How online platforms challenge traditional views of the firm and the regulation of market failures

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Abstract

Declining online transaction costs have facilitated entry of small suppliers into newly emerging online services markets that put competitive pressure on established firms. At the same time, large online platforms aggregate a substantial share of online transactions within a private market place. As such, information technology has not only changed the organisation of firms and the dynamics of markets; it has also shifted the boundary between the firm and the market or the modalities for doing transactions. This shift has triggered regulatory debates and controversies. Established firms claim that online market places circumvent existing regulation; market operators claim that this regulation does not apply to them. This paper proposes a theoretical framework to analyse the economic impact of shifting boundaries between firms and markets and the regulatory implications of that shift. It combines theories of the firm with recent developments in the theory of multi-sided markets to explain how falling information costs create this simultaneous trend of integration and disintegration, driven by the evolution of relative transaction costs in firms and markets. Property rights or residual decision making rights become endogenous to the state of information technology. This has important implications for the balance between private and public governance of markets and firms. It applies these insights to some EU policy debates on regulation for online firms and markets.

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1. Introduction

There is a lively public debate on the need to regulate online markets. Many regulatory provisions for offline markets, for instance in consumer protection, have already been amended to cover online services. More recently, the debate has focused on multi-sided markets or "platforms" and especially on the sub-category of collaborative or sharing economy platforms because they have disruptive effects on markets. This is usually a very normative debate. Established firms claim that online markets have an unfair advantage because they allegedly circumvent existing regulation. Small service suppliers complain that platforms leverage their gatekeeper role and asymmetric information to impose unfair terms and conditions.

This paper attempts to frame this regulatory debate in an economic framework that starts from the impact of digital information technology on transactions in firms and markets. Coase (1937) explained how transactions can be carried out in two distinct settings. Transaction decisions can be taken by individuals in a decentralized way in markets or, if that turns out to be too costly and complicated, in a centralized and hierarchical way inside a firm. The choice between these two settings depends on transaction costs. Most of the empirical economic literature takes the boundary between firms and markets as given. It studies the impact of digital technology on the internal organization of the firm (references) or on the dynamics of the market within which firms operate (references). However, recent developments in the theory and practice of online platforms, in particular in P2P platforms, clearly point towards the importance of shifting boundaries between firms and markets. The most controversial regulatory debates are also situated at that shifting borderline because it implies shifting factor and product market responsibilities and liabilities, including responsibilities for market failures that regulators try to address. This may create tensions with the existing regulatory framework that was designed for a well-defined borderline between firms and markets and the associated market failures, prior to the digitization.

In order to understand these regulatory tensions we need a framework that explains how the introduction of digital information technology and the concomitant decline in information costs affects the boundary between firms and markets and how it affects market failures and regulatory liabilities. Coase (1937) is good starting point because real ex-ante transaction costs are closely linked to information costs, and thus to information technology. Williamson (1979, 1985) has complemented this with hold-up costs or ex-post transaction costs that can be linked to liabilities and market failures. Gibbons (2005) combines several contracting theories of the firm and vertical integration, including property rights and incentive theories, in an integrated framework. Bresnahan & Levin (2012) point out that, besides contracting theories of the boundaries of the firm, industrial organization economics considers how fixed set-up costs can lead to economies of scale and scope and thereby affect the boundaries of the firm. Gibbons (2005) reminds us that a complete model of the boundary between firms and markets requires a combination of integration and disintegration forces to achieve equilibrium. Coase (1937) predicts that the boundaries of the firm will shrink and transactions will move out of the firm and take place in the market when information costs decline with digital technology. In practice, the impact is ambiguous because many other factors are involved. Information technology may not only reduce transaction costs

but also increase productivity and result in firm size expansion (Rowley & Simcoe, 2012). Economies of scale, increased product variety (Brynjolfsson et al, 2004), network effects in multi-sided markets (Caillaud & Jullien, 2003; Rochet & Tirole, 2003, 2006) and superstar economics (Rosen, 1981) in online search rankings may contribute to this expansion effect. Economies of scope in information aggregation across platform users also point towards the benefits of expansion of online firms (Rosen, 1983; Piolatto, 2016). Bar-Isaac et al (2012) argue that a reduction in information costs leads to a more unequal distribution in sales revenue, with more superstars and a thicker long-tail but a squeeze in the mid-range of the distribution.

