

Making the most of platforms: a policy research agenda

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Making the most of platforms: a policy and research agenda

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Executive Summary

Digital platforms are proliferating in many countries and many sectors of the economy. Platforms create immense value, for their customers and also for their suppliers. Yet all too often they are seen only through the lens of the ‘disruption’ of incumbents, resulting in a narrow debate about whether platforms should be more heavily regulated. Yet the right questions are: what policy framework will ensure the immense benefits are encouraged and widely shared; what will help create new platforms, and sustain healthy competition and innovation; and how can unwelcome aspects of platform behaviour be avoided?

For businesses, for policymakers and regulators, and for economic researchers, this revolution raises many questions. Despite an explosion of interest in platforms, and a rapidly-growing body of research, there are many open questions. What’s more, much of the existing research centres on the United States, with its distinctive economic and social context. There is a need for more European research, including looking at why are there not more big European platforms contributing to innovation and growth. This report outlines the present state of knowledge about platforms and sets out some of the important issues for research and policy. Policies should be assessed from the perspective of the contribution platforms can make to productivity and growth, and above all to the welfare of the many millions of people using them.

This paper gives a broad overview of theory and evidence to date on digital platforms and aims to set out the issues that remain to be addressed by researchers, policymakers, and the platform businesses themselves. The distinctive economic characteristics of platforms, their global scope and their rapid evolution make for a rapidly-changing landscape in which traditional policy tools and business strategies do not apply, and there are many questions to be answered.

After describing platforms and their basic economic characteristics, the paper turns to questions of business strategy and platform design, exploring why platforms make the choices they do and asking what challenges these pose for regulators. The issue of trust is key to the regulatory questions: platforms have no business if their users do not trust them so the question is the extent to which the means they use to sustain trust avert the need for detailed new regulation. This is a heated debate in the context of ‘sharing economy’ platforms, where it is important for policies to be based on solid research given the lobbying on both sides of the debate. The first step for regulators is to require the platforms to provide the data needed for an independent assessment; almost all the data available so far has been that provided by the platforms themselves.

The straightforward regulatory questions are not the only important policy challenges. Other issues needing research and discussion include: the incentives platforms have to innovate – an acute issue in the case of the advertising-funded media platforms; the ownership of information and social and legal rules around data sharing; the determinants of consumer switching between platforms. Above all, economists need to develop practical tools for competition authorities, given the fact that previous intuitions and rules do not apply in the platform context. While it is true to say every case is different when it comes to platforms, competition authorities at least need standard procedures for analysing each specific context.

There are still more profound questions. Why does Europe not have any home-grown digital platforms on the scale of Google, Uber, Airbnb or Facebook? Can platforms do a better job in providing some services such as transport or traffic management than traditional public sector providers – and if so, why should they not do so? What is in fact the evidence about the extent to which platforms are changing ways of working and therefore an uncomfortable fit with the traditional structures of social

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provision, taxation and employment protection? So there is an extensive and – given the speed of change – an urgent research and policy agenda.

In the public debate there has been a tendency, perhaps understandable, to focus on the platforms' threats to established ways of doing business. But it is more important to ensure the knowledge and policies are in place to take advantage of the opportunities. Platforms provide compelling benefits to their millions of users. Europe needs more of them, and the sooner we have a policy landscape establishing the principles of competition and regulation, the better.

What are platforms and why are they important now?

'Platform' is the term increasingly used for hybrid entities using digital technology as an interface between the users or consumers of a product or service and its suppliers. They share some of the features of: traditional businesses co-ordinating a supply chain; intermediaries or wholesalers connecting smaller suppliers to markets; networks connecting end-users to each other; and exchanges or market places where individual suppliers and buyers meet to trade. The innovative character of platforms in co-ordinating economic activities is reflected in the fact that different terms are used, and different strands of economic research involved, including the pioneering work of Jean Tirole and others on two-sided markets, an older literature on networks, and recent work on market design.²

There have long been examples of economic institutions or organisations that could be characterised as platforms. A traditional bazaar is one instance, acting as a known location for merchants and customers to meet and exchange. More recent examples include payments card networks enabling transactions between consumers and retailers; or operating systems co-ordinating the technical standards and terms of engagement for programme developers and computer users. And some forms are very new, such as the 'sharing economy' peer-to-peer platforms.



Photo: Rory Cellan-Jones

It is surprisingly hard to pin down a definition of platforms, however, as they have characteristics of firms *and* of markets, involving both production and exchange; and they involve different kinds of co-ordinating mechanism – sometimes technical standards, sometimes exchange algorithms, sometimes social norms. In a sense, a platform is a business strategy as much as a kind of organisation, and some firms operate both one and two-sided lines of business (such as Amazon as a retailer and Amazon Marketplace). The typology below is one attempt to categorise platforms but others would certainly be plausible, and there are examples of platforms that would not fit comfortably into any of the boxes.³

	Production	Intermediation	Exchange
B to B	Internal platforms,	Payment cards	Financial exchanges

² They are sometimes called multi-sided platforms, two-sided markets, peer-to-peer platforms, networks – depending on the specific context. Key early research includes Jean-Charles Rochet and Jean Tirole, "Platform Competition in Two-sided Markets," *Journal of the European Economic Association*, 2003, pp. 990–1029. Caillaud, Bernard and Jullien, Bruno, (2003), *Chicken & Egg: Competition among Intermediation Service Providers*, *RAND Journal of Economics*, 34, issue 2, p. 309-28. J.-C. Rochet and J. Tirole. Two-sided markets: A progress report. *The RAND Journal of Economics*, 37(3):645{667, 2006. Mark Armstrong, 'Competition in Two-Sided Markets', *Rand Journal of Economics* 37 (2006), 325-66. Surveys can be found in *The Economics of Two-Sided Markets* Marc Rysman, *Journal of Economic Perspectives*, Summer 2009, *Platform Economics: Essays on Multi-Sided Markets* by David S Evans, and Geoffrey Parker, Marshall van Alstyne and Sangeet Paul Choudary, *Platform Revolution*, Norton 2016.

³ See both David Evans (2009) and Annabelle Gawer (2014).

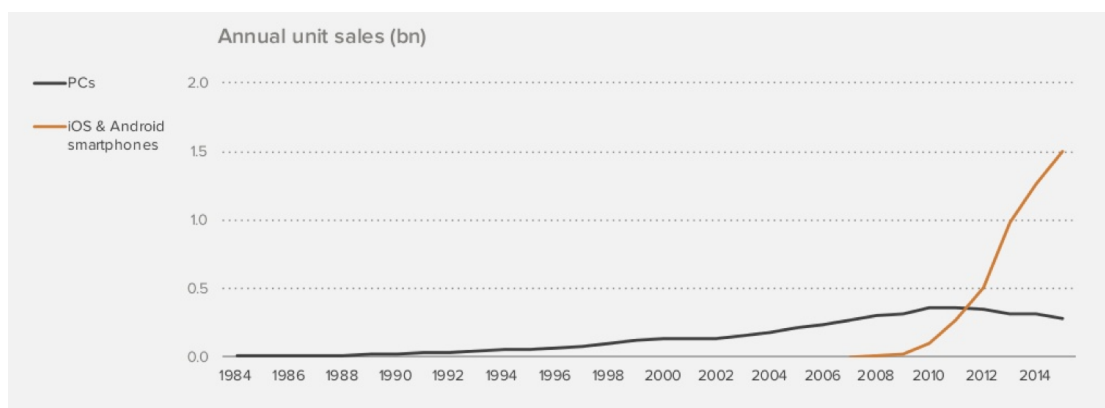
	Slack, AWS		
B to C	AWS, software OS, games consoles	Ad-funded media, phone networks, Zoopla, booking	Ebay, Amazon Marketplace
P to P	Sharing economy work platforms (Thumbtack, Taskrabbit)	Social media, UberX	Sharing platforms eg UberPool, Airbnb, home swaps. Kidney exchanges

B to B: business-to-business (wholesale); B to C: business-to-consumer (retail); P to P: peer-to-peer.

Platforms are a new way of addressing the fundamental problem of economic organization, how to co-ordinate the supply and demand (of millions of individuals in the case of consumer markets) in the absence of complete information. Traditional markets co-ordinate using location, as in the old-fashioned marketplace, or time, as in financial market auctions. Platforms achieve improved co-ordination using technology. Participants do not need to be co-located, and while individual transactions happen very quickly, they do not all need to occur at the same time.

The importance of information for the economy is well understood. In a classic 1945 article, Hayek made the point that the price system in a market economy is a decentralised mechanism for effective co-ordination when everyone has some unique information about their own preferences, or costs.⁴ But many economic transactions take place within firms, rather than in marketplaces, reflecting Coase's insight that sometimes the transactions costs involved in a market exchange would be higher due to asymmetries of information or an absence of clearly-defined property rights. He pointed out that changes in information technology (the telephone) and in management techniques could change the optimal size and organisation of a firm.⁵

It is not surprising then that the steep decline in the cost of exchanging information would alter transactions costs and therefore the kind of economic organisations that exist. The cost of information and communication technologies has been falling extremely rapidly for some time now, but some more recent innovations have opened the way for the growth of platforms as a model. In particular, access to ubiquitous fast broadband via wifi or 3G/4G and the exponential growth of smartphone ownership means platforms that connect many individuals at any time are now viable.



Technology is therefore an important element in the emergence of digital platforms. Another set of innovations has been an important enabler of certain kinds of platforms, from the discipline of 'market

⁴ Hayek (1945)

⁵ Coase (1937)

design', the strand of economics devising algorithms for matching heterogeneous demand and supply in a context of incomplete information.⁶ The computer science and economics approaches have converged in these examples, where the matching is highly co-ordinated. Finally, the context of economies with increasingly varied types of goods and services on offer, and increasing scope for customisation, have increased the value of the matching technologies.

The basic economics of platforms

How do platforms create value, as compared with more traditional forms of business organisation? Why do they seem able to disrupt so many conventional businesses? Why are non-monetary platforms in the 'sharing economy' now proliferating as well?

Platforms capture additional value for their participants, value that was previously out of reach. Apart from the intrinsic value of communication, there is better and faster matching of supply and demand, and a more efficient allocation of resources. Platforms can help overcome market failures – such as those arising with information goods (books, music, software) whose characteristics are unknown in advance – by building trust through their peer review mechanisms or payment mechanisms.⁷ Indeed, in the case of such 'experience' goods, platforms enable consumers not only to satisfy their preferences but also to discover new ones: think of the range of music discovery available through a platform like Spotify, with its discovery and recommendation algorithms, compared with the limited playlist of a traditional radio station. These matching and discovery benefits occur alongside the parallel revolution in the means of distribution thanks to the internet. In addition, there is more intensive use of under-utilised assets. This includes assets such as houses or cars in the case of sharing economy platforms, and those such as network infrastructure or investments in the case of other types of platform. Capital productivity is potentially increased. In short, platforms make markets work better. For successful platforms, these efficiency gains are large indeed. They potentially benefit all participants, those on both sides of the platform as well as the platform's owners (although, as with any form of social organisation, may also have some negative characteristics).

