Nikander, Pekka; Eloranta, Ville; Karhu, Kimmo; Hiekkanen, Kari

Digitalisation, anti-rival compensation and governance: Need for experiments

Published: 06/02/2020

Digitalisation, anti-rival compensation and governance: Need for experiments

Pekka Nikander, Ville Eloranta, Kimmo Karhu, and Kari Hiekkanen, Aalto University

Digitalisation brings forth data and information as major factors of success, redefining business models, changing operational structures, and necessitating strategic change. In the majority of current literature, these changes are assumed to take place within the current economic structures, defined by the prevailing legislation and treaties. However, at the same time some scholars have argued that digitalisation will lead to more fundamental changes, affecting the underlying structures of business in the longer term, in the form of shifting norms, laws, and international treaties.

In this extended abstract, we consider these potential longer term effects, focusing on the so-called anti-rivalry of data, or its negative subtractability, and its consequences. We briefly explore the untypical supply curve for digital products and discuss why their price cannot be based on open market valuation. In particular, we argue that if the subtractability of data and information is indeed negative, as it seems to be, then we may need to invent structurally new governance and compensation structures in order to efficiently clear the data and information markets.

1. Introduction and motivation

In this extended abstract, we present our initial argumentation for designing and experimenting with completely new, market-like, open, decentralised mechanisms for sharing digital products and compensating for their sharing. This argumentation is very much work in progress and should be taken as such.

Our long term goal for this work is to explore economic structures that go well beyond our current concepts of ownership, as a form of governance, and money, as a medium of exchange. In essence, we believe that by exploring and establishing new mechanisms it is possible to discover new forms that are a) similar to markets in the sense that they naturally lead to a Pareto optimal solution without any central planning, but are simultaneously b) fundamentally different, leading to establishing more efficient allocations of digital goods than what current market based mechanisms are able to achieve.

In the end of the day, our conjecture is based on the following three observations:

1. In practical terms, it is fundamentally less expensive to share than to strictly exchange data, wherein the latter requires erasure of the original data.
2. Due to the (near) zero copying cost, the Pareto optimal allocation of digital goods is (near) universal availability. Any diversion from such (near) universal availability is a (potential) loss of real efficiency.
3. For many digital goods, their real (social) value (initially) increases the more they are used, in stark contrast to material goods, whose value almost always decreases as they are used and consumed.

While our argumentation may be seen as a variation of those of e.g. Letza et al (2004), who essentially show that, for certain kinds of public goods, markets may lead to less efficient solutions than what can be achieved with other governance structures, our argument actually points to a far more radical position. We truly surmise that the currently existing economic structures are simply not able to create fully digital markets that would efficiently clear sufficiently to create even near-optimal allocations of digital goods. Consequently, if we are right, genuinely new structures need to be designed and their real-life working should be studied through large scale experiments. As we prefer decentralised solutions, e.g. in order to minimise the accumulation and potential misuse of power, we attempt to work towards such new forms of distributed governance and compensation. In that sense, our work can be seen as an early attempt for a radical follow up of Arrow's seminal works on information, learning, and innovation (Arrow, 1962, 1971).

The rest of this paper is organised as follows. First, in Section 2, we discuss digital products in terms of their rivalry. After a short remark on efficiency in Section 3, we discuss the formation of the prices of digital products in Section 4 and the underlying assumptions. Section 5 contains our main proposal, of designing new "anti-rival" governance and incentive mechanisms. Section 6 contains a few remarks of our already ongoing experiments, and Section 7 attempts to give some early conclusions.

2. Anti-rivalry

It is well known that data and information are non-rival in nature (Arrow, 1962, Romer, 1990), while most other factors of production are rival. In Ostrom's terms (Ostrom, 2009), the subtractability of non-rival goods is negligible while that of rival goods is clearly positive, meaning that the more rival goods are used, the more of their value gets subtracted while the value of non-rival goods does not markedly diminish as they are consumed. From this point of view, Smichowski (2016), Houghton (2005), and Cooper (2005) have argued that (most forms of) data are not only non-rival but *anti*-rival, basically meaning that data may gain real value when it is being used more, even implying that the *future* value of a dataset may increase with usage.