Anecdotal evidence seems to confirm this dual trend of simultaneous integration and disintegration. On the one hand, some of the largest global firms today are digital service providers such as Google, Apple, Facebook and Amazon. This suggests that integration effects such as network effects, economies of scale and scope dominate. On the other hand, disintegration in the wake of lower information costs is clearly present as digital distribution technology and platforms facilitate market entry for start-ups and smaller firms to distribute their goods and services. The myriad of smaller online sellers on eBay and Amazon as well as the famous Taobao villages in China[2] illustrate this phenomenon. Sharing or collaborative economy platforms, or peer-to-peer markets, are perhaps the best-known examples of these newly "emerging" online markets for services that were previously not considered suitable for market-based production and distribution because of prohibitive transaction costs. They are part of a rapidly growing new generation of online business models whereby firms organise markets rather than behave like a vertically integrated firm. Examples include well-known names like Uber, Lyft and BlaBlaCar transport services; Expedia as a travel service market place; Booking and AirBnB as accommodation service providers; Upwork as an online labour market; and even more stripped-down market places such as Yelp and TripAdvisor that trade information about travel, catering & accommodation services but not the underlying services (see Codagnone & Martens, 2016, for an overview). These market places are competing with and rapidly gaining market share from established vertically integrated firms (taxi companies, travel agencies, restaurant and travel guides) that were the traditional providers of such services. Figure 1 illustrates this dual trend and its impact on the shifting boundary between a firm and the market: Amazon's market share as a retailer has stalled while it's "market place" where users can trade goods directly has continued to grow at a much faster pace.

The objectives of this paper are (a) to develop a framework that can explain the impact of digital information technology on the boundary between firms and markets and the observed dual trend towards large integrated online platforms and small online firms and (b) to link this dual trend with regulatory issues that are triggered by these shifting boundaries.

This paper is structured as follows. Section 2 starts with Gibbons' (2005) integrated framework of transaction costs and property rights theories of the firm. We examine how information costs may affect the balance between firms and markets. An important implication from Gibbon's framework

[2] See http://www.alizila.com/an-introduction-to-taobao-villages/

is that the boundary between firms and markets is endogenous to changes in transaction costs and, by extension, endogenous to the state of information technology. Section 3 links this framework to the theory of multi-sided markets (MSM), the dominant economic model of online platforms that counterbalances the disintegration force of lower information costs with the integrative force of network effects. That explains the emergence of new online markets or "market places", as opposed to vertical integration and traditional retailing. Section 4 adds economies of scope in data analytics to explain the comparative advantage that platforms have over individual users. Section 5 add a more sophisticated transaction cost approach that distinguishes between ex-ante and ex-post transaction costs to explain the regulatory liability issues and potential market failures that emerge in large online platforms. The institutional architecture of private platform-based online markets has implications for government-produced market regulation. Section 6 discusses some specific examples in the EU regulatory environment, including the EU e-Commerce Directive. Section 7 concludes.

2. The theory of the firm revisited

Economics has not stood still since Coase (1937) formulated his seminal theory of the firm and vertical integration that revolved around coordination costs - re-labelled later as transaction costs. Williamson (1979, 1985) added his theory of hold-up costs or rent seeking in contracting. Holmstrom & Milgrom (1991) added agency or incentive theory models of contracting. Grossman & Hart (1986) came up with a theory of property rights and decision making. Gibbons (2005) identifies another strand of vertical integration theory, the "adaptation" theory that partly overlaps with the preceding theories. He integrates all these theories in a single theoretical framework and observes the interaction between them. Markets and firms are different types of institutional arrangements to manage transactions in an efficient way. In a firm, decisions are taking by hierarchical arrangements. The costs and benefits of these decisions are assumed by the owners of the firm. In a market, decisions are taken by individual market participants and the costs and benefits accrue to these individuals. Markets are not completely void of institutional rules; they require some minimal institutional arrangements or "rules of the game" (North, 1992) in order to operate effectively. We are interested in finding out how the introduction of digital information technology affects the balance between firms and markets.

That balance between transactions carried out in a market and inside firms is determined by the relative performance of each of these institutional arrangements. This is reflected in Figure 2A (taken from Gibbons, 2005). The vertical axis measures the effectiveness of a transaction in terms of remaining market frictions that result in imperfect matches between supply and demand. Market frictions entail welfare losses for all parties. Reducing frictions requires investment in transaction costs and institutional structures that set the rules for the market. No transaction is fully effective or completely frictionless but some come closer to that ideal than others. The horizontal axis represents the "difficulty" of doing transactions. Easy transactions are situated to the left. For example, in a traditional offline market place, buyer and seller meet face to face, can verify the goods and discuss the price directly. This requires little transaction costs and only a very light institutional set-up for the market. Difficult transactions are situated to the right. They

