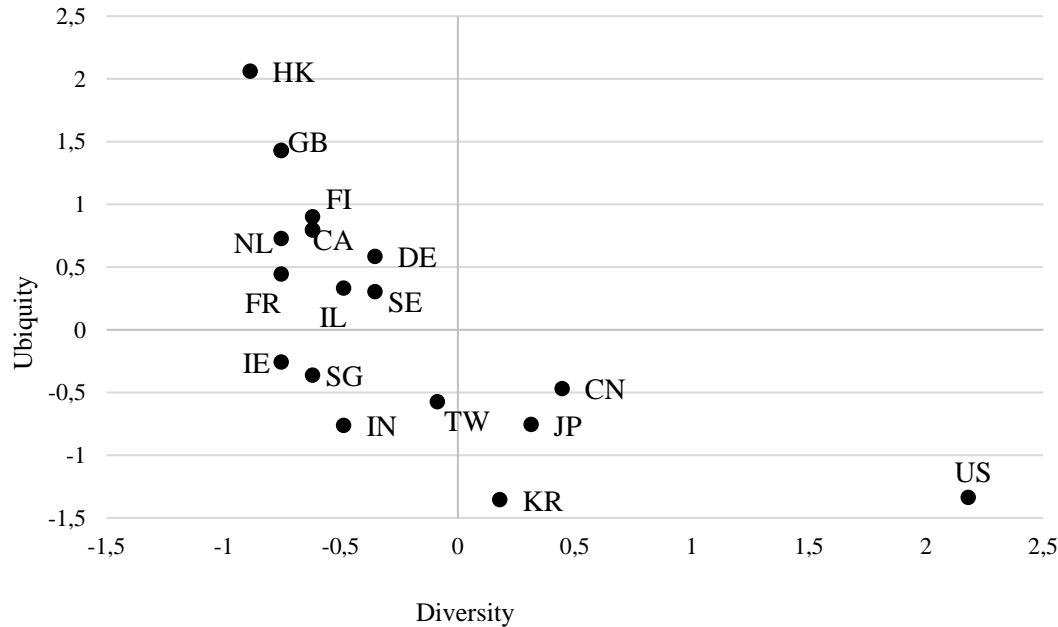
RESEARCH DESIGN



- Cooperative Patent Classification (CPC) represent the technological classes to which the patent pertain. The main CPC involved in the 5G are the following:
 - **H04** “electric communication technique”;
 - **G06** “computing; calculating or counting”;
 - **H01** “basic electric elements”;
 - **H03** “basic electronic circuitry”.
- The **number of patents** in these technological classes **increased** from less than 50.000 in the 2010 to more than 100.000 per year in the 2019.
- The **average number of CPC involved** in each of these patents **increased** form few more than 1.2 in the 2010 to almost 2.5 in 2019

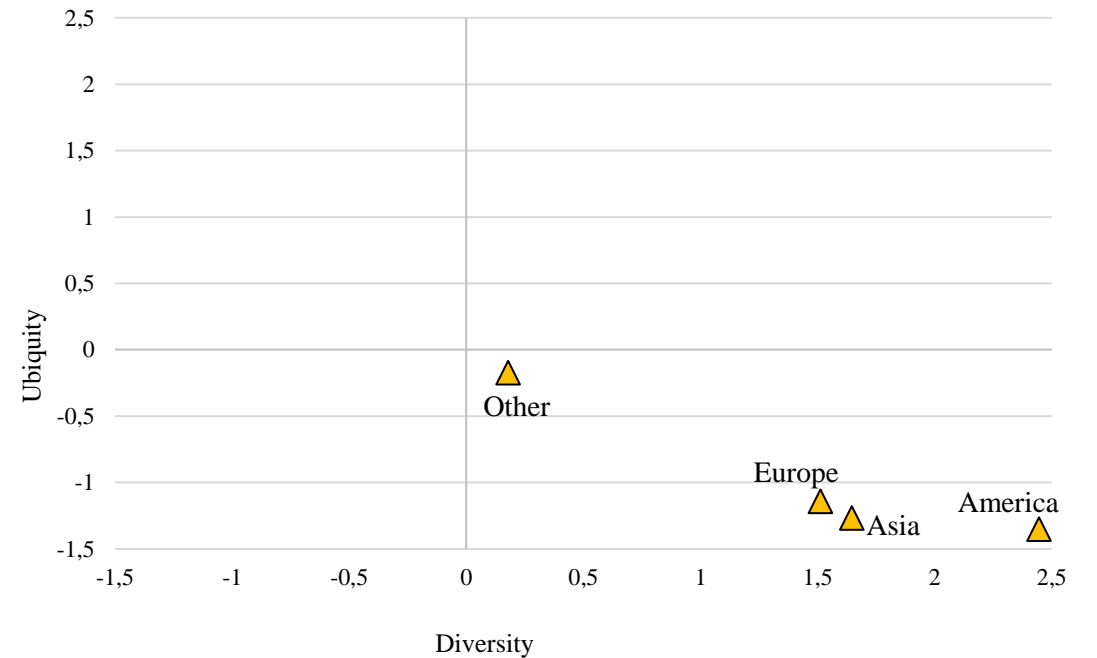
MAIN RESULT

Diversity and ubiquity 2010-2019 technological specialisations for the most “innovative countries”



All the countries in the lower-right quadrant (US, China, Korea and Japan) can be considered as the leaders in the 5G technology, apparently owning many and rare specialisations

Diversity and ubiquity 2010-2019 technological specialisations for world regions.



