An Evolutionary View on the Emergence of Artificial Intelligence

AI Relatedness in the considered IPC fields

AI Knowledge Complexity in the considered IPC fields

Period — Period 1 (1974-1988) — Period 2 (1989-2003) — Period 3 (2004-2018)
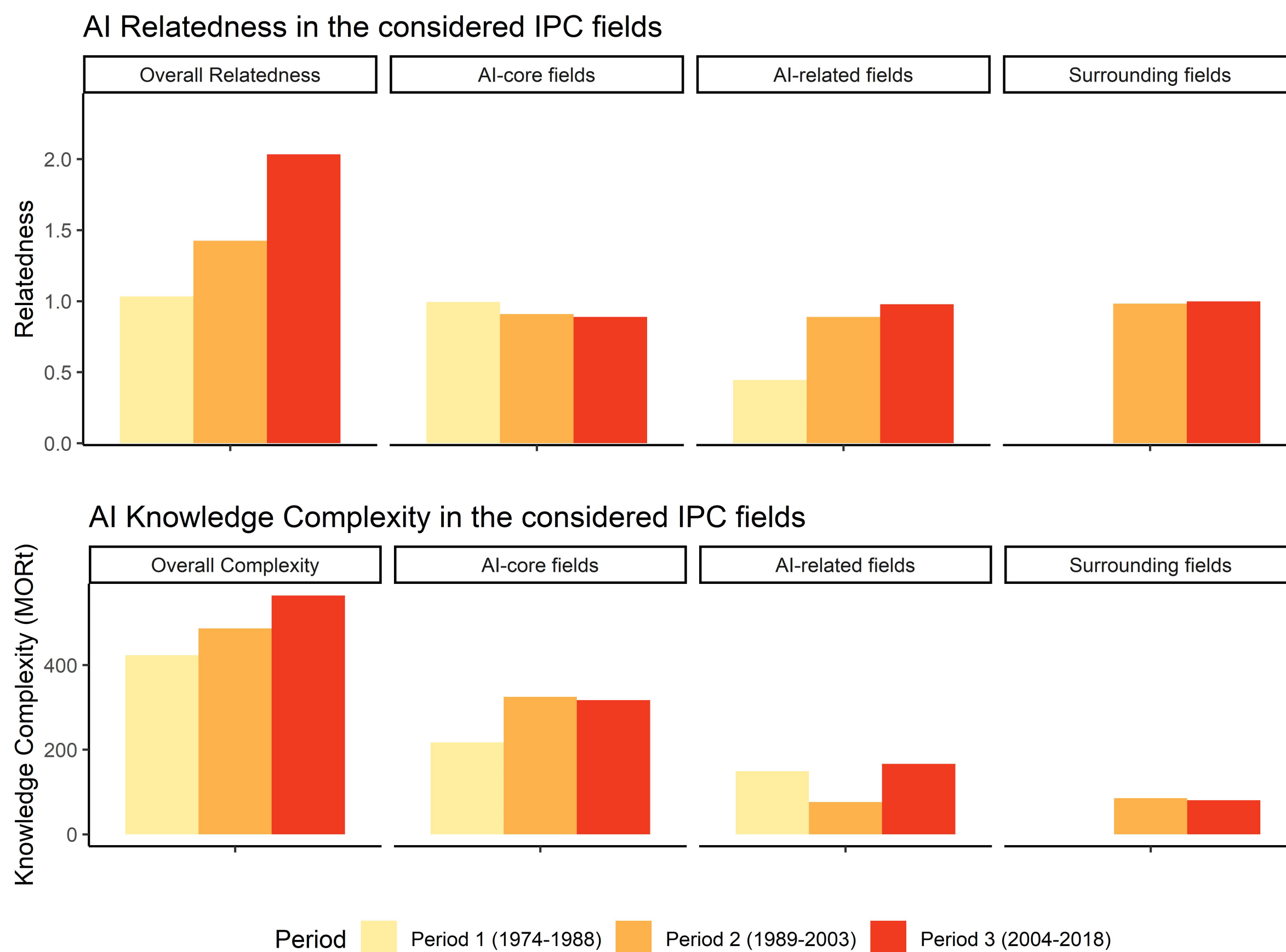
AI innovations are becoming increasingly complex and specialized.

- *Increase in complexity: AI is to bring greater economic benefits to companies and countries exploring it.*

- *Increase in relatedness: AI is becoming highly-specialized, meaning that AI innovations are becoming increasingly distinct from other technologies while also demanding greater efforts to be developed.*

Distinct trend for innovations at the core-fields of AI

- *Decreasing relatedness between technological fields at the technological core of AI, meaning that AI innovations in these fields are becoming increasingly distinct from each other.*

Theoretical background

Technologies present distinct specific characteristics that change over time: complexity (value) and relatedness (specialization).

- Complexity → more valuable technologies/products are harder to be produced because they demand more sophisticated capabilities (Hidalgo & Hausmann, 2009).

- Relatedness → companies are able to develop only technologies to which they share some related knowledge-base (Breschi et al., 2003).

Method and data

Patents and inventors' information as proxy for knowledge location (De Rassenfosse et al., 2019).

Analysis at the global and national level.

- Focus on four countries for the national perspective: US, South Korea, Japan, and China → 92% of AI patents.

Technological space framework (Hidalgo et al., 2007) to <u>visualize</u> the relatedness and complexity of techn. Fields.

Complexity and relatedness indices (Balland, 2017) to <u>quantify</u> the evolution of countries and AI over time.

Propositions

- Proposition I: AI emergence at the global level is associated with increasing related variety due to knowledge-relatedness as well as increasing complexity.

- Proposition II: AI's evolution affects the technological paths of countries exploring it by increasing the overall relatedness and complexity of innovations developed by these countries.

Main Takeaways

- <u>AI increasingly complex</u>, i.e., more sophisticated capabilities are needed to develop it but also increasing profitability.

- <u>AI increasingly specialized</u>, i.e., a higher variety of capabilities is needed to develop it and AI-specific knowledge can't be easily adapted to develop other technologies.

- <u>Countries</u> leading AI develop. are also <u>increasing the average complexity</u> (higher econ. benefits) of all of their inventions.

- <u>Not all countries</u> leading AI develop. are increasing the average relatedness of their inventions; i.e., some countries are producing technologies increasingly <u>distinct</u> from the ones they had created so far.

References

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January 2021