require overcoming complex coordination and collective action obstacles and the risks of asymmetric information. The two downward sloping lines represent transaction costs for firms and markets. They are downward sloping because complex transactions will inevitably be subject to more frictions and thus less effective. Crucially however, the slope of the two curves differs. The effectiveness of markets will decay faster because there is no central authority that steers collective action and imposes welfare-enhancing rules to overcome transaction costs. The switch from markets to firms occurs where the two lines intersect. To the right of the vertical line, firms dominate the scene because hierarchy and unified decision making are more effective in handling more difficult transactions (Williamson, 1985). To the left, markets dominate because they can handle transactions more effectively in a decentralized way, leaving decisions to individual market participants. As such, the vertical line marks a switch in ownership rights. To the left, residual ownership and decision making rights belong to individual market participants; to the right they belong to a hierarchically organised firm that organizes the transaction.

This graph combines several theories of the firm, including Coase's ex-ante and Williamson's ex-post transaction costs (see section 5) and Grossman & Hart's (1986) ownership rights. The incentive or agency theory approach is implicit in the downward slope of the curves in the sense that more complex transactions increase the risks of moral hazard and adverse selection caused by asymmetric information. We can add the nexus-of-contracts theory of the firm to this graph by widening the sharp vertical line into a wider grey zone where the distinction between firms and market becomes blurred and residual rights are highly fragmented among parties. This may happen for example in IPR-intensive products where many parties have some residual rights over the end product and ownership is highly dispersed.

What happens when digital information technology enters the scene and information costs, and therefore transaction costs, are reduced, both for firms and for consumers? Take the example of a retail firm. Online stores can reach a wider geographical market of potential customers than offline stores, they can collect information on consumers visiting the store and use this for strategic product, pricing and marketing choices. These factors generate more benefits for the firm, compared to the market. Of course, markets can also benefit from reduced transaction costs and improve their effectiveness with the help of digital technology. Simple tools like websites, email, text messages and mobile phones can facilitate communication and coordination between decentralized decision makers. The net impact of digital technology therefore remains an empirical question linked to shifts in the relative effectiveness of markets and firms. Figure 2B shows the case where integration forces dominate and firms become relative more effective than markets. This results in an expansion of the realm of the firm, at the expense of the market. Note that ownership of residual rights moves in tandem with relative transaction costs in this setting. Figure 2C reflects the case where disintegration forces dominate and new online markets emerge. This may happen for example in MSM when the market mode becomes more effective than the retailer mode (see next section).

We can illustrate these shifts with an example. Bringing together a large number of individual ride services providers in a city and assigning them to rides in an effective way would have been difficult in a pre-digital era when the most efficient solution was to call a taxi company telephone

number. The taxi firm's central dispatching service would then assign the task to a specific driver. That dispatching service could not handle thousands of drivers at the same time, especially not when they were entering and exiting the market on highly variable schedules. With digital information technology, that coordination problem can be solved however - think Uber, Lyft and many other ride apps. Similarly, travel agencies were once needed to centralize and handle booking services with a limited number of suppliers and customers. Handling a large variety at the same time would have been very difficult. Digital technology made the travel agency firm more effective but made direct interaction between service providers and consumers even more effective because it can bring into the market a much larger variety of supply and more customers with heterogeneous preferences. That pushed many transactions out of the travel agency firm and into a more open market arrangement - think Expedia, Booking, TripAdvisor, etc.

Faced with this ambiguity, are there any outcomes that are more likely than others? In order to address that question we turn to the dominant economic model of online transactions, the multi-sided market (MSM) model, more popularly known as the online "platform" model.

3. A short history of the economics of online platforms

In its most generic form a "platform" is a market place where two or more distinct types of users (for instance buyers and sellers) can meet to exchange goods, services information, etc. Offline platforms have existed for millennia as ordinary village markets. Besides buyers and sellers, they may attract for instance street artists and pick-pockets. Platforms benefit from indirect network effects occur when more buyers attract more sellers and vice versa. They may work differently according to the user group: pick-pockets will positively appreciate the presence of others but the effect is likely to be negative in the other direction. Direct network effects occur within user groups. For example on Amazon book buyers can benefit from the recommendation lists compiled on the basis of purchases by others. Direct effects can also be negative, for example when too many identical suppliers become price competitors on the platform. The combination of all these positive and negative network effects drives the economic welfare of the parties operating on the platform. The prime attraction of offline and online platforms is that they reduce transaction costs for users: they are more effective in bringing buyers and sellers together, compared to single-sided markets where each party has to search separately for a counterpart.

