



palgrave▶pivot

The Digital Innovation Race

Conceptualizing the Emerging New World Order

Cecilia Rikap
Bengt-Åke Lundvall

palgrave
macmillan

The Digital Innovation Race

Cecilia Rikap · Bengt-Åke Lundvall

The Digital Innovation Race

Conceptualizing the Emerging New World Order

palgrave
macmillan

Cecilia Rikap
City, University of London
London, UK

CONICET
Buenos Aires, Argentina

Bengt-Åke Lundvall
Aalborg University
Copenhagen, Denmark

ISBN 978-3-030-89442-9 ISBN 978-3-030-89443-6 (eBook)
<https://doi.org/10.1007/978-3-030-89443-6>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer
Nature Switzerland AG 2021

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Cover illustration: © John Rawsterne/[patternhead.com](https://www.patternhead.com)

This Palgrave Macmillan imprint is published by the registered company Springer Nature Switzerland AG

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

PREFACE

The collaboration leading to this book began almost two years ago and it started with a meeting in cyberspace between two scholars with quite different backgrounds. Bengt-Åke, a senior male European working within economics and management of innovation and knowledge and Cecilia, a young woman scholar from Latin America working on corporate power in the era of intellectual monopoly capitalism. This is reflected in the analytical perspectives in the book where insights from innovation studies are combined with political economy perspectives.

What we have in common is a deep concern regarding current trends in world development. While the enormous resources invested in science and advanced technologies have created the potential to establish an egalitarian and democratic world that could put a stop to global warming as well as global pandemics, at present, these opportunities are squandered.

This gap, between what could be done to create a sustainable world and what we actually witness, reflects, as we see it, two fundamental characteristics of world governance: the transformation of knowledge into private property and techno-nationalism. With fundamental changes in these two dimensions, there are grounds for optimism.

As compared to tangible resources, knowledge has unique characteristics. It is not a scarce resource—the more you use it the more you get. This is certainly true for experience-based knowledge, where people and

organizations learn from what they do. In the current era of artificial intelligence, in particular of machine learning, a similar cumulative mechanism is at work when algorithms are trained through input streams of data.

Within this general perspective, we have focused on digitalization as a second phase of the information and communication technology revolution. Artificial intelligence and digitalization have been hyped for decades, but it was not until recently that this combination has shown an enormous potential both to stimulate economic development and to tackle global challenges related to health and the environment. However, the national and global institutional set-ups hamper the realization of this potential.

As the control of these strategic technologies gets concentrated in a handful of private corporations located in two superpowers increasingly engaged in technological warfare among themselves, there is less room for directing these powerful technologies to address global challenges. Current regulatory regimes and modes of governance are inadequate when it comes to handle this new era of globalized intellectual monopoly capitalism. This is true for national and regional regimes and not least for the weakly developed and contested global regime characterized by a transition from a US-dominated world order to a more multipolar but also more disorderly world.

Our general perspective has taken on new significance in the wake of the Covid crisis. While the speed of developing new vaccines illustrates the power of science, the access to vaccines has been absurdly uneven, with rich countries hoarding vaccines, leaving the population in poor countries with very limited access. Building on research financed by taxpayers, big pharma companies have enriched their shareholders by selling vaccines at prices reflecting the extraction of substantial rents. Even within the rich countries, there is now growing concern that capricious private actors and nationalist strategies determine their citizens' access to jobs.

Furthermore, big pharma companies have expanded their intellectual monopolies since the pandemic started. The enormous amassment of financial resources and intangible assets by digital tech giants documented in this book got another boost from the Covid-19 global crisis. Restrictions on face-to-face interaction resulted in rapid growth in digital services and, as a result, these intellectual monopolies reinforced their worldwide dominance in terms of markets as well as technologies. So, while it took us some time to finalize the book, the delay did not make it lose its relevance.

Overall, this book presents rich and detailed empirical data on digital tech giants, the role of artificial intelligence and the techno-nationalist

strategies of the US and China. In order to give meaning to these data, we introduce them within theoretical framings with roots in political economy and innovation studies. The intention is to contribute to raising awareness of the scale of the changes taking place and, ultimately, stimulate the formation of programs of action. In order to do so, we offer theoretical conceptualizations more adequate than what students can find in standard economic textbooks.

