Towards Eco-Logical Antitrust

Elena Rovenskaya and Alexey Ivanov

Rethinking antitrust in the digital era

Digitalization has brought about a new challenge for the competition authorities around the world. Zygmunt Bauman metaphorically referred to the new economic reality as 'Light Capitalism' (as opposed to the traditional 'Heavy Capitalism') and described its challenges for the regulators as follows:

> The passengers of the 'Light Capitalism' aircraft discover to their horror that the pilot's cabin is empty and that there is no way to extract from the mysterious black box labelled 'automatic pilot' any information about where the plane is flying, where it is going to land, who is to choose the airport, and whether there are any rules which would allow the passengers to contribute to the safety of the arrival. (Bauman, 2006, p. 59)

Digital platforms can engage a large number of users and complementors and wield enormous economic and social power through algorithmic collusion, personalized pricing, control of consumer choice, and other features which the 'automatic pilot' enables. Antitrust authorities are supposed to regulate digital giants and other actors of the digital economy, but the economics of digital platforms and platform ecosystems is not sufficiently understood and some of its parts are even perceived by regulators as a 'black box'.

Historically, antitrust emerged as a solution to complex economic puzzles. Back in the late 19th century, the Standard Oil trust took over most oil refineries in the U.S. by constantly reorganizing their business and adapting to the new regulatory environment. The Encyclopedia Britannica calls this structure the 'Mother Trust' defined as 'a maze of legal structures, which made its workings virtually impervious to public investigation and understanding' (Britannica, 2020). The suite of approaches and tools developed at the early age of antitrust was specifically tailored to dealing with the proliferation of such complex trust-based structures.

Over time, however, antitrust was growing increasingly detached from the economic reality it is called upon to address and has eventually transformed into a set of rather formalist and unbending practices. In this legal and institutional environment, the new digital 'trusts' have been successful in escaping oversight and regulation by exercising new degrees of adaptivity and flexibility enabled by complex webs of locked-in complementors, consumers and even rivals (often turning into what are called 'frenemies') which they create and maintain. This challenges the competition authorities to rethink their methods of defining, measuring, and protecting economic competition.

Ecology for antitrust

Moore (1993) famously coined the term 'ecosystem' to describe emerging networked businesses such as Apple and IBM. 'Digital platform ecosystem' (DPE) quickly became the common denomination for the new business model in the digital era. We argue that, beyond providing figurative metaphors, ecology can offer effective approaches to model and understand the complexity and dynamics of digital platform ecosystems. In what follows, we discuss three modelling approaches that are widely used in ecology – game theory, network science, and agent-based modeling – and their potential applicability to DPEs.

Game theory is an approach to model strategic interaction of agents and emergence of cooperation in social dilemmas where individual agents are prompted to avoid cooperation even though it is beneficial for all if everyone cooperates. 'Strategic interactions' occur when agents independently optimize their behavior in response to other agents' actions, a setting which describes decentralized behavior of rational agents. In this setting, agents are expected to collectively settle in an equilibrium, a configuration from which no agent has an incentive to deviate unilaterally. In nature, cooperation is as abundant as competition and many theories and modelling approaches have been developed in ecology to explain and predict this phenomenon (e.g., Hauert et al., 2006; Nowak, 2012). A firm deciding to join a DPE is an act of cooperation as an ecosystem business model may require complementors to share data and profits. Hence, a game-theoretic approach can be suitable to understand this process and inform regulators regarding the to-be-expected scope of the collective action and its sustainability. Several collective-action models addressing some aspects of this phenomenon have already been presented in the literature very recently (e.g., Liu et al., 2022; Zhiwen et al., 2020; Wu et al., 2021), however, the variety and richness of issues and complexities involved in the collective action in the context of digital platforms call for a more extensive modelling and analysis effort.

A digital platform ecosystem can be conceived of as a network of economic agents – firms and products they produce – interacting with each other. Likewise, in ecology, ecosystems can be represented as networks of species interacting with each other through feeding and other kinds of relationships. *Network science* has been extensively used in ecology to unravel the role of the network structure for the functioning of the ecosystem. For example, the famous complexity-stability debate articulates two opposing views: complexity either promotes or hinders stability. Depending on the specifications of both notions and on the research methods used, evidence has been found in support of each of the two views (Ives & Carpenter, 2007). Other studies employed network science in ecology to investigate the role of weak links (Neutel et al., 2002), to identify keystone species based on their network centrality (Martín González, et al., 2010) and to analyze sustainability of food webs based on information theory (Ulanowicz, 2004), among many others. Very recently, some researchers have started to explore if and how network science could be useful in understanding and regulating DPEs. As one notable example, Lianos & Carballa-Smichowski (2022) suggested using network centrality metrics to measure market power. The wealth of theoretical and empirical insights accumulated in ecology could be used as a source of inspiration by researchers and regulators who are looking into the relations between ecosystems network structure and its functioning.