Platforms enable interactions or exchanges that make all participants better off by more, the more people take part on the other side of the platform; there are *indirect network effects*. The platform benefits buyers by co-ordinating sellers, and sellers by co-ordinating buyers. Without the platform, transactions costs would make it impossible for the resulting exchanges to take place. An old economy example is advertising-funded television, which gathers the audience for advertisers and pools advertising revenues to create programmes for audiences. An early vintage new economy example is Ebay, which makes it possible to sell or purchase niche products – such as the broken laser pointer of its founding story – because it assembles large enough numbers of buyers and sellers. And a new digital example is Airbnb, which is bringing new supplies of short-term accommodation to market because it is a go-to site for travellers, and is a go-to site because it has a large number of properties listed. Some platforms (such as social media networks) also feature direct network effects.

The indirect network effects make it vital to get the right balance between providers and consumers on the platform, which depends on pricing to both sides. In their classic early paper in this literature, Rochet and Tirole make this central to the definition of a two-sided market: "The price structure matters, and the platform must design it so as to bring both sides on board." There is in general one side of the platforms whose participants subsidize those on the other side. The subsidy will go to the side whose demand is more sensitive to price, and the two prices will be related to each other depending on how much benefit each side gains from the presence of the other. This relationship between prices on the two (or more) sides of the market connected by platforms, and the cross-subsidy greatly complicates competition assessments.

Another influence on price structure is the strength of consumers' desire for variety: the stronger it is, the more likely it is that the platform will charge the suppliers (although not inevitably, as suppliers sometimes themselves provide the variety). Hence video game platforms subsidise consumers who prefer to have lots of games and make most profit from developers, whereas operating system

⁶ Well summarized in Roth (2015)

⁷ Orman (2016)

software makes most of its profit from consumers and subsidises developers.⁸ Another factor is the extent to which the prices are public, or instead known only to the platform and each individual supplier. The information asymmetry could alter the platform's pricing strategy if it needs to entice consumers onside by reassuring them they are not being taken advantage of.⁹

If the platform gets it wrong, and sets the price too high for consumers so there are few of them participating, the price suppliers are willing to pay to access the platform will be lower. Discouraging participation on one side by getting the price wrong can lead to a downward spiral in the number of transactions. Conversely, a positive feedback loop can lead to rapid growth in transaction volumes when a platform manages to attract consumers, which attracts more suppliers, which attracts more consumers, and so on. New platforms therefore need to reach a critical mass beyond which the positive feedback operates.

Often, both consumers and suppliers will use several different platforms (called *multihoming*). Somebody wanting to book a holiday has every reason to look at many websites, while a property owner similarly will probably advertise on several platforms to reach a larger number of potential holiday-makers. However, many platforms (such as operating systems, estate agencies) have single-homing on one side, creating a competitive bottleneck, and multi-homing on the other side. There are also some examples of platforms dominating their markets because of the scale of the indirect network effects. Social media, search, and operating systems are examples: the benefits to consumers of everybody using the same platform or standard are compelling. This too poses significant challenges for competition policy, explored below.

In older networks, such as telephone networks, the co-ordination of the two sides of the market comes about partly because of a standard set externally, for example technical standards such as GSM for mobile telephony, or regulatory actions such as the allocation of spectrum bands or phone numbering. Telecoms companies still offer benefits from co-ordination, and still need to price outgoing and incoming calls appropriately to balance them, as well as set interchange fees and protocols between their individual networks. Newer platforms largely internalise the network externalities and determine how the benefits so captured are shared. The realisation of the value from the externalities – the better matching of supply and demand, the reduced transactions costs on the platform – means there is scope for everybody to benefit. So now that technology and organisational design mean platforms can exist, it is no wonder that they are spreading so quickly.

An interesting area for economists (and platforms) looking at the dynamics of platform growth is the influence of social preferences on demand. Platforms often create the impression of great demand for invitations at the beta stage by sending personalised and apparently exclusive invitations to join. Here is one recent example from Blendle, a news aggregator platform.

Hi Rory,

We're one week into our closed beta and I've been receiving a lot of emails about how people can let their friends see what we're working on. I know that our waiting list is pretty long now (over 20,000!), and who really wants to wait in line if they know someone already on the inside? Probably not your friends :)

So here's an exclusive beta code you can send to three special people you really like. And I've included \$2.50 free credit with each!

<https://blendle.com/access/Cf4zk2>

Feel free to just forward this email directly to those lucky three - the invites only last for the next 72 hours. If you want a few more, just ask and I'll see what we can do!

Best,
Alex

⁸ Hagiu (2009)

⁹ Llanes and Ruiz-Aliseda (2015)

How effective are such tactics? How do they compare to ‘viral’ campaigns that at least appear not to come from the platform but from individual users? Is there a point at which they can backfire by undermining exclusivity – a consideration for dating platforms, for example, which might want to trade off a wide choice for each user of the platform against the appearance of social exclusivity.¹⁰

Business model choices

Since the early research on two-sided markets and platforms, there has been a proliferation of work looking at the organisation of these new digital businesses, although there remain many interesting questions.

To think about the choice of a platform as business model, consider the transactions costs in the case of a platform as opposed to a traditional firm with contracts with suppliers and sells its product on to consumers, in a conventional supply chain. (There is of course also a large literature about firms’ choice between vertical integration and contracts with external suppliers.) The advantage of a platform lies in its ability to reduce consumers’ or buyers’ search costs and to reduce shared transaction costs between the various sides, to a greater extent thanks to direct contact between suppliers and customers.¹¹ For example, Amazon as an online retailer has the advantage of large economies of scale and its significant investments in logistics. Amazon as a platform has additional advantages: adding Marketplace added indirect network effects. Google started as a one-sided search business and has steadily added more ‘sides’ beginning with AdWord and AdSense. The business landscape is changing in many countries as traditional businesses try to capture the advantages of two-sided or multi-sided operation, and existing platforms increase the number of ‘sides’ to increase the network effects they can capture, and share with their users on all sides. This flux is often labelled ‘convergence’. As Hagiu (2007) puts it: “Indirect network effects generate powerful demand-side economies of scale and scope, which, combined with technology, render industry barriers quite porous and easy to straddle with sound MSP expansion strategies.”

Hagiu and Wright (2016) argue that the decision between traditional vertically integrated organization of the firm and platform organization reflects the allocation of control over the transaction and the extent of moral hazard affecting the firm and its employees or contractors. They see the control (over pricing, bundling, marketing, delivery and so on) by individual agents as a key distinction between a platform and other models of business organisation. The choice of model is not always obvious. For example, a traditional consultancy employs professionals directly whereas a platform matches independent consultants setting their own fees to clients. The quality of the individual consultants’ work is hard to monitor. “A key tradeoff emerges between the need to coordinate decisions such as marketing that generate spillovers across professionals (best achieved by a vertically integrated firm) and the need to both motivate unobservable effort by professionals (best achieved by a MSP).”

The structure of prices – to balance the two sides – is critical, and the decision has been extensively explored in the literature. As well as the choice of which side to subsidise, the platform needs to decide what mix of access or membership fees and usage or per unit fees to charge. The determinants will include: the variety of consumers’ tastes (which makes suppliers less good substitutes for each other); the extent of multihoming by consumers and by suppliers; and the risk of a hold-up of suppliers by a platform (when for example they have to incur costs to get onto the platform).¹²

In reality, the choices are not always obvious, especially for new platforms, and there is much trial and error. For example, the use of mobile telephones spread more slowly initially in the United States than in Europe due to the choice of ‘receiving party pays’ pricing in the US rather than the ‘calling party pays’ adopted in Europe. And while often consumers are subsidised, a few platforms are the opposite way round. The structure of incentives needed to establish a new platform might well be different from

¹⁰ Campbell et al (2012)

¹¹ Summarised by Hagiu (2007); Hagiu and Wright (2015)

¹² Hagiu (2009)

those required for an established platform; much of the literature explores already-established platforms.

An important category of platforms offer a free online service to consumers and are funded by advertising. This includes many media platforms; subscription models are relatively rare. The peculiarity of these markets is that while advertisers want access to consumers, consumers typically do not want (much of) the advertising. In addition, the economic characteristics of information as a good are quite distinctive, in that it has strong public good characteristics and typically high fixed costs but low or zero marginal costs. There is a large literature on media, which is of course also a special case because of its cultural, civic and political importance.¹³

Early platforms were more likely to set prices using an auction mechanism, but auctions are decreasingly popular – Ebay’s progressive move from auctions to traditional pricing is the obvious example. Economists have also expected platforms to practice price discrimination more than they seem to, or in other words to use the information they hold about each individual buyer to set different prices and increase the platform’s profit at the expense of consumers (or suppliers). In fact this seems a far bigger concern in theory than in reality. There is some evidence of concern about price discrimination in the form of websites (such as Sherrif) that collect price information so individuals can check the price they face against the price paid by others. Some instances of online price discrimination have been identified.¹⁴ But there is no real evidence of widespread price discrimination on an individual basis, as opposed to the use of mechanisms (such as premium delivery charges) to identify groups of customers. Some economists have been puzzled that there is not more price discrimination, especially as consumers are very used to price discrimination by airline and travel websites, even to the extent of often knowing the price will change if the site is checked twice from the same IP address. This might just reflect the ease of consumer switching online, but perhaps in the combination of the retreat of auctions and the absence of price discrimination there is more to understand about the advantages of simple pricing rules.

With such a recent phenomenon, there are also questions about the evolution of platforms. Is it just a matter of time before platforms drive out incumbents with traditional business models, or before the incumbents switch organizational model? Might some platforms indeed evolve toward becoming traditional supply chain intermediaries with users on each side not having direct contact with each other? Certainly, some incumbent industries fear the former will occur, and are either calling for regulatory protection. Alternatively some are taking action by acquiring platforms. Recently Accor purchased the luxury accommodation platform One Fine Stay and Enterprise car rentals purchased City Car Club.

It is also interesting to ask why some platforms have failed. An early crop of B2B platforms failed and have not (yet) been replaced by newcomers, raising the question as to whether platforms will largely succeed because they can co-ordinate large number of end-consumers: are they therefore largely a retail proposition or were the early B2B failures simply due to design mistakes now understood and avoided by platforms?¹⁵ Are newer B2B models now emerging, able to create more extra value than the earlier examples?

There are likely to be sectors less vulnerable to disruption by platforms. Platforms may be successful for one-off transactions but not for repeated transactions. In the latter case, buyers who find a seller suiting their needs through the platform will be tempted to carry out future transactions off the platform. This is a common problem for temporary employment agencies, which try to mitigate the risk by imposing a charge when an employer hires permanently one of their temporary workers. It is harder for an employment platform to monitor when this occurs, and so their charging structure is more often an upfront access fee rather than an ongoing usage fee.