London, UK
Copenhagen, Denmark

Cecilia Rikap
Bengt-Åke Lundvall

CONTENTS

I	A Global Race Between Giant Corporations and Nation States	1
1.1	<i>Introduction</i>	1
1.2	<i>Why Technology War?</i>	3
1.2.1	<i>Artificial Intelligence and the Critical Role of Big Data</i>	3
1.2.2	<i>Platforms, Cloud Computing and Economic Concentration</i>	6
1.2.3	<i>National Security, Warfare and Artificial Intelligence</i>	7
1.2.4	<i>Does China Constitute a Real Threat to US Supremacy?</i>	8
1.2.5	<i>Competing National Innovation Systems</i>	10
1.2.6	<i>New Patterns of Globalization and Trade</i>	10
1.3	<i>Presenting the Corporate Protagonists from the US and China</i>	12
1.3.1	<i>Mechanisms Behind World Dominance</i>	13
1.3.2	<i>Investments in Research and Development and Patenting</i>	13
1.3.3	<i>Pairwise Comparisons Between the Activities of US and Chinese Giants</i>	14
1.3.4	<i>Technological Cooperation and Competition Between Tech Giants</i>	17

1.4	<i>The Structure of the Book</i>	18
	<i>References</i>	20
2	Tech Giants as Intellectual Monopolies	23
2.1	<i>Introduction</i>	23
2.2	<i>The Empirical Evidence</i>	24
2.3	<i>Intellectual Property Rights and Assetization of Knowledge</i>	26
2.4	<i>Mechanisms Behind the Emergence of Intellectual Monopoly Capitalism</i>	27
2.4.1	<i>The Concentration of IPRs</i>	27
2.4.2	<i>Intellectual Monopolies Go Far Beyond IPRs</i>	30
2.4.3	<i>Data-Driven Intellectual Monopolies Are Reinforced by Platform Ownership</i>	31
2.5	<i>Degrees of Intellectual Monopoly—a Taxonomy</i>	32
2.5.1	<i>Intellectual Monopoly of Second Degree</i>	33
2.5.2	<i>Intellectual Monopoly of Third Degree: The GPT Intellectual Monopoly</i>	33
2.5.3	<i>Intellectual Monopoly of Fourth Degree: The Data-Driven Intellectual Monopoly</i>	34
2.5.4	<i>On the Need to Rethink Innovation, Monopoly and Antitrust</i>	35
2.6	<i>Conclusion: Corporate Winners and Losers</i>	37
	<i>References</i>	39
3	Tech Giants' Corporate Innovation Systems	43
3.1	<i>Introduction</i>	43
3.2	<i>The Corporate Innovation System</i>	44
3.3	<i>Why Do We Need a New Concept? Revisiting the Literature</i>	45
3.4	<i>Outsourcing R&D</i>	48
3.5	<i>Profiting from Open-Source Software and App Developers</i>	53
3.6	<i>Acquiring Technology and Entering Markets Through Acquisitions or Investing in Smaller Companies</i>	55
3.7	<i>Conclusions</i>	59
	<i>References</i>	60

4	Tech Giants and Artificial Intelligence as a Technological Innovation System	65
4.1	<i>Introduction</i>	65
4.2	<i>Technology Innovation Systems</i>	66
4.3	<i>Artificial Intelligence as a Technological Innovation System</i>	68
4.3.1	<i>On the Geography of the AI TIS</i>	70
4.3.2	<i>Summing Up on the Characteristics of the AI TIS</i>	71
4.4	<i>AI at the Centre of Tech Giants' Research Efforts</i>	72
4.4.1	<i>Tech Giants Focus on Machine Learning</i>	74
4.4.2	<i>Tech Giants' Engagement in Generic and Specific Functional Application</i>	81
4.4.3	<i>Tech Giants' Dependence on Data Harvesting</i>	82
4.5	<i>The Actors of the AI TIS and the Unique Role of Cloud Computing</i>	84
4.5.1	<i>Cloud Computing and the AI TIS</i>	85
4.6	<i>Concluding Remarks</i>	87
	<i>References</i>	88
5	Amazon and Microsoft: Convergence and the Emerging AI Technology Trajectory	91
5.1	<i>Introduction</i>	92
5.1.1	<i>Technological Paradigms and Technological Trajectories</i>	92
5.1.2	<i>Two Tech Giants' Technological Convergence</i>	93
5.2	<i>Methodology</i>	96
5.2.1	<i>Patents and Publications' Content Analyses</i>	97
5.3	<i>Microsoft's Technological Trajectory</i>	100
5.3.1	<i>Microsoft's Patent Portfolio Analysis</i>	100
5.3.2	<i>Microsoft's Recent Scientific Publications</i>	101
5.4	<i>Amazon's Technological Trajectory</i>	105
5.4.1	<i>Amazon's Patent Portfolio Analysis</i>	105
5.4.2	<i>Amazon's Recent Scientific Publications</i>	107
5.4.3	<i>Concluding Remarks</i>	111
	<i>Appendix: Figures</i>	112
	<i>References</i>	118