Of course, the subtractability of digital (and other) goods may vary over their lifetime. Let us consider, for example, a new piece of music or other digital form of arts that is considered socially enjoyable. Initially, as more and more people consume the product, they are likely to recommend it to their friends, leading to an increasing projected future real value for the product, i.e. projecting that more people will enjoy the product more in the future. These positive network effects are likely to continue until the market saturates, eventually leading to a ceiling value or a tip, after which the future real value of the product may diminish. That is, after a while people may not find it as enjoyable than in the beginning. In such a case, the subtractability of the the product is initially negative — more consumption increases its value — then zero, and finally positive. However, due to the (relative) market saturation, the increasing subtractability does not appear to coincide with increasing excludability, as has been classically observed (Arrow, 1962) and often implicitly assumed.

Considering a more industrial setting, if a firm has a dataset of industrial measurements, and if they provide the dataset to their customer that has a related dataset, the first dataset becomes more valuable, both for the seller (in the form of their increased revenues) and to the customer (through their ability to combine the datasets), without diminishing the prospective future real value of the dataset. (How the real future value may be captured and monetised is a more complicated issue, to which we return shortly.)

These considerations have lead to a proposal (Nikander and Elo, 2019) to extend the commonly used fourfold model[1] of goods with an additional column for goods whose subtractability is negative, shown as Table 1 below.

TABLE 1. PROPOSED EXPANSION OF THE FOURFOLD GOODS MODEL

	Subtractability		
Excludability	**Rival**	**Non-rival**	**Anti-rival**
Excludable	Private goods	Club/toll goods	"Network" goods
Non-excludable	Common-pool goods	Public goods	"Symbiotic" goods

In this expanded model, "Network goods" are ones whose subtracability is negative, typically due to network effects, but that are excludable. "Symbiotic goods," in turn, are goods whose subtractability is negative but that are non-excludable. An example of the former class could be a computer game that can only be played in a controlled platform, such as a game console that has a fully working DRM mechanism. The prime examples of the latter class are the Internet and open blockchains, which — while not free — are both non-excludable in most countries and whose value clearly increases the more they are used.[2]

1 The history of the fourfold model of goods goes back at least to Musgrave & Musgrave (1973) and probably well into the 1960s, with many variations. For example, Adams and McCormick (1987) present a model with a third column, with contestable goods, which are somewhat subtractable. Our version is based on that in Ostrom 2009.

2 It must be noted that while the blockchains are non-excludable and anti-rival, the cryptocurrencies implemented on the top of blockchains are rival, due to their built-in artificial scarcity mechanisms.

3. Efficiency

Classically, efficiency has been defined in terms of Pareto optimality, implying that one cannot allocate the goods “better” without harming someone. When considering information and data from the real economy point of view, it is clear the Pareto optimal allocation of at least industrial data is one where everyone who can benefit from the data has access to the data. This is a direct implication of the non-rivalry of data: an extra copy of a dataset is not away from anyone else, thereby making that party to prefer their received allocation less than one where the extra copy has not been made.

In terms of the current monetary economy, the situation is totally different, of course. An extra copy of a trade secret may totally hamper the competitive position of a firm. However, that is mostly a consequence of the current market structure and not so much part of the underlying real economy.

For the purposes of this paper, we consider this situation as a fault that should be fixed. Indeed, we surmise that that the present situation may be considered as a *structural* market failure: in terms of the real economy, the markets do not lead to a Pareto optimal allocation of the digital goods, leading to a large social and economic loss, due to e.g. lost production potential, potentially slower rate of innovation, and probably also due to increasing inequality and its socially costly consequences. But that argumentation falls on the side of political economy and thereby beyond the scope of this paper (cf. e.g. Sætnan et al, 2018).

4. Market prices and impossibility of open market valuation

Another aspect of the conjectured market failure is the apparent inability to define open market valuation (OMV) for many if not most digital goods. The main problem herein is that OMV implicitly expects excludability of goods, while digital goods are excludable only through fiat. In other words, the marginal cost of producing more copies of a digital good are constant and almost zero, at least when compared to the cost of producing the first copy of a digital good. Hence, in a classical supply and demand chart, the supply curve is an “inverse L”, starting at the production cost of the first unit and then dropping at the near-zero, essentially constant marginal cost of copying.