On the other hand, there might yet prove to be disruptive platform entry in some surprising sectors. For example, electricity transmission and distribution has traditionally been a highly centralized

¹³ For surveys see Gabszewicz et al (2015) and Anderson and Jullien (2016).

¹⁴ Hannak et al (2014). Mikianset et al (2012)

¹⁵ Evans (2011)

network because electricity is generated by a few large power stations. If more generation in future comes from (say) small-scale photovoltaics, so many people supply power to the grid as well as consuming it, this could become a platform industry, and there are already some start-ups. Likewise, airports could be redesigned as platforms for matching travellers to flights. “Airlines prefer to operate at airports which are attractive to passengers and passengers enjoy airports where they can access more air links and destinations, as well as a wide range of shops and restaurants, and convenient parking and transportation facilities.”¹⁶

As these examples, and others demonstrate, new platform businesses piggy-back on traditional physical networks. There is a rich literature on some aspects of this. The vigorous net neutrality debate, for instance, is concerned with the allocation of cost and division of value between the physical platform and the business platform using it.¹⁷ However, the fact that platform business models are becoming so widespread could intensify this debate about who pays for underlying backbone networks, and who gets the increased economic value of platforms serving downstream markets. The economic analysis needs to apply from end to end of the whole network infrastructure rather than any single platform component. Sometimes this is alluded to by the description of industry sectors in terms of ‘ecosystems’ (rather than linear supply chains). There is little work on how to value a business network or ecosystem as a whole and how to analyse the division of value between its components, but this is surely an important question. Regulatory and competition analysis needs to take into account the links between the components, and beware of the unintended consequences elsewhere of intervention in one part of the system. There are many issues here, both in terms of research and business practice, and not least because the relevant ecosystems will almost always cross national borders.

As the spread of platforms is such a recent phenomenon, there is much still to understand about the dynamic evolution of the model. One question is how and when a platform reaches the tipping point for viability.¹⁸ It would be interesting to bring to this question any business strategy lessons from network economics about how specific network structures develop; percolation thresholds in random networks have been well explored but not with the incorporation of economic incentives. Another question is whether platforms themselves will face new forms of competition, for example from automated vehicles or online personal assistants.

Platform design

There are several important aspects of market design explored in the economics literature, yet also many further interesting questions. Although one of the most important decisions the platform has to make concerns its pricing structure, there are many other design issues.

Researchers should be aiming to combine the insights of the two-sided models of industrial organisation with those of the matching market design literature. This is particularly the case with so-called sharing economy platforms, growing very rapidly now, whose defining characteristic is their peer-to-peer nature. The economic value created by sharing economy platforms lies exactly in their ability to capture the efficiencies of improved matching of supply and demand, and reduced search and other transaction costs. The market design literature concerns the algorithmic search and matching process, but has so far not paid much attention to the business organization questions such as how to design the platform to balance the different sides and reach critical mass. For example, one natural extension would be to make demand and/or supply endogenous, or in other words make the arrival of new users on each side depend on the past evolution of the platform.

Another important design choice for the platform is whether it will capture efficiencies simply by better matching of diverse supply and demand, or whether it is more a question of a ‘liquid’ platform with a large amount of participants on each side so people can accomplish a transaction in a more homogeneous service very quickly. In other words, is the platform differentiated or commoditized?

¹⁶ Ivaldi et al (2015)

¹⁷ Greenstein et al (2016)

¹⁸ Bresnahan et al (2015)

Examples of the former include marketplaces such as Ebay or Etsy or professional worker platforms such as Thumbtack, where buyers might be looking for a very specific item or service. An example of the latter is UberX, where the user's main requirement is getting a car as fast as possible but the identity of the driver (subject to some minimum standards) is not relevant. A further question is how to ensure a 'thick' or adequately liquid market in the absence of the traditional means of co-ordination in space and/or time. Platforms seem to use their classification and recommendation systems to achieve this; and there might be lessons to learn from the literature on agglomeration economies¹⁹ There will be subtleties in this choice, when it comes to evaluating the economic welfare outcomes. As Budish (2015) has observed, high-frequency trading platforms appear to be highly liquid and commoditized, with ultra-rapid diffusion of information; but considered at the small time intervals relevant to computerized trading, these markets are actually not very liquid at all. Budish shows that liquidity would be improved in the sense of each cleared market being thicker (and welfare gains more evenly divided) if there were regulation to limit the frequency of trading.

Platforms often change the scope of their activities over time. This strategy of 'envelopment' whereby some platforms incorporate new kinds of activity from their position of strength in existing activities sometimes concerns competition authorities – although arguably not enough. Thus for instance Airbnb recently announced plans to expand into the markets for tours and other leisure activities.²⁰ This strategy exercises competition authorities, as can be seen from the cases in which Google has come under increasing scrutiny as it has added more and more activities – such as maps and books – in addition to its basic search and advertising. However, Google has also purchased nearly 200 companies in a range of markets with no regulatory intervention (because existing tools for market definition and assessment of market power cannot deal with it). Yet the strategy is understandable in terms of the power of network externalities, which make acquiring more customers extremely valuable. Design is one way to do so, but so are advertising and marketing spend on other platforms, as well as the acquisition of 'neighbouring' platforms.

Trust

One fundamental dimension of platform design is creating mechanisms that establish trust between buyers and sellers.²¹ Without a repeated relationship, it is harder to create the trust that enables a transaction, and so platforms have a number of strategies for building trust. Ratings systems are one method that has been considered in a number of papers – including the scope for gaming ratings, and the bias towards giving good ratings.²² Other trust-building techniques include provision of payment and sometimes escrow mechanisms through the platform, or sanctions against 'misbehaving' suppliers. Platforms also spend considerable sums on marketing; while this is important for building the number of users, it is also the case that just as in conventional businesses, establishing a brand reputation is important for creating trust.

In practice, platforms implement a wide range of rules concerning access and participation, technical standards, contracts and so on. These rules are intended to manage uncertainty and share risk; to overcome or mitigate information asymmetries; and to co-ordinate their 'ecosystem' in a complex environment. Boudreau and Hagiu suggest that platforms in fact act as 'regulators' or rule-making governance institutions in the context of many market failures and co-ordination problems – and that they indeed substitute for the need for government regulation: "MSPs are in a unique position to be focal, *private regulators* by virtue of the one-to-many asymmetric relationship between them and the other players."²³ In effect, the platform aims to maximize the value generated by its entire ecosystem and so influence decisions taken off the platform as well. The variety of approaches taken by different platforms over time suggests there is much still to understand here about a range of choices, such as whether or not to be open or closed, which standards to adopt, how to write contracts to share risk and induce the revelation of private information, and how these levers interact with price-setting. A particularly interesting context is the challenge of designing a two-sided market when both sides have

¹⁹ Adomavicius et al (2005)

²⁰ [http://www.bbc.co.uk/news/technology-36212451?](http://www.bbc.co.uk/news/technology-36212451)

²¹ Boudreau & Hagiu (2007)

²² Surveyed in Dellarocas et al (2006)

²³ Boudreau and Hagiu (2009)

private information. Social welfare would be maximized when the design mechanism gives both sides an incentive to reveal their true preferences or costs; but if it did this, the platform would make a loss because the price buyers are willing to pay will be at or below the price sellers need to be paid.²⁴

Their fundamental need to establish trust raises the question of whether platforms can in effect act as a kind of self-regulatory organization. The interests of the platform will often be at least partly aligned with those of its users, and with finding a reasonable balance between benefits for buyers and sellers, including when transfers are not possible. Sundararajan (2016) argues that much of the regulation of platform markets can indeed be left to platforms. Uber wants to ensure its drivers are safe and insured (in some countries, Uber drivers are indeed more likely than traditional taxis to be insured and are therefore seen as safer); Airbnb wants hosts not to lie about the quality of the accommodation and guests not to trash their rooms.²⁵ The technology itself offers safety features such as GPS tracking, or the ability to record through photos. He suggests that self-policing is more effective in achieving the desired outcomes. For instance, although formal regulations about safety standards in hotels can seem on the face of it better at protecting consumers, they might in reality only be inspected once at the opening of a hotel; whereas Airbnb guests can give constant quality feedback through the rating system and the platform is strongly incentivized to ensure this is effective. (Similarly, TripAdvisor ratings may do a better job than formal regulation and inspection in monitoring hotel standards.) Formal regulation would then only be required to address other externalities, such as the increased noise and carelessness of many short-term visitors in a residential neighbourhood. Even then, Sundarajan optimistically suggests, social norms will evolve in this new market that could make government intervention unnecessary. This is surely an open question, given instances of, for example, discriminatory behaviour. For example, Edelman et al (2016) find experimental evidence of racial discrimination by suppliers to online platforms. If discrimination were to prove more systematically prevalent on platforms than in traditional businesses, governments may want to introduce measures to ensure compliance with equality laws.

This discussion touches on another strand of transactions cost economics. While Coase and his successors focused on business organization, Elinor Ostrom looked at the conditions for informal social co-operation to succeed. While she studied the provision of collective goods such as water for irrigation, or policing, her argument about the scope for self-organised regulation when there are major externalities or information asymmetries seems highly relevant in the context of platforms. The likelihood of successful outcomes depends on factors such as the level of trust and social norms, she concluded. Ostrom's design principles for organization in such conditions could perhaps extend to sharing economy platform design, or be amended for them. Alternatively, could they inform the regulatory approach to the sharing economy, implementing regulation in terms of design principles rather than specific characteristics of each platform.

Ostrom's institutional design principles:

- Rules are **clear** about who is entitled to what
- **Monitoring** is feasible and straightforward
- There are **mechanisms for resolving conflicts**
- Individual **duties correspond to the benefits** they gain
- **Users** themselves responsible for monitoring and enforcement
- **Sanctions should start mild and get progressively tougher**
- Decisions need to be **legitimate** – users participate and have authority to make decisions

This opens an interesting line of thought about the potential of platforms to deliver social benefits where

there are indirect network externalities. Do they offer a form of collective organisation that is not driven (only) by individual profit or gain, but is not state-organised? This is certainly the promise held out by

²⁴ Loetscher et al (forthcoming)

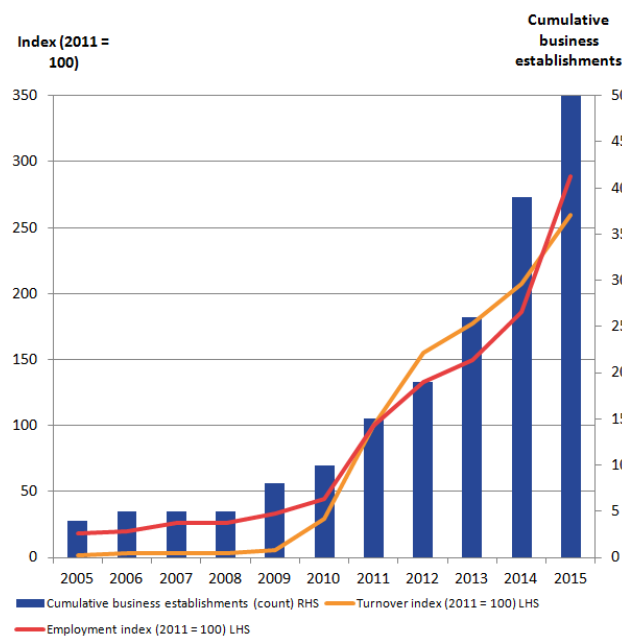
²⁵ Sundararajan (2016,), Chapter 6

some ‘sharing economy’ platforms. Their origins lie in the application of digital technology to non-monetary and socially beneficial exchanges – moving away from this spirit could help explain why some for-profit sharing economy platforms have become rather controversial.