6	China's Catching-Up Process and Its Emergence as a Potential Lead Country in Artificial Intelligence	121
6.1	<i>Introduction</i>	121
6.2	<i>China's National Innovation System and Its Catching up in AI</i>	124
6.2.1	<i>Brief Remarks on the Evolution of China's NIS</i>	124
6.2.2	<i>On the STI Performance—Quality vs Quantity</i>	127
6.2.3	<i>China's Catching-Up in Artificial Intelligence</i>	130
6.3	<i>On the Co-Evolution of National and Corporate Innovation Systems</i>	136
6.4	<i>Conclusions</i>	139
	<i>References</i>	141
7	AI Policies and Politics in China and the US Between Techno-Globalism and Techno-Nationalism	145
7.1	<i>Introduction</i>	145
7.2	<i>AI is Seen as a Strategic Technology in China and the US</i>	147
7.3	<i>The US AI Strategy: A Lead Country Defending Its Economic and Military Dominance</i>	148
7.4	<i>A World Economy Between Techno-Globalism and Techno-Nationalism</i>	155
7.4.1	<i>Is Techno-Nationalism Bad?</i>	158
7.4.2	<i>How the State Laid the Foundation for AI and Tech Giants in China and the US</i>	159
7.5	<i>Final Remarks</i>	161
	<i>References</i>	161
8	Alternative Futures and What is to Be Done	165
8.1	<i>Introduction</i>	165
8.2	<i>Predominant Policy Responses to Tech Giants: Antitrust and Digital Acts</i>	168
8.2.1	<i>The European Union</i>	168
8.2.2	<i>The United States</i>	171
8.2.3	<i>China</i>	172
8.3	<i>Alternative Futures</i>	172
8.3.1	<i>Antitrust and Natural Monopolies</i>	172
8.3.2	<i>The Role of Tech Giants and Industrial Digitalization</i>	174
8.3.3	<i>Data Privacy Acts or Socializing Data?</i>	176

8.3.4	<i>On the Future of Techno-Nationalism</i>	177
8.4	<i>Policy Recommendations</i>	178
8.4.1	<i>Focusing on Underdeveloped Countries</i>	181
8.5	<i>We Need More Activism</i>	183
8.6	<i>Final Remarks</i>	184
	<i>References</i>	186
	Index	189

LIST OF FIGURES

Fig. 2.1	IPRs application class counts for the top 20 offices (in millions) (<i>Source</i> WIPO)	26
Fig. 2.2	World GDP, patent application and licences growth (<i>Source</i> World Bank and WIPO)	29
Fig. 3.1	R&D over revenues. Selected tech giants (<i>Source</i> Compustat)	48
Fig. 5.1	Evolution of Microsoft's patent portfolio content. Tubes layout (<i>Source</i> Authors' analysis based on Derwent Innovation)	99
Fig. 5.2	Microsoft's scientific publications (2014–2017) lexical analysis (<i>Source</i> Authors' analysis based on Web of Science)	102
Fig. 5.3	Microsoft's recent publications (2018–2019) lexical analysis (<i>Source</i> Authors' analysis based on Web of Science)	103
Fig. 5.4	Evolution of Amazon's patent portfolio content. Tubes' layout (<i>Source</i> Authors' analysis based on Derwent Innovation)	106
Fig. 5.5	Amazon's publications (2014–2017) lexical analysis (<i>Source</i> Authors' analysis based on Web of Science)	108
Fig. 5.6	Amazon's recent publications (2018–2019) lexical analysis (<i>Source</i> Authors' analysis based on Web of Science)	109
Fig. 5.7	Microsoft's patents. Lexical analysis (1986–2008) (<i>Source</i> Authors' analysis based on Derwent Innovation)	113