Due to this unusual shape of the supply curve, the typical market and Nash equilibria do not apply. Instead, there seems to be always more than one equilibria. The exact number and type depend on what external assumptions we make on the strategic goals of the producers and consumers of the digital goods. Since one of the goals of this paper is to explore the efficiency consequences of different incentive and governance models, we initially attempt to assume the minimum.

To start with, we assume a real economy with digital products, whose initial production is costly but copying very inexpensive. Furthermore, we do not assume any DRM-like technology nor enforcing legislation or court system that were to oblige the parties to refrain from making further copies of any digital products they receive. It should be noted that, to some extent, these assumptions apply to “pure data,” which is not protected by any IPR laws in most jurisdictions and which can be trivially copied.

Under these assumptions, if the supply curve is the “inverse L” and the demand curve is a typical downward sloping willingness to pay, there appear to be three distinct Nash equilibria:

1. A very large number of copies of the product are produced and exchanged at a price somewhat above of the marginal cost.

   This is the simplest situation, applicable if there are enough of consumers willing to pay a price larger than the marginal cost, so that the initial production cost can be covered. However, this equilibrium is only feasible if the original producer can keep its marginal cost smaller than that of anyone else. If the consumers are able to produce further copies at a cost equalling or lower than that of the original producer, the original producer may not be able to recover the original production cost, yielding this equilibrium unreachable.

2. A single copy of the product is produced and exchanged at a price equalling to or exceeding the production cost.

   Both the producer and the consumer agree not to sell further copies of the product, since the number of customers willing to pay above the marginal cost is too low to cover the potential losses from such redistribution. This equilibrium can be reached only if the producer and consumer can trust each other to adhere to their mutual agreement. Of course, with sufficient trust this equilibrium can be extended to a number of mutually trusting parties. However, given that trust per se is typically intransitive, such mechanisms cannot easily span larger groups of parties.

3. The product is not produced at all or produced only for the producer's internal use.

   If no single customer is willing to pay enough to cover the initial production cost and and the number of consumers willing to pay above the marginal production cost is too small to cover the initial production cost, or if equilibrium #1 cannot be reached due to the producer's inability to recover their costs, then it remains unprofitable to produce the product in the first place.

For the purposes of this paper, it is important to notice that the prices corresponding to the equilibria are very different: either near zero, slightly above the marginal copying cost, or equal to or larger than the original production cost. Hence, it looks like the typical market mechanisms that direct the market price of rival goods towards their open market valuation do not apply to non-regulated digital goods.

All other solutions require either full trust between the transacting parties, externally imposed rules that create disincentives or increase the cost of third-party copying, or technology that prevents the copying of the product by consumers. Of course, the copyright and patent laws as well as DRM technologies have been invented and are used to create such disincentives and hinders. In essence, such mechanisms create *artificial scarcity*, thereby leading a) to per se lesser efficiency due to some parties not receiving a copy of the product and b) to increased enforcement and technology costs.

From this point of view, the important question we want to explore is what kind of mechanisms could both clear the markets and lead to maximal efficiency. In particular, we surmise that since digital goods are structurally different from private goods, there may exist structurally new mechanisms that can be used to create market-like open mechanisms that have higher social efficiency than mechanisms that are based on enclosure and artificial scarcity.

5. Introducing anti-rival compensation and governance

Above, we have essentially argued that many (if not most) digital goods are anti-rival, that the socially most efficient allocation of digital goods is (near) universal availability,[3] and that the pure (non-regulated) market mechanisms are unable to create a market or Nash equilibrium that would provide an open market valuation for any digital good. There is further related argumentation, e.g. related to the transaction costs, which we are obliged to omit due to the page limitation of the present paper.

We now continue to outline the properties of our purported new governance and compensation mechanisms that supposedly could create and clear market-like, open, decentralised mechanisms for allocating digital goods in a manner that would lead to near Pareto-optimal efficiency.

In our previous position paper (Nikander and Elo, 2019), we surmised that the current compensation and ownership structures are inefficient to clear the data markets. We further proposed that data commons and data unions should be considered as means of governance for data, instead of enclosure and privatised data ownership. In addition, we briefly elaborated a novel concept called anti-rival compensation. In this section, we dive slightly deeper into these new concepts, in the light of the above argumentation.