Sharing economy platforms

The growth of the so-called sharing economy has been a notable recent phenomenon, sufficiently rapid to have gained significant attention. Big companies in this sector – Uber and Airbnb – have prompted a great deal of commentary about their business model and practices, and calls (often from incumbents) for specific regulation. The number seems to be accelerating. For instance, in the UK the Office for National Statistics estimated there were 50 sharing economy platforms in 2015, up from 10 in 2010. Interestingly, it reported that more than half of these reported their activity as being ‘business services or finance’ so including peer-to-peer lending platforms and crowdfunding platforms. There are some studies on this sector, but the apparent speed of its growth warrants more study.²⁶ While the UK is in the lead in terms of the amount raised by crowdfunding, France, Germany and Sweden have also seen rapid growth in the sector.

The distinction between sharing economy platforms and other types of platform is not a sharp one, and is arguably mainly marketing. But sharing economy platforms can be characterised as aiming to match many suppliers and many consumers (or in other words they are peer-to-peer), where the suppliers are able to use more intensively through the platform an asset they own, such as an apartment, car, tool or skill. The technology – the combination of matching algorithm, pervasive internet connectivity and digital device – make it feasible to rent out the asset when it is not in use because transactions and search costs have been lowered so dramatically.



Source: Office for National Statistics

These basic economic characteristics mean sharing economy platforms are viable when there is sufficient heterogeneity in demand and when there are no large economies of scale in supply. Individuals are choosing whether to buy or rent an asset, and the ownership decision will depend on their intensity of usage, the price in the rental market, and in some cases (a second apartment) income or access to credit. P2P platforms are likely to result in reduced purchasing of durable assets and increased renting, and owners and renters will achieve the same marginal benefit.²⁷ Like other

²⁶ Surveyed by Belleflamme et al (2015)

²⁷ Horton & Zeckhauser (2016)

platforms, online ratings systems are also a key part of the design problem, to establish trust. In addition, interface design and the presentation of search results seem empirically very important.²⁸

There are costs in bringing under-used assets to the new rental markets, including labour costs and the opportunity cost of not using the asset. In addition, supplying to the platform will include costs that depend on how easy it is to plan and implement making the asset available in relevant units of time. Sharing economy platforms devote considerable effort to making this easier – for example, Airbnb advises hosts on remote key exchange and suitable insurance policies. There is also some reintermediation, with start-ups entering the market to provide these rental-facilitating services, such as Airsorted for Airbnb hosts. The platform can also provide economies of scale for individual asset owners in providing services such as handling payments and disputes. The platform has strong incentives to reduce the cost to suppliers of bringing their under-used assets to the market.

The experience of some sharing economy start-ups suggests these costs, and the platform's costs and fees, mean there is unlikely to be a 'Uber-for-everything' model, however.²⁹ In addition to the characteristics described above, there will need to be enough of a gap between offline search costs and the additional online bring-to-market costs, even when online search costs are so greatly reduced. For example, finding a cleaner by word of mouth is not much different in total (search plus money) costs from hiring one via Taskrabbit (lower search cost but higher monetary cost including platform fee).

The welfare benefits for individual participants in sharing economy platforms seem likely to be large. Not only is there the revealed preference argument – that there are many outside options so nobody would drive for UberX or rent an apartment via Airbnb if they did not benefit – there is also a distributive argument in that people previously unable to purchase assets will gain access to using them. There are also pure efficiency gains from the more intensive usage of durable assets and the improved matching of heterogeneous demand and supply. The platform's profits (in a competitive context at least) are highest when it achieves a balance (in terms of value to each side) between renters and owners, which occurs when the cost of ownership is not too high (which would mean too few owners – a sharing economy platform for aircraft carriers seems implausible) or too low (which would mean too many owners – there is no platform for sharing saucepans).³⁰

However, the sharing economy is controversial. One argument made is that the platforms succeed mainly because they can evade existing regulations. Uber and Airbnb have faced regulatory restrictions in various cities around the world, often at the behest of incumbents. The competitive threat to existing rental companies is serious as the platforms can always offer lower prices and greater variety unless there are significant economies of scale in rentals – for example, high fixed costs of handing over room keys for many guests one night at a time.³¹ This is exactly where the platforms put much effort, though, in reducing these kinds of cost. As a result it is not too surprising that conventional rental companies are acquiring P2P platforms. One suggestion is that large-scale sharing economy platforms can only exist where there are high regulatory barriers to entry and therefore much scope for regulatory arbitrage. This could help explain why such a high proportion of P2P start-ups are in fact in the financial sector.

As noted, it is unlikely that the new platforms are significantly more unsafe than established businesses – indeed, they are arguably safer. They have substituted a combination of upfront checks and ongoing monitoring and feedback by users for one-time approval and occasional enforcement checks by regulators. Self-regulation is potentially a more effective option than traditional government regulation, except perhaps where the platforms impose external costs. Some argue that this is a justification for increased regulation of P2P rentals, for example, as Airbnb is resulting in more short-term visitors in residential areas. But this imposes a substantial loss of welfare on Airbnb customers and on residents seeking to use their property more efficiently. Competition – and certainly competition

²⁸ Einav et al (2015)

²⁹ See the failures described in <http://www.fastcompany.com/3058299/why-a-new-generation-of-on-demand-businesses-rejected-the-uber-model?>

³⁰ Benjaafar et al (2015)

³¹ Edelman and Geradin (2015)

combined with peer review mechanisms and technological mechanisms – has the potential to substitute for some regulation to the benefit of all. Simply blocking consumer and supplier access to the potential value unlocked by platforms seems the least appropriate policy response; a better approach is to reassess the regulatory landscape across business models of all types to ensure it is delivering the intended public benefit without imposing unnecessary costs.

The same approach should apply to the other area of controversy, employment via sharing economy platforms. Some critics arguing that it is a ‘gig economy’, represents no more than casualization of the labour force. This controversy has been greatest in the United States, where the outside options for sharing economy workers differ greatly from Europe; the minimum wage is low and job security and conditions are poor for many workers. The distinctions between platforms for professional workers with high human capital (such as Thumbtack) and those for more standardised work such as cleaning or gardening are important. In the former case the individual worker will have more control over their work, will rely more on individual reputation and rating, and will be likely to work on several platforms or off the platform as well. The current legal cases in the United States hinge precisely on questions such as the degree of control the individual has over hours, the way the task is performed, whether they must use platform branding and so on.³² The focus on employment also overlooks the supplier benefits provided by platforms. Millions of people are able to use their assets (including human capital) more efficiently to make some additional income, often with control over their hours and locations. The platforms provide an on-ramp to the formal labour market for people who might have been out of work for some time – such as mothers who have been caring for children, or the long-term unemployed.³³

Fundamentally, however, many people distrust the ‘sharing economy’ because it has moved away from its non-profit roots.³⁴ Even the Financial Times bizarrely complains: “Airbnb has lost its soul. It was the epitome of the sharing economy - and then money got in the way.”³⁵ Platform models clearly pose a challenge to the existing framework of employee and consumer protection, shaped around traditional business organisations. But it is perverse to argue that the best policy response is to prevent the new models from benefiting workers and consumers, in order to maintain the existing regulatory framework. The European Commission has recently cautioned against over-rigid application of regulations to what it termed the ‘collaborative economy’ platforms, while recognising that taxation and regulation will need to adapt to the new models.³⁶

Issues galore

The platform phenomenon is relatively new and evolving rapidly, and it is fair to say there are very many policy questions economists should be helping address. Some of the most pressing – and difficult – are set out briefly here.

Incentives to innovate

There is relatively little work looking at the incentives to innovate as this requires models in which the platforms differ, and these are analytically complex. Belleflamme and Toulemonde suggest that there are direct profit incentives (due to cost reduction) and indirect strategic incentives (due to competition) for platforms to innovate, and these can work against each other. If a cost-reducing innovation will trigger an increase in competition on the side that is subsidized, there can be a negative incentive to innovate. Moreover, platforms will tend to concentrate their innovation on different sides to limit these cross-group competitive effects.³⁷ Understanding incentives to innovate is an important issue in the context of competition policy (see below). Platforms recovering their costs from suppliers in order to keep consumers on board may make innovation among suppliers less feasible. Platforms that become dominant may have a reduced incentive to innovate themselves. Both sources of innovation need to be considered for a complete welfare analysis.³⁸

³² Sundararajan (2016) Chapters 7-8, See also <https://www.thumbtack.com/blog/beyond-the-gig-economy/>

³³ Fraiberger and Sundararajan (2015); Chassany, Financial Times 3 March 2016.

³⁴ Botsman & Rogers (2010). See also Henten and Windekilde (2015)

³⁵ How Airbnb Lost Its Soul, Williams, Financial Times April 15, 2016.

³⁶ EU Commission (2016)

³⁷ Belleflamme and Toulemonde (2016)

³⁸ Gawer and Cusumano (2014)

Information as a public good

The economics of information are well known to have distinctive characteristics like those of supplying public goods: the initial fixed cost of provision is high, the marginal cost of reproducing is low or zero, and consumption is non-rival ie. many people can consume the information good simultaneously. Creating a for-profit market in information is therefore problematic. Subscription in the case where it is technologically possible (and legally possible via intellectual property protection) to exclude consumers who do not pay is an efficient pricing model from the perspective of the platform, but social welfare will be lower than if the information good is freely available to everyone. The alternative of advertising financed models is discussed below.

Ownership of information

Platforms will invest in information goods only if they can achieve a return, and yet all of the methods of doing so are problematic. One approach is to see the platform as a data factory, investing in the identification of characteristics of participants, data which can then be sold to advertisers or suppliers.³⁹ Although there seems to be little public concern about the loss of privacy involved, this may be changing as awareness increases, including awareness of the value of personal data. Another possibility is to claim intellectual property rights, legally enforced, and technologically implemented. However, it is clear that the social norms concerning intellectual property are not settled. There is a vigorous literature debating this, not to mention evolving legal case law.⁴⁰ One interesting recent example was the claim by John Deere to the US Copyright court that farmers do not in fact own the tractors they buy – contrary to the existing social understanding of ownership. John Deere's aim was to prevent farmers modifying the complex software and sensors now installed in tractor cabs, and so they claimed (with partial success in the court) that farmers are leasing the company's intellectual property in the software.⁴¹

Scale

The need to grow the platform to critical mass, usually with a subsidy to one side of the platform, can make entering a platform a loss-making proposition for some time. The bigger the losses that can be sustained, though, the faster the platform will get to critical scale, and the more rapidly it will grow. Early stage financing at scale is therefore an important competitive advantage. This could explain why the biggest and best-known digital platforms are so often Silicon Valley-based, as they have been able to raise substantial venture capital funding. The EU has always lacked the scale and depth of the American venture capital industry. This gap has become a yet more serious disadvantage, and given the competition and indeed power issues discussed below, it has ever more significant consequences.