Fig. 5.8	Microsoft's patents. Lexical analysis (2009–2013) (<i>Source</i> Authors' analysis based on Derwent Innovation)	114
Fig. 5.9	Microsoft's patents. Lexical analysis (2014–2017) (<i>Source</i> Authors' analysis based on Derwent Innovation)	115
Fig. 5.10	Amazon's patents. Lexical analysis (1996–2011) (<i>Source</i> Authors' analysis based on Derwent Innovation)	116
Fig. 5.11	Amazon's patents. Lexical analysis (2012–2013) (<i>Source</i> Authors' analysis based on Derwent Innovation)	117
Fig. 5.12	Amazon's patents. Lexical analysis (2014–2017) (<i>Source</i> Authors' analysis based on Derwent Innovation)	118
Fig. 6.1	Business expenditure in R&D allocated to Higher Education (<i>Source</i> Author's analysis based on OECD data)	126
Fig. 6.2	R&D expenditures as a share of GDP. Selected countries (<i>Source</i> World Bank)	128
Fig. 6.3	Share of total granted patents. Selected countries (<i>Source</i> Authors' analysis based on WIPO)	129
Fig. 6.4	AI patent counts by inventor(s)'s country(ies) of residence (<i>Source</i> OECD data based on IP5 Patent families)	133

LIST OF TABLES

Table 1.1	Market capitalization (December 31, 2019) and liquid assets (annual reports 2019)	12
Table 1.2	R&D Expenditure and number of US patents	14
Table 3.1	Selected tech giants' publications and patents, co-authorships and co-ownerships	50
Table 3.2	Selected tech giants' top co-authors (2014–2019)	52
Table 4.1	Publications' most frequent multi-terms for selected tech giants	73
Table 4.2	Tech giants' initiatives for AI application fields. Illustrative examples	75
Table 5.1	Summary of patents and publications' corpuses	96
Table 6.1	Publication output. Selected countries	129



A Global Race Between Giant Corporations and Nation States

Abstract This book conceptualizes the global innovation race between nation states and corporations in the second phase of a technological revolution characterized by Artificial Intelligence and explosive growth in digital services. Each chapter elaborates on an existing or new conceptual framing to analyse empirical dimensions of the economics and politics of innovation in the context of digital capitalism. In this introductory chapter, we set the scene by presenting the main actors and highlight the crucial role of Artificial Intelligence. We end it by introducing the structure of the book.

Keywords Innovation race · Artificial intelligence · US–China conflict · Tech giants · Globalization

1.1 INTRODUCTION

The global innovation race refers both to the technology war between the United States (US) and China and to the struggle between giant corporations from these two countries to establish world dominance in artificial intelligence (AI), in particular machine learning and related technologies. The recent acceleration in the development and use of digital technologies, spanning from 5G communication systems to cloud services and

AI, is transforming the world order. It gives rise to extreme degrees of concentration of capital, and it offers a window of opportunity for China to challenge the US as a hegemonic power.

The US and Chinese governments increasingly engage in technonationalist strategies. They use science, technology and innovation policies to promote strategic (digital) technologies. They use protectionist measures to reduce rivals' access to critical resources in order to slow down their technological development. They engage in shaping international intellectual property regimes to promote national interest and standard setting. Concerning the latter, they make diplomatic efforts and design projects in third countries to promote the diffusion and use of their own technology standards. In Chapters 6 and 7 we analyse in more depth how the state in China and the US engages in the AI innovation race.