When Europe is considered as a whole, it reaches values very close to Asia in the lower right quadrant. This suggests that an EU common strategy could change the panorama of the global competition for 5G



CONCLUSIONS

- The study provides a first evidence-based indication that the technologies and the **specialisations needed to develop the 5G** are increasingly in **the hands of few companies/countries** around the globe, and that there is a strong and **increasing divide between these countries and the followers.**
- This mechanism of cumulative innovation **severely limit the opportunity of other countries to specialise in the 5G. Only few most advanced countries,** which specialise in the largest possible number of technologies, are **able to participate to the race to license the “complex technology” that leads to 5G.**
- In the 5G technology the present **leadership of US, China, Japan and Korea** is clearly to be acknowledged, as well as the **weakness and retard of single European countries** - with few notable exceptions.
- However, our **analysis for regions** suggests that the **position of Europe could significantly change** if the countries within the EU were able to develop the **right incentives to cooperate. In this case the global competition could take a different and more satisfactory turn.**



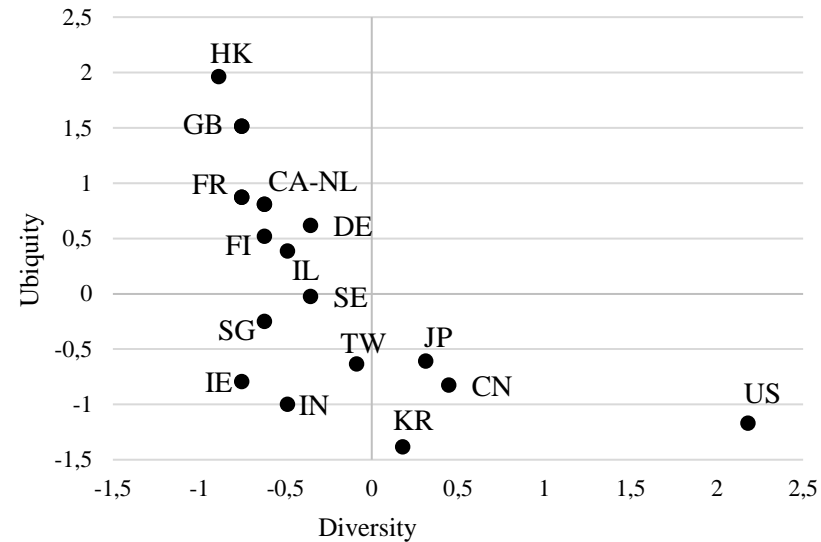
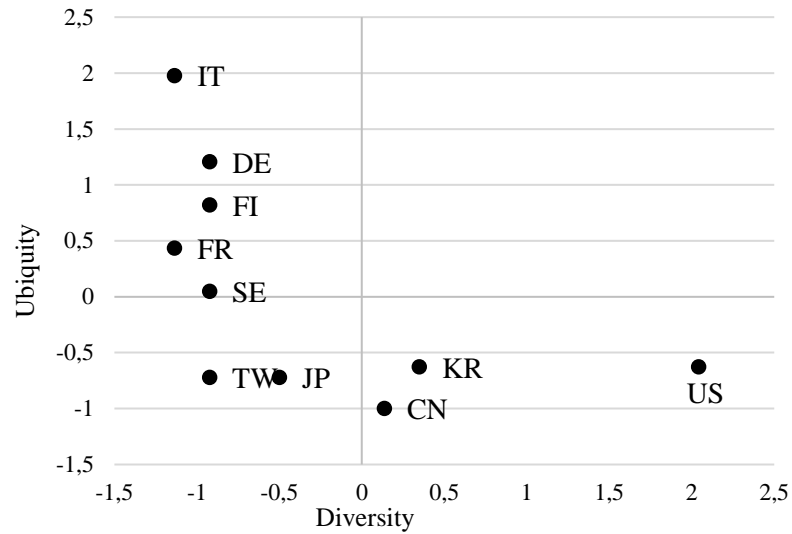
European
University
Institute

ROBERT
SCHUMAN
CENTRE FOR
ADVANCED
STUDIES



Thank you for your attention!

Diversity and ubiquity technological specialisations 2010-2014 and 2015-2019 “most innovative” countries.



Diversity and ubiquity technological specialisations 2010-2014 and 2015-2019 for regions.