Substitutes and complements

There is too little evidence still on the impact of platform entry in important markets such as taxis and accommodation where incumbents claim the platforms are taking advantage of a regulatory vacuum to cannibalise the market. However, these are separate questions. Appropriate regulation is one debate. A separate question is what service the new platforms are in fact substituting for. Are UberX users switching away from incumbent taxi firms, from public transport, from private cars, from walking or cycling, or from staying at home? Is Airbnb substituting for hotels for travelers, or for rental accommodation in cities; is it expanding the demand for accommodation in total? It is not possible to assess either market or indeed environmental impacts without being able to answer such questions. This research is just starting to emerge and clearly depends on data access, at present dependent either on the platforms or on web scraping, both potentially biasing the research. More open access to data is an issue policy makers should address.

Repugnant platforms

There has been little work on the impact of platform models on criminal and anti-social activities such as money laundering, drugs trading and gambling. Clearly it is undesirable for such activities to become more 'efficient' and there may be new regulatory and enforcement needs. These platforms themselves face a trade-off between brand recognition/reputation and the probability of prosecution.

³⁹ Bergemann and Bonatti (2015)

⁴⁰ For an overview, see Menell et al (2016)

⁴¹ <http://www.wired.com/2015/04/dmca-ownership-john-deere/>

'Behavioural' considerations

The existing literature on platforms assumes consumers and suppliers behave rationally, as in conventional economic approaches. But as in any market, 'behavioural' considerations can change the analysis profoundly. There are many open questions here about how suppliers and consumers approach their choice of platform, whether to multihome, switching, the trust mechanisms described above, and so on. In particular, it seems natural to explore whether the profit-maximising pricing structure balancing both sides accords with the price structure that will balance the sides of the platform in terms of the psychology of consumers and suppliers. One case study might be the mobile phone pricing question and calling party versus receiving party pays. Economists have no doubt much to learn from management literature on this front.

The problem of free

One obviously important 'behavioural' consideration is the compelling consumer psychology of anything free. A number of psychological studies have demonstrated how irresistible consumers find a 'free' good even knowing logically that a price is somehow paid, although this may be changing as customers become more accustomed to the time or attention costs involved. Even without this research, the prevalence of 'free' services online is testament to this being a compelling model.⁴² One question is exactly what value platforms gain from the sale of data or of advertising space, or in other words what price are consumers paying for 'free' services and how does this compare to what a subscription model or usage fee model might cost them. Is the veil of the 'free' service a means of redistributing surplus from either suppliers or consumers to the platform?

Many consumers are unaware of the extent to which their personal data can be harvested and aggregated, or have some idea but do not care. Google collects almost all the log information, including details of the search queries, telephony log information, IP address, hardware settings and cookies planted by web- sites. While Google promises to protect and not to sell users' privacy and information, it has made billions of dollars through targeted online-advertising. Any individual is unaware of the economic value of his or her private information. One study found that only 15% of the subjects are willing to pay half a penny for preventing data sharing with third parties.⁴³ In other words, most people significantly underestimate its value. The value of the aggregate information is in fact enormous. The power of big data is well beyond the imagination of many people and opens up a new horizon of online marketing. Even the available privacy protections are incomplete as Muth (2015) has documented.⁴⁴

There are therefore public policy concerns about privacy and transparency. The standard terms and conditions many platforms require consumers to accept are long and confusing, far from the true meaning of transparency. Many people will not bother to read privacy policies at all. The value of personal data is such, though, that search engines and aggregators have strong incentives to shift users' behaviour by altering ranking algorithms. They also have a strong incentive and the clear ability to favour their own vertically integrated sites, and maximise advertising revenues.

⁴² Evans (2009) presents a comprehensive overview of the evolution of the online advertising industry.

⁴³ Preibusch (2013)

⁴⁴ Muth (2015)

The evolution of accommodation platforms

Online travel agencies (OTAs) have to a large extent replaced traditional high street agencies. Kim et al. (2007) identify nine determinants of successes of OTAs; they are security, ease of use, price, useful and relevant content, visual materials, speed of the website, ability to book all travel arrangement, booking flexibility and sorting options. Customers can search for hotels, local attractions, transportation, and other related goods and services in a centralized way. For example, users of Booking.com can compare prices, facilities, and surroundings of the listed hotels before making a booking through the site without a need for contact with the hotel. Users can check the comments and evaluations by others. Smaller hotels can compete better with bigger corporations since OTAs provide the essential exposure. So on the whole OTAs are seen as having enhanced competition and broadly speaking helped the hotel industry.

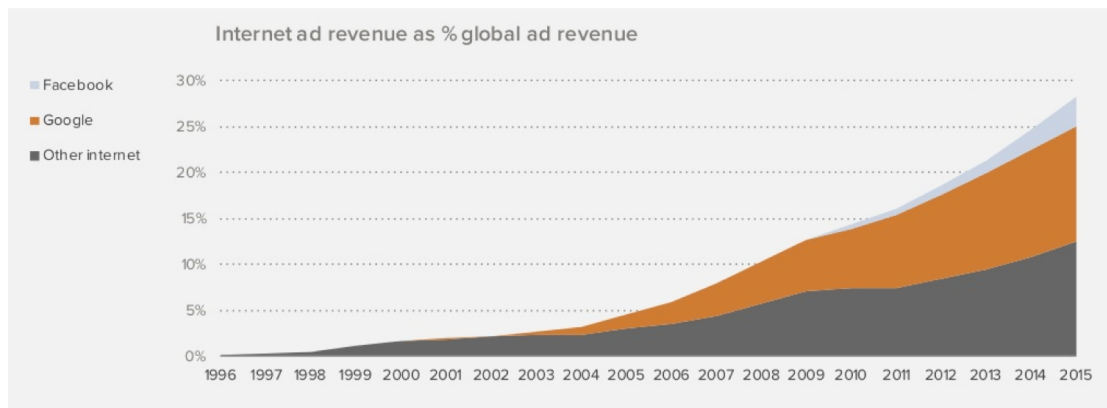
While OTAs offer customers a wide variety of choices, their practices may not always enhance consumer welfare. One competition concern is the Most-Favoured Customer (MFC) clauses. Online hotel booking websites, like other online shopping platforms and their respective suppliers, are engaged in a vertical relationship with hoteliers. The most common contractual arrangement is the agency model (Johnson, 2014). Suppliers set the prices of the products on the platform, which receives a commission on each transaction. In the agency model, OTAs and hoteliers usually agree on the MFC clause. The clause obliges the supplier not to sell the same product or service at a lower price through another channel. The MFC can be narrow or wide. A narrow MFC clause ensures the price quoted on the platform is at least as low as the price quoted on the supplier's own website. It does not prevent the supplier agreeing on a lower price on another platform. A wide MFC clause ensures the price quoted on the platform is the lowest among all platforms, including the supplier's own website. Since most of the platforms maintain the wide clause with hoteliers, it simply equalizes the prices on all online channels.

The main defense of the MFC clause is that it protects investment by the downstream platforms. If the suppliers can charge a lower price on their own website, they could free-ride on the investment made by the OTAs. Customers might search on the platform, but then book the room on the hotel's website at a lower price. Therefore, the clause arguably protects the incentive of the platform to invest and innovate. However, Ezrachi (2015) suggests that the wide MFC clause harms customers because it weakens competition among OTAs. The equalization of all prices for the same hotel on all online channels removes the incentive of the OTAs to improve because investments do not help them compete on price. However, the narrow MFC clause is an agreement between one single platform and one hotel, and thus the OTAs can still compete for customers by lowering prices and would try to offer more competitive terms in negotiation with hoteliers.

Competition authorities have been concerned with the adverse effect of the wide MFC clause. Booking.com is the most popular online hotel booking platform in the US, and globally ranking at 112 among all websites. In June 2015, Booking.com settled antitrust cases against it in Sweden, Italy and France. It promised to abandon the wide MFC but still keep the narrow MFC clause. Besides, it also maintains its Best-Price Guarantee. Due to its market power, the promise in fact does not significantly change the competitive dynamics in the industry. Given the global scale of Booking.com, it is very likely that the Best-Price Guarantee will drag the price of a hotel room down to its lowest price elsewhere.

A more recent development is arguably a bigger challenge to the hotel industry; that is the rise of sharing economy and specifically Airbnb.com. The booking and the evaluation systems are basically the same as those of OTAs, except that the commission fee is explicitly added onto the total rent and shown to the customers before paying. Customers can search on the website and pick the one among many properties according to the comments, the location and the price. One study found that a 10% increase in Airbnb listings caused a 0.4% fall in quarterly hotel revenues in Texas (Zervas et al., 2015). The effect is not large for several reasons. A room in a private apartment and a room in a hotel are not perfect substitutes. Some customers may still prefer the quality, the cleanliness, and the service provided by hotels. Furthermore, the supply of private rooms is still limited since not everyone is willing to share their properties for strangers. However, hoteliers complain that sellers on Airbnb.com do not pay the taxes imposed on hotels and can avoid other regulations - although as noted above, the platform's feedback mechanisms might be a good substitute for certain kinds of regulation. Some research on Airbnb is beginning to emerge. Coyle and Yeung (2016) provide a summary and present some new data on Airbnb in European cities.

It might be possible to start to answer this by looking at the evidence on consumer disbenefits from being served adverts, as well as at the advertising revenues earned by platforms. Rhodes (2011) demonstrates the importance of location on the screen for advertisers; prominence is highly profitable.⁴⁵ Increasingly some consumers are purchasing ad blockers, which indicate the price for those individuals. Another avenue could be the proportion of mobile phone users' data allowances being absorbed by the download of increasingly bandwidth-hungry advertising. Google's dominance in terms of advertising revenues is clear, although Facebook is growing rapidly in the mobile ads market.



The online advertising market has become extremely complex with a proliferation of intermediaries and automated trading. In many ways it increasingly resembles the algorithmic, high-frequency trading markets in finance.