Agent-based modelling (ABM) is a modelling approach that has gained popularity across various disciplines (Axelrod, 2006) including ecology and economics. ABM simulates complex systems at the level of individual agents which allows to represent agent heterogeneity and their dynamic interactions. Detailed modelling of agent behaviour at the micro level allows obtaining and analyzing patterns emerging from this behaviour at the macro level. In ecology, agent-based modelling, also called individual-based modelling, has been used extensively to model plant and animal communities. This modelling delivered assessments of the impact of various disturbances on these communities, which are more nuanced than those obtained by other, more aggregated modelling (DeAngelis & Grimm, 2014). For example, (Railsback & Johnson, 2014) used an individual-based model to disentangling the complex relationships among availability of natural habitat, delivery of ecosystem services, and crop production. (Farmer & Foley, 2009) set a research ambition for agent-based modelling in economics suggesting that '[i]n principle, it might even be possible to create an agent-based economic model capable of making useful forecasts of the real economy'. 'Useful' in this context would mean more accurate and/or more detailed (among other criteria) compared to forecasts provided by the standard tools for economic forecasting and analysis, i.e. General Equilibrium-based models and statistical models. To the best of our knowledge, (Poledna et al., 2020) present a macroeconomic ABM that, as of now, has come closest to realizing this ambition. As the power of agent-based modeling lies in its ability to represent behavior and bounded rationality, this approach to modelling appears particularly suitable to simulate the dynamics of individual digital platform ecosystems as well as entire digital economies. Indeed, by design, DPE members engage in complex power relationships with each other and employ diverse strategies to succeed on the market going beyond a mere profit maximization approach. These two features, among others, make DPE dynamics more complex and unlike that of the conventional economic agents thus making the case for ABM. Developing an ABM that would represent a specific real-life digital ecosystem(s) is not straightforward, though, as this would require specifying behavior rules. This in turn requires detailed research on the behavior of DPEs and data to support model calibration.

Conclusions

Digital giants can successfully evade traditional antitrust scrutiny. Competition authorities need new tools which would provide them with better understanding of digital economy actors and effective policy assessment. Game theory, network science, and agent-based modelling are three promising approaches to inspire and inform the development of new tools for antitrust. Widely applied in ecology, they provide powerful methodologies to model and analyze natural ecosystems as complex adaptive systems. Since digital platform ecosystems also develop as complex adaptive systems, transferring these methodologies to the digital economy context is justified.

References

Axelrod, R. (2006). Chapter 33 Agent-based Modeling as a Bridge Between Disciplines. *Handbook of Computational Economics*, 2, 1565-1584.

Bauman, Z. (2006). *Liquid Modernity.* Cambridge: Polity.

Encyclopedia Britannica. (2020). *Standard Oil.* https://www.britannica.com/topic/Standard-Oil

DeAngelis, D. L., & Grimm, V. (2014). Individual-based models in ecology after four decades. *F1000prime reports*, 6, 39.

Farmer, J.D., & Foley, D. (2009). The economy needs agent-based modelling. *Nature*, 460(6), 685-686.

Ives, A.R., & Carpenter, S.R. (2007). Stability and Diversity of Ecosystems. *Science*, 317(5834), 58-62.

Hauert, C., Holmes, M., & Doebeli, M. (2006). Evolutionary games and population dynamics: Maintenance of cooperation in public goods games. *Proceedings. Biological sciences,* 273(1600), 2565–2570.

Martín González, M.A., Dalsgaard, B., Olesen, J.M. (2010). Centrality measures and the importance of generalist species in pollination networks. *Ecological Complexity*, 7(1), 36-43.

Moore, J.F. (1993). Predators and Prey: A New Ecology of Competition. Harvard Business Review, 71, 75-86.

Lianos, I., & Carballa-Smichowski, B. (2022). A coat of many colours – New concepts and metrics of economic power in competition law and economics. *Journal of Competition Law & Economics*, 00(00), 1–50.

Liu, W., Liang, Y., Shi, X., Gao, P. & Zhou, L. (2022). Platform opening and cooperation: a literature review and research agenda. *Modern Supply Chain Research and Applications*.

Neutel, A-M., Heesterbeek, J.A.P., & De Ruiter, P.C. (2002). Stability in Real Food Webs: Weak Links in Long Loops. *Science*, 296(5570), 1120-1123.

Nowak, M.A. (2012). Evolving Cooperation. *Journal of Theoretical Biology*, 299, 1-8.

Poledna, S., Miess, M.G., & Hommes, C.H. (2020). Economic Forecasting with an Agent-Based Model. IIASA Working Paper. Laxenburg, Austria: WP-20-001.

Railsback, S.F., & Johnson, M.D. (2014). Effects of land use on bird populations and pest control services on coffee farms. *Proceedings of the National Academy of Science*, 111(16), 6109-6114.

Ulanowicz, R.E. (2004). Quantitative methods for ecological network analysis. *Computational Biology and Chemistry,* 28(5-6), 321-339.

Wu, H-P., Li, H., Sun, X-L. (2021). Evolutionary Game for Enterprise Cloud Accounting Resource Sharing Behavior Based on the Cloud Sharing Platform. *IAENG International Journal of Applied Mathematics*, 51 (1).

Zhiwen, Z., Yujun, X., Junxing, L., Limin, G., & Long, W. (2020). Supply Chain Logistics Information Collaboration Strategy Based on Evolutionary Game Theory. IEEE Access, 8, 46102-46120.