Data commons (Miller et al 2008, Yakowitz 2011, Contreras & Reichman 2015, Evans 2016, Grossman et al 2016) and data unions (Smichowski 2019, Nikander & Elo 2019) are proposed new governance structures for data. Data commons are typically designed according to the common-pool goods principles, often following Ostrom's guidelines. The main idea is to define a boundary, within which the data is considered as a jointly controlled, freely copyable public good, while keeping it unreachable or very controlled to those outside of the trusted boundary. Data unions, in turn, are kind-of data commons that are modelled similar to labour unions. Their main goal is to gain collective bargaining power, thereby allowing individual people to assert more control over how data about them is being used by firms.

---

[3] Whether the most efficient allocation is fully universal availability or near universal availability depends, in the end of the day, on the relative cost of making an additional copy of the good vs. the utility of the good for those who prefer the good least. In practice, as any transaction costs, including search costs, are likely to orders of magnitude higher than the actual copying cost. The practical implications appear negligible.

Data commons and data unions are but examples of a larger class of so-called anti-rival governance structures. They both create value by combining data, resulting in a combination that clearly has more real value than the sum of the uncombined constituting pieces. Furthermore, they attempt to create a governance structure that allows the stakeholders of the pieces to exert more control over those pieces than would be possible without such a structure.

In order to progress further with anti-rival governance structures, it may be necessary to introduce elements of anti-rival compensation into the designs.

The idea of anti-rival compensation is based on the observation that data is usually shared, not exchanged. Indeed, strictly exchanging data implies that the original data is destroyed as a part of the exchange, and only the copy is retained, in exchange for the monetary or other compensation. As it is practically easier to simply copy and share data, almost all data transactions involve sharing. In contrast, money, as we know it now, is by definition a medium of exchange. Hence, from a structural point of view, it does little sense to compensate with a strictly exchangeable, strictly excludable good for a freely shareable, poorly excludable good.

Consequently, “anti-rival compensation” is an implied, at this point still imaginary good, a concept for a new medium and structure that can be used to compensate in transactions involving anti-rival goods.

It should act as a unit of account and store of value of delayed compensation, just like money, but instead of being a medium of exchange, it should be a “medium of sharing.” At this point of development, we surmise that such generic media do not exist, even though we may have a few candidates that get close. Clearly, its indicated value cannot have any linear relationship with monetary units. It remains as an open question how such “non-linear” a unit of account would compare to the linear media of exchange.

Naturally, we do not expect such new mechanisms just to appear. Instead, there appear already exist a few alike mechanisms, such as various informal reputation mechanisms in the open source market and in a few social credit systems. Furthermore, we expect that there will be financial innovation that essentially attempt to build anti-rival compensation mechanisms through contractual approaches. However, especially in the latter case the transaction costs are likely to relatively high, limiting the resulting markets to high-value digital goods.

6. Early stage experiments

We are currently working with three empirical, early stage designs: REC currency, Mesensei community empowerment framework, and Merits rewarding system. Using DLT based infrastructure and mobile apps, based on these already ongoing community experiments and gradually expanding thereof, we are experimenting and systematically studying new, collaborative and anti-rival economic structures.

REC (real economy currency) is a social currency created as a method for channelling public expenditure towards the local economy: 600 families that live in the Besòs area of Barcelona spend 25% of their MIS (Municipal Inclusion Support) payment using RECs in local, independently managed businesses. As a result, the local multiplier effect of the public spending has increased by 54% within the first year, coproducing an additional public policy in supporting the local economy.

Mesensei is a community empowerment framework. It’s software engine is used by communities such as Tapiola High School (Finland), Dare to Learn Festival of Rethinking Learning (Finland), The Children and Youth Foundation Finland, Finnish Institute of Public Management, and University of Cambridge (UK) to build their own community platforms.

Merits is a Milan (Italy) -originated platform created to facilitate the transition to a sustainable economy, by assisting and rewarding individual and collective behaviours that generate sustainable and shared prosperity. Society needs people and organisations to invest in little, daily acts of generosity, courage and care for people and nature. Merits helps people to realise that they are not alone. It rewards and recognises their effort with digital tokens. Merits is also carrying out new interventions in the health sector.