It is clear that there is a welfare-destroying arms race between advertisers (via platforms) and consumers. After all, platforms providing 'free' services such as search or social networking funded by

⁴⁵ Rhodes (2011)

advertising sales are not really matching demand and supply in the same way as platforms charging an explicit price to one side or the other. For consumers do not demand all or much of the advertising. The more consumers are able to ignore or avoid certain kinds of adverts, the more sophisticated, and intrusive, the techniques become: more prominent on the screen, pop-ups over the desired web-page, videos not stills, pre-roll advertising that cannot be skipped, and so on. The platforms are the main beneficiaries of the arms race as they are capturing a growing share of all advertising revenue as advertisers switch away from traditional media. Yet advertisers are paying more for any incremental sales with decreasing returns and pass their advertising costs to consumers; consumers are paying more in indirect ways; but online and mobile advertising revenue is increasing rapidly. There is evidence of substantial fraud in the market.⁴⁶ There are some means for consumers to fight back but they involve significant frictions and require sophistication on the part of users.⁴⁷

There is a question as to whether the 'free' model acts as an entry barrier too. Just as challenger banks find it almost impossible to enter markets where large incumbent banks minimize consumer switching by offering 'free' current accounts, challenger platforms will find it hard to attract sufficient numbers on both sides of the platform to get to viable scale. Although the scale economies of the large incumbents would be daunting anyway, it is possible that entry would be easier in a paid-for world.

It is not obvious that the 'free' business model is sustainable, though. One significant question concerns the failure to invest in upstream supply. The most important example concerns journalism and the content industries more generally. The platforms are not making any investment in the continuing provision of the content they provide 'free', and the loss of traditional advertising revenues means of course that those publishers are decreasingly able to generate content. How is the special civic role of the media to be safeguarded: "The public sphere is now operated by a small number of private companies, based in Silicon Valley," according to one digital journalism expert.⁴⁸ How can polities sustain investment in journalism, and other forms of national or local cultural content?

Other policy questions include data governance and regulation; the protection of personal privacy; individuals' own rights over their personal information; and public access to information aggregated by the platforms. This goes beyond the scope of this paper, but economists, other social scientists and lawyers need to offer policy makers and regulators better guidance about these issues. The EU has already intervened the 'right to be forgotten' and the cookie law, but as implemented these impose a burden on consumers – to have to request take-down in specific instances, or an irritating extra click on every new webpage when failure to accept cookies actually makes almost all websites unusable. They also create a new entry barrier for other search engines. Intervention must also recognize that there is a trade-off as better privacy protection will impose some costs, including consumers being served less relevant advertising.⁴⁹ The regulatory burden needs to fall on the platforms gaining the surplus in this market. The debate could extend to radical proposals such as a requirement to delete personal data after a certain length of time, or an individual right of access to their own combined data. In addition, the online platforms need to be required to provide data for official purposes, just as offline businesses are.

Consumer behaviour

Behavioural considerations need to enter into the economic analysis of platforms, including explanations of customer inertia or the psychological cost of each click. The previous section addressed specifically the psychology of 'free' and its significant consequences. There are questions concerning norms and ethics, bringing in other dimensions of social science. One area to be explored is the way people's standards of acceptable behaviour differ online, with aggression and trolling widespread in the absence of the normal social constraints on behaviour. This can have business consequences; the spread of such behaviour is said to have contributed to the decline of MySpace, once dominant in social networking. More recently Microsoft's AI social bot, Tay, was rapidly

⁴⁶ Kalkis Research (2016)

⁴⁷ See for example <https://diasporafoundation.org/>, <https://www.eff.org/privacybadger>, <http://sheriff.dynu.com/views/home>

⁴⁸ Bell (2014)

⁴⁹ Goldfarb and Tucker (2011)

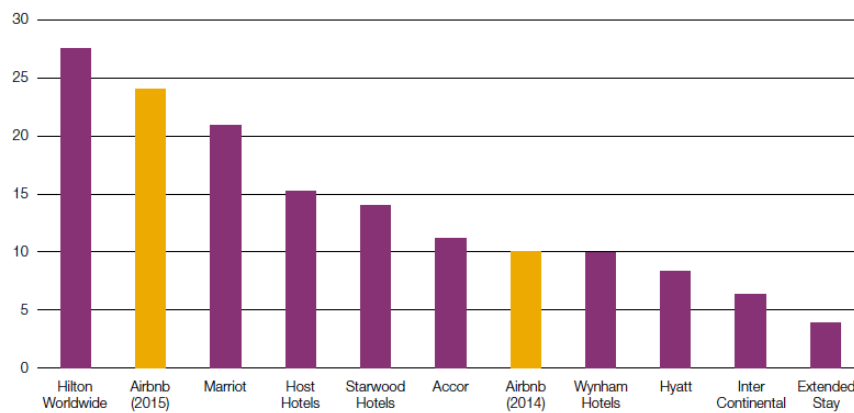
withdrawn when it too quickly learned from others online to be rude and make unacceptable comments.

Another ethical as well as economic question concerns the ability of social networks and search platforms to influence individual choices. This might be a choice about what to buy, but Facebook caused some controversy with its experiments on whether changes to users' news feeds could affect their mood or behaviour – including likelihood to turn out to vote. While this seems worthy, the company's selection of locations and differential impact is not known.

Platform competition

In his 1888 novel *Looking Back*, Edward Bellamy envisaged in the year 2000 a world run by one single organisation, the large industrial trusts of his own day having merged and somehow eventually morphed into a single giant public trust. So the fear (or hope) of a dominant organisation goes back a long way. The giant digital platforms – Google, Facebook, Amazon, Apple, seemingly being rapidly joined in their dominance by newcomers such as Uber and Airbnb – are the closest the Bellamy vision has come to being realised. They go far beyond any other commercial entities in the scale and dominance they have achieved. Even in smaller markets than search, social media or operating systems, the tendency for a dominant platform to emerge is clear. For example, Airbnb's growth suggests it will achieve the same feat in the market for short-stay accommodation. Not surprisingly, platforms pose some significant challenges for competition analysis.

Chart 3.K: Market capitalisation of Airbnb compared to major hotels, 2015 (£ billion)



Source: Davidson, L., (2015). 'Airbnb boss calls the UK the "centre of the sharing economy",' *The Telegraph*.

There is no obvious relationship between price and marginal cost on either side of the platform; at a competitive equilibrium one side will subsidize the other. This means the most obvious litmus test in competition analysis cannot be applied: the 'SSNIP test' reasoning of looking at the effects of a 'small but significant' price increase does not apply. Regulators cannot draw any conclusions from looking at the price on just one side. The need to keep both sides in the appropriate balance means that any platform that tried to raise prices on one side would risk losing people on the other side, and even entering a downward spiral. In general, positive feedback effects will make demand on all sides of the platform more elastic than might appear to be the case in a simple analysis.

Another basic tool of competition policy, market definition, is also next to impossible to apply in the conventional as well, again because of the feedback link between the two (or more) sides. It is impossible to consider, say, the search and advertising markets separately. One form competition between platforms takes is 'envelopment', adding another group of customers on one side and using those revenues to reduce the price charged to the profit-generating side of another platform. Another tool platforms use is the bundling or tying of services in order to cross-subsidise between different groups of users when they are unable to set a negative price to subsidize one side directly. Here too

the standard competition tools can lead to misleading conclusions.⁵⁰ Traditional attempts to define a market would often understate the competitive constraints (on another side) on a platform. On the other hand, dominant platforms can also pursue a strategy of envelopment to prevent entry. In any specific case it is always possible to look at the degree of substitutability between the products or services provided by a platform and alternatives, so at least on a case-by-case basis it should always be possible to assess the competitive landscape.

The inapplicability of standard tools leaves a vacuum in competition analysis, yet to be filled by economic analysis. There is a need for more dynamic analysis of the entry, growth and failure of platforms, empirical work looking at the successes and failures as well as analytical work. Many platforms are clearly still experimenting, so there is much to be learned from case studies as well as econometric work. As David Evans notes, “Many firms in a two-sided market have to produce multiple products in order to sell any products at all.” The product set will need to respond to the complex landscape of competing platforms.

What’s more, multihoming (on at least one side) is common in many markets now featuring platforms, such as travel or finance – although the existence of fixed costs and the indirect network effects mean the number of competitors is likely to stay small. The more homogeneous consumer demands, the stronger the indirect network effects and the larger the fixed costs or economies of scale in supply, the fewer platforms will be viable.

Potential for entry seems a key consideration. Where platforms have stable dominant positions, this could lead to inefficiency, including through an absence of innovation. Although the indirect network effects make demand on each side of a platform more elastic, they also make entry by a new competitor harder. Platform start-ups will need to sustain losses on entry as they grow both sides, so in assessing the competitive landscape the likely cost of successful entry and reaching critical scale will be important.

There must be a question as to whether Google’s dominance in search can be overturned, although this might be a straightforward matter of its scale rather than the role of indirect network effects. This is an activity in which there is little multi-homing; consumers choose one search provider (Google’s share of search is about 64% in the United States, 90% globally). For advertisers, on the other side, the cost of joining a platform consists of the fixed costs of set-up on the platforms’ software, the cost of running a keyword campaign, and the cost-per-click. As the fixed cost element is high, there is a strong incentive to choose the platform (Google) that gets the most search queries. Even though the size of the positive feedback between the two sides has probably declined as Google has grown larger, a challenger search platform would need to be of better quality and reduce the fixed costs for advertisers by enough to compensate for the smaller number of consumers. This is daunting, although regulatory intervention could aim to decrease the cost of multihoming for advertisers.

There is plenty of scope for Google to degrade the quality of search results to consumers (for example, by advertising its own products more prominently) before they will move away. The fact that Google's profit comes solely on one side also gives Google the incentive to favour the side of the advertisers, albeit at some potential cost in terms of consumer trust. It will not guarantee the quality of the advertisements shown on Google. And it does little to manage the quality and legitimacy of the companies advertising, despite occasional outcries.⁵¹

And – as past and current competition cases suggest – this means Google is potentially powerful in other online markets. A number of complaints have alleged abuse of dominance due to changes in rankings or location on the page. There is evidence of the importance of ranking in determining the number of clicks a website receives; and what’s more the ranking affects click through rates through two channels, both through the access to users’ attention and through the halo effect of the search engine’s reputation on the individual websites listed.⁵² Regulators have apparently drawn different conclusions. In recent decisions about online map services, for example, a UK court gave Google a

= Amelio & Jullien (2012)

⁵¹ ‘Jihadi website with beheadings profited from Google ad platform’, Robert Cookson, Financial Times 17 May 2016.

= Glick et al (2014)

clean bill of health for replacing (free) Streetmap with Google maps in the display box; while an earlier French decision – although recently overturned on appeal – found in favour of (paid-for) Bottin Cartographes in a similar case.⁵³

Facebook is another titan it might now be impossible to dislodge. Waller (2011) identifies two reasons.⁵⁴ First, it is quite difficult to terminate an account. Users have to confirm and re-confirm after a cooling period. Even after the deactivation, Facebook owns all the information and files uploaded. Second, Facebook does not allow other websites to acquire the information uploaded. Re-posting the information to another website is simply too cumbersome for ordinary users. Yoo (2012) is also concerned about the lack of data portability may effectively block potential entrants.⁵⁵ Users of Facebook establish their own pages bit by bit. Users have invested hundreds of hours in polishing their profile, history, photos, interests and connections. Since the content is not transferable, it makes switching to another network very costly. The locked-in relationship may significantly contribute to the consolidation of the market power of Facebook as switching is so costly; it is not clear that recent interventions such as France's Loi sur la République Numérique will overcome this.