The other main participants in the race are a handful of giant firms from these two countries: Google, Amazon, Facebook, Apple and Microsoft (GAFAM) in the US and Baidu, Alibaba, Tencent and Huawei (BATH) in China. They operate production and innovation globally, offshore earnings, minimize paid corporate taxes and they replace states in the definition of norms and regulations of the digital economy. In Chapter 2, we focus on how they operate as intellectual monopolies harvesting rents from their global operations. In Chapter 3, we see how each of them builds and profits from its own global corporate innovation system.

The twenty-first-century global innovation race is shaping the world's future. It has an impact on world economic growth and on how economic gains and losses will be distributed between and within economies. In Chapters 4 and 5 we analyse the technologies emerging from this race and we show how they are applied to a wide set of fundamental economic and social activities, hereby affecting the future of work, health and culture, including human rights and privacy as well as the climate and other ecological challenges. The more intense rivalry between two great powers raises fundamental issues of war and peace. To explore what lies behind this innovation race is, therefore, of great urgency and a prerequisite for finding ways to cope with its consequences.

To analyse this historically unique constellation, where technology has become the central subject of geopolitical conflict and giant corporations challenge the sovereignty of nation states, requires alternatives to the conceptual frameworks that still dominate textbooks in standard

economics. In this book, we combine insights from political economy and innovation studies and propose alternative theoretical concepts at three different levels: the corporation, technology and the state.

In Chapter 2, we introduce the concept *intellectual monopoly*, offering a different perspective of economic power, and in Chapter 3 we elaborate on the concept, *corporate innovation system*, offering a new perspective on inter-firm relationships and innovation. To capture the technological specificity and evolution of AI we analyse it as a *technological innovation system* in Chapter 4. Moreover, to capture its evolution we refer to the concepts *technological paradigm and trajectory* in Chapter 5 focusing on Amazon and Microsoft's technological convergence. To understand the roots of the technology war between the US and China, we refer to the literature on *national innovation systems* and *catching-up* in Chapter 6 and to the concepts *techno-nationalism* and *techno-globalism* in Chapter 7.

In the rest of this chapter, we present the main actors and highlight the crucial role of AI in contemporary capitalism. The chapter ends with an introduction of the structure of the book.

1.2 WHY TECHNOLOGY WAR?

Why have the US and the Chinese governments moved in the direction of techno-nationalism, and why has the US declared technological war on China? Answering these questions requires an analysis of the specific character of the emerging new technologies and of the current geopolitical context. Nonetheless, we can draw important lessons from world history. While the specific constellation of AI as a transformative technology and the US and China as the major national actors is unique, there are historical precedents of how a transformative technology plays an important role in upsetting the ruling world order. In Chapter 6, we refer to the work by Christopher Freeman and Carlota Perez on how technological revolutions open up windows of opportunity for catching-up and challenge world leadership.

1.2.1 *Artificial Intelligence and the Critical Role of Big Data*

In order to understand why leadership in a specific technology has emerged as a major issue in geopolitics, confronting the US with China, it is necessary to look closer at the character of the technology. In the following sections, we will point to the importance of cumulative effects

and scale economies, emanating from the combination of major advances in AI and supporting technologies related to telecommunication and supercomputers in combination with major organizational innovation, including privately managed platforms and cloud computing.

At the world level, this has resulted in an extreme concentration of capabilities in the biggest and most data-rich countries, the US and China. The cumulative character of technological advance in AI, where the inflow of data upgrades the technology itself, makes leaders in both countries fear that getting behind in the innovation race would lead to a downward spiral in terms of economic and political power.

In Chapters 4 and 5 we focus on AI as the most important of the emerging new technologies characterizing the second phase of the ICT revolution. AI refers to a set of related technologies that make it possible for computers to imitate human thinking and learning from experience. Following WIPO (2019), AI systems are learning systems, where machines get better at a previously human task with limited or no human intervention. Between 2011 and 2017, patent applications in AI grew by a factor of 6.5 per year—i.e. with staggering 650% per annum.

Within AI techniques, machine learning dominates. It can be defined as “an AI process that uses algorithms and statistical models to allow computers to make decisions without having to explicitly program it to perform the task” (World Intellectual Property Organization, 2019, p. 146). Machines learn to solve problems by processing big data, thus depending on access to permanent streams of data.¹

The most popular machine learning approaches are deep learning and neural networks (World Intellectual Property Organization, 2019).² Examples of AI functional applications based on deep learning and neural

¹ Tech giants’ dependence of access to big data makes them vulnerable to regulations that restrict their access. As we demonstrate in Chapter 5, they are aware of this risk and invest substantial resources in developing new forms of machine learning where they can reuse data or train algorithms with smaller volumes of data.