In addition to these, which all are relatively small and specialised markets of digital goods, wherein reputation naturally plays a largish role, we are now looking for more industrially oriented experiments, where — for example — an automatically assessed quality of data may play an important role in creating anti-rival governance and compensation aspects.

7. Tentative conclusions

Given our ongoing early analysis, we have a reason to believe that the current economic structures, based on the concepts of private property and monetary exchange, are insufficient to create well working markets that clear efficiently for digital goods. Instead, any digital markets that function primarily through the concepts of private ownership and money are likely to lead to socially inefficient allocations, thereby hampering innovation and production. As a side effect, they appear to support the formation of virtual monopolies, as is apparent from the (non-existing) markets around GAMEY and BAT.

We have outlined two distinct aspects of digital goods that seem to contribute to this situation: firstly, the apparent *anti-rival* nature of many digital goods, or their negative subtractability, and secondly, the apparent lack of equilibria that would provide an open market valuation for digital goods. More colloquially, we imply that it is impossible to use unregulated open market mechanisms to form a price for digital goods.

If these observations turn out to be true, the consequence is dire: contrary to common belief implied by the neoclassical theory, it may be simply impossible to create open markets for digital goods, without the help of regulation. Therefore, if new regulation is needed in any case, it becomes urgent to study and experiment with what kind of governance would lead to highest efficiency and welfare. Given this background, we call for radical mechanisms design that largely questions, among other things, Arrow's results and the theory behind the current IPR legislation, utilising modern technologies to create new economic structures that are by-design potentially more fair, efficient, and welfare maximising than the current ones.

References

Adams, Roy & Mccormick, Ken. Private Goods, Club Goods, and Public Goods as a Continuum. Review of Social Economy. 45, 1987. 192-99. 10.1080/00346768700000025.

Arrow, Kenneth Joseph. "Economic welfare and the allocation of resources for invention." In The Rate and Direction of Inventive Activity: Economic and Social Factors, Princeton University Press, 1962. 609-626.

Arrow, Kenneth Joseph. "The economic implications of learning by doing." Readings in the Theory of Growth. Palgrave Macmillan, London, 1971. 131-149.

Contreras, Jorge L., and Jerome H. Reichman. "Sharing by design: Data and decentralized commons." Science 350.6266 (2015): 1312-1314.

Cooper, Mark. "The economics of collaborative production in the spectrum commons." New Frontiers in Dynamic Spectrum Access Networks, 2005. DySPAN 2005. 2005 First IEEE International Symposium on. IEEE, 2005.

Evans, Barbara J. "Barbarians at the gate: consumer-driven health data commons and the transformation of citizen science." American journal of law & medicine 42.4 (2016): 651-685.

Grossman, Robert L., et al. "A case for data commons: toward data science as a service." Computing in science & engineering 18.5 (2016): 10.

Houghton, John. "Economics of publishing and the future of scholarly communication." Scholarly Publishing in an Electronic Era 2004 (2005): 165.

Letza, Steve R., Clive Smallman, and Xiuping Sun. "Reframing privatisation: Deconstructing the myth of efficiency." Policy Sciences 37.2 (2004): 159-183.

Miller, Paul, Rob Styles, and Tom Heath. "Open Data Commons, a License for Open Data." LDOW 369 (2008).

Musgrave, Richard A. and Peggy B. Musgrave. Public Finance in Theory and Practice, New York, 1973.

Nikander, Pekka, and Tommi Elo. "Will the data markets necessarily fail? A position paper." ITS Europe (2019).

Ostrom, Elinor. Understanding institutional diversity. Princeton University Press, 2009.

Romer, Paul M. "Endogenous technological change." Journal of political Economy 98.5, Part 2 (1990): S71- S102.

Sætnan, Ann Rudinow, Ingrid Schneider, and Nicola Green. The Politics and Policies of Big Data: Big Data, Big Brother? Routledge, 2018.

Smichowski, Bruno Carballa. Data as a common in the sharing economy: a general policy proposal. HAL, CEPN Working Paper, Oct. 2016.

Smichowski, Bruno Carballa. "Alternative Data Governance Models: Moving Beyond One-Size-Fits-All Solutions." Intereconomics 54.4 (2019): 222-227.

Yakowitz, Jane. "Tragedy of the data commons." Harv. JL & Tech. 25 (2011): 1.