The digital platforms have two main kinds of argument in response to competition challenges. One is that their dominance is temporary, that the markets are winner-takes-all by nature, but the identity of the winner can change. Examples given include Microsoft's Internet Explorer (halted in part by competition authority action) or its operating system (overtaken by technological innovation, tablets and smartphones bypassing its near-monopoly). There is clearly a possibility of competition for the market – and examples of dominance being overturned even in social networking.

A second argument is that there is dominance but it increases consumer welfare through the capture of indirect network externalities, and to deconstruct the market position would be to harm consumers. This is clearly true but it is not possible to evaluate the argument in any specific context without a means of evaluating the size of those gains, the division of welfare as between suppliers, consumers and the platform, and the dynamic consequences. There is a great need for more empirical work on the size of the gains, although some research has taken creative approaches.⁵⁶

Economists have for now left competition authorities with more questions than answers. How big are the consumer gains from network effects? How should they be weighed against dynamic costs such as reduced future innovation? How important is the possibility of multi-homing or switching? And to what extent does consumer psychology need to be taken into account (see section on 'free')? Is entry feasible or rather unfeasibly costly, especially when it comes to the handful of digital titans? Joshua Gans has argued that any disruptive entry will take the form of 'supply side' disruption in the shape of a new technology, just as it took smartphone technology not to displace the Windows position in the OS market, but to make it less relevant to the things consumers want to do.⁵⁷

As markets can 'tip', to create a dominant player as with Google in search, should regulators be considering some ex ante regulation, or alternatives like regulation on open standards, to keep open a possibility of entry? Certainly, competition decisions would ideally be made more quickly. It is not the business of competition authorities to select between business models. But the more platforms of huge scale behave like markets or exchanges than like conventional businesses, the greater the public interest in ensuring they observe fair rules to preserve competition.

There is a deeper question, however. The competitive assessment and the welfare assessment diverge for two reasons. One is that platforms crystallise external benefits, only some of which they capture. Additional consumer benefits therefore need to be considered alongside competition analysis.

⁵³ <https://chillingcompetition.com/2016/02/17/streetmap-v-google-lessons-for-pending-article-102-tfeu-cases-including-google-itself/>
<https://tlfnews.wordpress.com/2016/01/11/paris-court-of-appeal-overturns-google-abuse-of-dominance-ruling/>

⁵⁴ Waller (2011)

⁵⁵ Yoo (2012)

⁵⁶ Lendle et al (2016); Cohen et al, in progress.

⁵⁷ Joshua Gans, 'What would it take to disrupt Facebook?' <http://www.digitopoly.org/2016/03/26/what-would-it-take-to-disrupt-facebook/>

The other is that competing platforms choose their price structure to balance participation between the sides and prices will target the marginal supplier and consumer. The prices chosen are unlikely to be those that will maximise social welfare, as the socially optimal prices would address the average rather than the margin. Do these wedges between market outcomes and social welfare mean competition authorities should shift their focus from a competitive assessment to a welfare assessment? Or are there just too many dangers in reverting to a policy framework that distinguishes between public interest and competitive outcomes?

In short, economics has yet to deliver practical anti-trust tools to competition regulators, to enable them to draw up theories of harm in platform markets of different kinds, and implement them empirically. As one authoritative survey puts it: “The relevant theory, at least in its current stage of development, yields fewer clear predictions, and there is relatively little empirical work from which one can draw general lessons.”⁵⁸ However, general lessons are exactly what is needed. The future growth of platforms will benefit from predictable principles of competition assessment; the principles need to be rooted on a thorough welfare assessment.

Conclusions

This brief overview of the work already done and still to do on the economics of platforms has already raised a wide range of issues. These are difficult and often pressing questions, and researchers have a responsibility to ensure the public debate is well informed by the evidence and analysis they can provide.

Given that the large digital platforms are almost all US-based and Silicon Valley funded, there are questions about power, politics and nationality that economists have tried to avoid for many decades. The presence of such powerful companies in media and search has a political dimension of course.⁵⁹ Americans are inclined to believe policy interventions such as the European Commission’s investigation into Google are nationalistic. This is symptomatic of a deep-seated belief in Silicon Valley that the interests of the digital platforms and the interests of consumer are aligned. Although the consumer benefits of digital platforms are immense, the Silicon Valley giants would be more persuasive about their good intentions if they would acknowledge some of the genuine issues raised by market dominance and the tactics of some big US companies. For a fundamentally nationalist approach to digital platforms, China offers some clear examples of strategic, national approaches to the market.⁶⁰ The prism of nationality gives a distorted picture of social or consumer welfare, especially given the risk of policy makers paying too much attention to special pleading by incumbent industries. But the dynamics of platform markets point to the importance of scale and the tendency for one platform to dominate. Europe has not grown its own large platforms. There are no doubt several reasons, including the lack of the scale of funding available in Silicon Valley and the absence of barriers to external competition protecting Chinese platforms.

Another area where platforms may be challenging long-held assumptions concerns the distinction between private and public sector. Digital goods have the characteristics of public goods. Platforms are furthermore able to internalize indirect network externalities and capture efficiencies from improved matching and the flow of information. These features stand in sharp contrast to the assumptions economics typically makes about private sector firms. Some critics of the big US platforms are troubled by the possibility that we are ‘outsourcing the commons’ to for-profit (and foreign) corporations. Examples given include Uber’s supposed ambitions to provide public transport in the form of a fleet of autonomous cars; Parker providing app users with information about where to find public parking spots; Waze providing crowd-sourced traffic information to manage the flow of vehicles on busy roads, and avoid speed cameras or radar traps.

This can be asked the other way. Why should sharing economy platforms not provide public goods and services if they do so more efficiently than public authorities can manage? Taxpayers might get better services, more closely matched to their preferences. Equivalently, why are public services not

⁵⁸ Evans and Schmalensee (2014)

⁵⁹ See for example Moore (2016)

⁶⁰ Parker et al (2016)

imitating the platform model? After all, the original sharing platforms, outside the for-profit sector, were very much conceived as providers of public goods.

There are some important macroeconomic issues worth mentioning. One of these is the tax question, often in the headlines. While the use of low tax jurisdictions and intra-company payments to minimize tax bills is common to all multinationals, the measurement and enforcement issues are extremely tricky in the case of digital platforms with intangible products and no obvious geographical location for much of their activity.

The reshaping of traditional supply chains into platforms with many smaller suppliers on one side calls into question the traditional categories of employers and workers. This has been particularly controversial in the case of the 'sharing' economy, often called the 'gig economy' in the US with the implication of the casualization of labour. The employment status of 'partners' or suppliers is being tested in a number of US legal cases. In time the tests for self-employment normally used by tax authorities will no doubt be updated to cover such activity. However, there are some wider policy questions. Much public policy in the past, from parental leave and the collection of tax to management and provision of pensions and training, have been implemented through the vehicle of employers, and with a presumption that most people have a sufficiently strong employment relationship with a firm to make this approach viable. This seems unlikely to last much longer. All of these social policies will need reshaping around provision to the individual.

In addition to the work place policy issues, there is also the question of why the ferment of digital business activity, and disruption of many business sectors by dynamic platform entrants, has coincided with a flat (labour and multifactor) productivity performance in so many OECD economies. Solow's famous 1987 productivity paradox has re-emerged since 2007. Is this coincidence? Is it an artifact of the categories and measurements used to calculate productivity? Does it mean a great deal of complementary investment and organizational change will be needed to crystallise the productivity potential of the platforms? Is it a sign that the competition mechanism, or force of creative destruction, that normally brings about aggregate productivity improvements, has stopped functioning in the world of digital platforms?

Finally, there is a real need for better data to understand all the issues raised here. In my own work currently I am looking at the implications of the digital economy for aggregate economic statistics, as there are some significant analytical and practical challenges. The current legal framework for official statistics does not extend to the US-based digital platforms, and these need to be required to provide more information to statistical offices. While web scraping techniques will be one path to improving data collection, it has limited reach and can be altered at any time when the platforms change their algorithms or the public information they provide.⁶¹ Other than that, all the data so far available for studying digital platforms has been provided on a case by case basis by the platforms themselves. They must provide the basic information policy makers need to do their job in serving citizens with a legal and regulatory framework that benefits society as a whole. Ensuring better access to data is an important issue that deserves to feature prominently on the policy agenda.

It is not surprising that there are many important research and public policy questions raised by platforms, a rapidly growing and novel form of organising economic activity. In the public debate there has been a tendency, perhaps understandable, to focus on the threats to established ways of doing business. But it is more important to ensure the knowledge and policies are in place to take advantage of the opportunities. Platforms provide compelling benefits to their millions of users. Europe needs more of them, and the sooner we have a policy landscape establishing the principles of competition and regulation, the better.

⁶¹ Quattrone et al (2016)