² Deep learning refers to hierarchically layering data or information. It builds hierarchies of concepts with different levels of genericity (think for instance of the Linnaean taxonomy). Neural networks try to emulate humans’ interconnected neurons. It is an approach where an interconnected framework of functions processes multiple data inputs. Using both approaches together (building different deep learning layers of neural networks) leads to far and wide AI-learning systems where each layer’s output is an input of the following layer.

network approaches are speech processing, recognition and synthesis, natural language processing and images and video segmentation.

Algorithms are at the very core of machine learning models. An algorithm is a set of rules or instructions to be followed for problem-solving operations or to perform a computation. Algorithms are used to process data in computing systems. The specificity of machine learning algorithms is that they evolve and become more “knowledgeable” on the basis of inflow and analysis of data. This is why scale is important for the development and use of AI. Machine learning requires big volumes of data.

Scholars have compared data to raw oil and cloud services and datacentres to oil refineries. But this parable is misleading in several respects. First, while oil is a rival good that can be used only once, data is non-rival—data points can be used again and again without losing their value. Second, in terms of impact on value creation, machine learning (the transformation and upgrading of the algorithm) is more important than the refined data. Sticking with the parable, the most important outcome is not the refined oil but a more productive refinery.

In the digital era, the issue about *excludability* of data is at the core of political and ethical concerns. Some data exist as knowledge commons to which everybody have access—examples are public databases and statistics, phone books and maps. Other data remain secret and/or private for different reasons. Sometimes, the privacy of data is protected by law. Individuals usually prefer to keep some data private rather than public (such as information on their health and on their political preferences). Firms rely on specific technological knowledge that they do not want to share with competitors. States protect military and diplomatic secrets, sometimes with death penalty for those breaking the rules, and central and commercial banks keep banking and broadly financial data secret. This is another reason why this field is unique in relation to other economic activities, such as the oil industry. Digital technologies raise issues about individual human rights, industrial espionage and national sovereignty, offering one explanation of why states gets so strongly engaged in this specific innovation race. Another, at least as important, reason is the economic potential of the new technologies.

1.2.2 *Platforms, Cloud Computing and Economic Concentration*

The recent acceleration in the development and use of AI reflects major organizational innovations such as the formation of digital platforms and cloud computing controlled by tech giants. The resulting concentration of intangible assets within a few corporations from the US and China fuels the conflict between the two countries.

The first phase of the ICT revolution, based on microelectronics and desktop computing, transformed working life. Widespread mobile communication gave new opportunities for citizens and enterprises all over the world to exchange information. When this first phase was at its early stage—around 1975–1985—there were exaggerated expectations on its short- and medium-term impact on employment and productivity. In retrospect, we can see that the quantitative changes took place more gradually than expected, while the long-term qualitative effects on work, economic organization and everyday life have been dramatic. This first phase lay the ground for the one we are currently in the midst of.

One major difference is that, while the first ICT phase gave room for decentralization, new entrepreneurial entrants and increased competition, the second phase is predominantly characterized by economies of scale and scope leading to extreme degrees of concentration and centralization of capital.

One important organizational innovation leading to industrial transformation and market concentration is the formation of “technology platforms” owned by private enterprises and characterized by unique mechanisms driving economies of scale and scope. Platforms generally involve three parties: The owner of the platform (Amazon’s marketplace, Google’s search engine, Facebook, Airbnb, Uber, etc.) and two types of *clients*, the service provider (which for gig economy platforms are unrecognized workers) and the service user.

Platforms are characterized by complex *network effects* both when it comes to providers and users. First, as the number of users increases, more users are encouraged to join—cf. Facebook. Second, the increased number of users makes the platform more attractive for providers (advertising firms in the case of Facebook). Likewise, as the number of providers increases, more users are attracted since they get access to a more diverse offer of goods and services (cf. Amazon). This implies that incumbents have an advantage that makes it difficult for newcomers to enter platform