REFERENCES

- Adomavicius, Gediminas and Alexander Tuzhilin, 'Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-art and Possible Extensions,' *IEEE Transactions on Knowledge and Data Engineering*, 2005, 17 (6), 734–749.
- Amelio, Andrea, and Bruno Jullien, 'Tying and Freebies in Two-sided Markets,' *International Journal of Industrial Organization*, 30 (50), 2012, pp436-446.
- Anderson, Simon and Bruno Jullien, 'The advertising-financed business model in two-sided media markets.' In *Handbook of Media Economics* Volume 1B ed S Anderson, J Waldfogel and D Stromberg, North Holland 2016.
- Armstrong, Mark, 'Competition in Two-Sided Markets', *Rand Journal of Economics* 37 (2006), 325-66.
- Bell, Emily, 2014, 'Silicon Valley and Journalism: Make up or Break up?'
<http://reutersinstitute.politics.ox.ac.uk/news/silicon-valley-and-journalism-make-or-break>
- Belleflamme, Paul, Nessrine Omrani, Martin Peitz, The economics of crowdfunding platforms, *Information Economics and Policy*, Volume 33, December 2015, Pages 11-28, ISSN 0167-6245, <http://dx.doi.org/10.1016/j.infoecopol.2015.08.003>
- Belleflamme, Paul and Eric Toulemonde , 'Innovation incentives for competing two-sided platforms', http://idei.fr/sites/default/files/IDEI/documents/conf/Internet_2016/Articles/belleflamme.pdf
- Benjaafar, Saif , Guangwen Kong, Xiang Li, Costas Courcoubetis, 'Peer-to-Peer Product Sharing: Implications for Ownership, Usage and Social Welfare in the Sharing Economy' (2015)
<http://dx.doi.org/10.2139/ssrn.2669823>
- Bergemann, Dirk and Alessandro Bonatti. 2015. 'Selling Cookies.' *American Economic Journal: Microeconomics*, 7(3): 259-94.
- Botsman, R., & Rogers, R. *What's Mine Is Yours: How Collaborative Consumption is Changing the Way We Live*. New York: Harper Collins, 2010.
- Bresnahan, Timothy, Joe Orsini, and Pai-Ling Yin Demand Heterogeneity, Inframarginal Multihoming, and Platform Market Stability: Mobile Apps September 2015.
- Boudreau, Kevin J., and Andrei Hagiu. 'Platform Rules: Multisided Platforms as Regulators', In *Platforms, Markets and Innovation*, edited by Annabelle Gawer. Cheltenham, UK: Edward Elgar Publishing, 2009.
- Budish, Eric, Peter Cramton and John Shim, 'The High-Frequency Trading Arms Race: Frequent Batch Auctions As A Market Design Response', *The Quarterly Journal Of Economics*, Vol. 130 November 2015 Issue 4, pp1547-1621
- Caillaud, Bernard and Jullien, Bruno, 'Chicken & Egg: Competition among Intermediation Service Providers,' *RAND Journal of Economics*, (2003) 34, issue 2, p. 309-28.
- Campbell, Arthur , Dina Mayzlin and Jiwoong Shin, 'Managing Buzz', 2015.
https://msbfile03.usc.edu/digitalmeasures/mayzlin/intellcont/RAND_Resubmission%20%28edited%29%20%281%29-1.pdf
- Anne-Sylvaine Chassany, 'Uber: a route out of the French banlieue,' *Financial Times* 3 March 2016.
- Coase, Ronald H, 'The Nature of the Firm', *Economica*, New Series, Vol. 4, No. 16. (Nov., 1937), pp. 386-405.
- Cohen, Peter, Robert Hahn, Jonathan Hall, Steven Levitt, Robert Metcalfe, Using Big Data to Estimate Consumer Surplus: The Case of Uber
- Robert Cookson , 'Jihadi website with beheadings profited from Google ad platform', *Financial Times* 17 May 2016.
- Dellarocas, Chrysanthos and Dini, Federico and Spagnolo, Giancarlo, 'Designing Reputation (Feedback) Mechanisms.' *Handbook Of Procurement*, Nicola Dimitri, Gustavo Piga, Giancarlo Spagnolo, eds., Cambridge University Press, 2006.
- Edelman, Benjamin G., & Damien Geradin 'Efficiencies And Regulatory Shortcuts: How Should We Regulate Companies Like Airbnb And Uber?' November 2015
<http://www.benedelman.org/publications/efficiencies-and-shortcuts-2015-11-24.pdf>
- Edelman, Benjamin, Michael Luca and Dan Svirsky, 'Racial Discrimination in the Sharing Economy: Evidence from a Field Experiment,' Harvard Business School Working Paper, January 2016.
<http://www.benedelman.org/publications/airbnb-guest-discrimination-2016-01-06.pdf>
- Einav, Liran , Chiara Farronato, and Jonathan Levin Peer-to-Peer Markets', NBER Working Paper No. 21496, August 2015

European Commission, *A European Agenda for the Collaborative Economy*, COM2016 356 (Final), http://ec.europa.eu/growth/single-market/strategy/collaborative-economy/index_en.htm

Evans, David S, 'The Online Advertising Industry: Economics, Evolution, and Privacy.' *Journal of Economic Perspectives*, (2009) 23(3): 37-60.

Evans, David S, *Platform Economics: Essays on Multi-Sided Markets*, Competition Policy International, 2011

Evans, David S. and Richard Schmalensee 'Antitrust Analysis Of Multi-Sided Platform Businesses', in Roger Blair And Daniel Sokol, Eds., *Oxford Handbook On International Antitrust Economics*, Oxford University Press (2014).

Ezrahi, Ariel, 'Sponge' (March 1, 2015). Oxford Legal Studies Research Paper No. 16/2015; The University of Oxford Centre for Competition Law and Policy Working Paper CCLP (L) 42.

Fraiberger, Samuel P. and Sundararajan, Arun, 'Peer-to-Peer Rental Markets in the Sharing Economy', (October 6, 2015). NYU Stern School of Business Research Paper.

Gabszewicz, Jean J. , Joana Resende and Nathalie Sonnac, 'Media as multi-sided platforms', in *Handbook of Media Economics* Robert G. Picard and Steve S. Wildman E Elgar 2015.

Gans, Joshua , 'What would it take to disrupt Facebook?' <http://www.digitopoly.org/2016/03/26/what-would-it-take-to-disrupt-facebook/>

Gawer, Annabelle, 'Technological platforms: Toward an integrative framework,' *Research Policy*, Volume 43, Issue 7, Sept 2014, Pages 1239–1249

Gawer A, Cusumano MA, 2014, Industry Platforms and Ecosystem Innovation, *Journal Of Product Innovation Management*, Vol: 31, Pages: 417-433, ISSN: 0737-6782

Glick, Mark, Greg Richards, Margarita Sapozhnikov, Paul Seabright, 'How Does Ranking Affect User Choice in Online Search?' *Review of Industrial Organisation*,, September 2014, Volume 45, [Issue 2](#), pp 99–119

Goldfarb, Avi and Tucker, Catherine, 'Privacy Regulation and Online Advertising', (August 4, 2010). <http://dx.doi.org/10.2139/ssrn.1600259>

Greenstein, Shane; Peitz, Martin; Valletti, Tommaso, 'Net Neutrality: A Fast Lane to Understanding the Trade-offs', *The Journal of Economic Perspectives*, Volume 30, Number 2, April 2016, pp. 127-149(23)

Hagiu, A., 'Two-Sided Platforms: Product Variety and Pricing Structures.' *Journal of Economics & Management Strategy*, 18: 1011–1043. doi: 10.1111/j.1530-9134.2009.00236.x

Hagiu, Andrei. "Merchant or Two-Sided Platform?" *Review of Network Economics* 6, no. 2 (June 2007): 115–133.

Hagiu, Andrei, and Julian Wright. "Multi-Sided Platforms." *International Journal of Industrial Organization* 43 (November 2015): 162–174.

Hannak, A., Soeller, G., Lazer, D., Mislove, A., Wilson, C., 2014. 'Measuring price discrimination and steering on e-commerce web sites,' Proceedings of the 2014 conference on internet measurement conference. ACM, pp. 305-318.

Hayek, Friedrich A. "The Use of Knowledge in Society." *American Economic Review*. XXXV, No. 4. pp. 519-30. American Economic Association. 1945

Henten, Anders; Windekilde, Iwona (2015) : Transaction costs and the sharing economy, 26th European Regional Conference of the International Telecommunications Society (ITS), Madrid, Spain, 24-27 June 2015

Horton, John J. & Richard J. Zeckhauser, "Owning, Using and Renting: Some Simple Economics of the "Sharing Economy" NBER Working Papers 22029, 2016

Ivaldi, Marc, Senay Sokullu And Tuba Toru Airport Prices in a Two-Sided Market Setting: Major US Airports TSE Working Paper, n° 15-587, mai 2015. <https://www.tse-fr.eu/fr/publications/airport-prices-two-sided-market-setting-major-us-airports>

Johnson, J. P., 'The agency model and MFN clauses,, Working paper, Cornell University, Ithaca, (2014)

Kalkis Research, *A Real Life Example of Google's Implication in Ad Fraud and Traffic Laundering*, <https://kalkis-research.com/real-life-example-google-implication-ad-fraud-traffic-laundering> 19/5/16.

Lendle, A., Olarreaga, M., Schropp, S. and Vézina, P.-L. (2016), There Goes Gravity: eBay and the Death of Distance. *The Economic Journal*, 126: 406–441. doi: 10.1111/eoj.12286

Llanes, Gastón and Ruiz-Aliseda, Francisco, 'Private Contracts in Two-Sided Markets' (October 1, 2015). NET Institute Working Paper No. 15-16.

Loertscher, Simon, Leslie M. Marx, Tom Wilkening, 'A Long Way Coming: Designing Centralized Markets with Privately Informed Buyers and Sellers', forthcoming in *Journal of Economic Literature*

Menell, Peter S. and Lemley, Mark A. and Merges, Robert P., *Intellectual Property in the New Technological Age*: 2016

Moore, Martin, *Tech Giants and Civic Power*, King's College London, April 2016.
<http://www.kcl.ac.uk/sspp/policy-institute/CMCP/Tech-Giants-and-Civic-Power.pdf>

Mikians, J., Gyarmati, L., Erramilli, V., Laoutaris, N., 2012. 'Detecting price and search discrimination on the internet.', *Proceedings of the 11th ACM Workshop on Hot Topics in Networks*. ACM, pp. 79-84.

Muth, K. T., 'Googlestroika: Five years later.' *NCJL & Tech.* (2015) 16, 487-527.

Orman, Levent V., *Information Markets Over Trust Networks* Cornell University (2016)

Geoffrey Parker, Marshall van Alstyne and Sangeet Paul Choudary, *Platform Revolution*, Norton (2016).

Preibusch, S, 'The value of privacy in web search.' *The Twelfth Workshop on the Economics of Information Security (WEIS)* (2013).

Quattrone, Giovanni, Davide Proserpio, Daniele Quercia, Licia Capra, Mirco Musolesi, 'Who Benefits from the "Sharing" Economy of Airbnb?', *WWW 2016*, April 11–15, 2016, Montréal, Québec, Canada.
<http://dx.doi.org/10.1145/2872427.2874815>

Rhodes, Andrew, 'Can Prominence Matter even in an Almost Frictionless Market?', *Economic Journal*, (2011) 121, issue 556, p. F297-F308

Rochet, Jean-Charles, Jean-Charles and Jean Tirole, 'Platform Competition in Two-sided Markets,' *Journal of the European Economic Association*, 2003, pp. 990–1029.

J.-C. Rochet and J. Tirole. 'Two-sided markets: A progress report.' *The RAND Journal of Economics*, 37(3):645{667, 2006.

Roth, Alvin, *Who Gets What And Why?* By, William Collins, 2015.

Rysman, Marc, 'The Economics of Two-Sided Markets.' *Journal of Economic Perspectives*, (2009) 23(3): 125-43

Sundararajan, Arun, *The Sharing Economy*, MIT Press, 2016.

Waller, S. W., 2011. 'Antitrust and social networking.' *NCL Rev.* 90, 1771.

Kyle Wiens, 'We Can't Let John Deere Destroy the Very Idea of Ownership', *Wired*, 21 April 2015,
<http://www.wired.com/2015/04/dmca-ownership-john-deere/> 22/5/16

Williams, Aime.' *How Airbnb Lost Its Soul*, *Financial Times* April 15, 2016

Yoo, C.S., 'When antitrust met Facebook.' *George Mason Law Review*, (2012), 19, 1147.