Historically[3], economists began to pay attention to MSM with the rise of online markets that could generate strong network effects (Katz & Shapiro, 1985). As a result, the user gets more (or less) than what he pays for and prices no longer correspond to actual benefits or costs. This creates an anomaly in the behaviour of MSM compared to ordinary single-sided markets where price equals marginal cost or marginal utility. Caillaud & Jullien (2003) found that MSM operators can leverage network effects to expand their market share. Access and transaction fees can be manipulated to maximize the attractiveness of the platform for different user groups and help the platform operator to maximize his market share and revenue. Depending on the price elasticity of supply

[3] For a more detailed discussion of the history of MSM economics see Martens (2016), chapter 2.

and demand, either suppliers or customers should be made to pay a fee for access to the MSM while the other side can be subsidized (Armstrong, 2006; Rochet & Tirole, 2003, 2006; Parker & Van Alstyne, 2006). In ordinary markets, total price determines the volume of activity. In MSM with network effects, the split of the price between different sides or users in the market will determine the volume. For example many of the most successful online platforms offer "free" services to users: they make one side pay (the advertiser) and subsidize suppliers and consumers. They exchange ubiquitous information in return for scarce attention (for the advertiser) and personal data (for the platform operator). The absence of a price does not mean the absence of a market; free services may compete with paid services in the same market. Free services may raise barriers to entry for other services and affect competition. The combination of network effects and potentially predatory pricing behaviour in MSM drew the attention of economists and competition authorities because it may explain why some successful platforms manage to reach a very strong market position in a relatively short time and increase the risk of lock-in. It also explains why subsequent research around MSM focused mainly on competition issues.

However, the network-effects based consensus view on MSM quickly evaporated. Rochet & Tirole (2006, p.657) considered that indirect network effects lead to an 'under-inclusive' definition of MSM because it excludes MSM with weak or non-existent indirect effects. They propose that the key characteristic of an MSM is that the price structure is non-neutral by charging more to one side of the market and reducing the price paid by the other side. Armstrong (2006), Evans (2003), Evans & Schmalensee (2007) and Filistrucchi et al. (2013) further relaxed the MSM definition and consider that the existence of a one-way indirect network effects for at least one group of users is a sufficient condition for a MSM. As a result of this debate the definition of an MSM became an empirical question and depends on the relative strength of the network effects and externalities. Today there is no consensus among economists on the definition of MSMs (Li, 2015). For example, Li (2015) casts doubt over whether advertising-supported media should be considered as an example of MSM and Lucchetta (2015) claims that the Google Search engine is not a MSM.

Recently, the definition pendulum has started to swing again towards more narrow definitions. Hagiu & Wright (2015) argue that any corner grocery story offers a platform that brings suppliers and consumers together to transact and generate indirect network effects: the more consumers, the more suppliers will want to deliver to the store and the price structure creates externalities. That over-inclusiveness is too vague to be operationally useful. Hagiu & Wright (2015) narrow the definition of MSM and add two conditions on top of indirect network effects and pricing externalities: (a) direct interactions between sellers and buyers or between two or more distinct sides and (b) each side is "affiliated" with the platform and makes specific investments that binds them to the platform and makes it costly to leave (non-zero entry and exit costs). According to the authors, direct interactions set "marketplaces" apart from retailers (like grocery stores for example) and fully vertically integrated firms. On the other hand, this narrow definition would exclude some important online service providers from the category of platforms or MSM. For example, Netflix would not classify as a media MSM but merely as a retailer of films because there is no direct interaction between buyers and sellers. Similarly, only Amazon Market Place would

classify as an MSM because buyers and sellers have some direct interaction; the rest of Amazon remains an online retailer.

The authors provide some empirical evidence in support of this view. Based on data collected from the Amazon website they show that Amazon operates predominantly in R-mode in books because it has privileged information about the preferences of buyers that makes demand and inventory management more predictable, except for the long tail in book sales where demand is much harder to predict and the M-mode is more prevalent. Amazon works in M-mode for electronic goods because the variety of products and variance in consumer preferences is much higher and more difficult to predict. Working in R mode for these products would undermine Amazon's cost advantages in logistics and inventory management. In M mode, residual ownership and control rights (over pricing, promotion campaign, sales conditions, etc.) remain with the supplier. In the R mode the platform buys the products from the supplier and acquires ownership and control rights. The authors argue that the choice between these modes is determined by the relative information advantages of the seller versus the market organiser.

In a subsequent paper, Hagiu & Wright (2015) expand this model with two additional typologies: the vertically integrated firm (VI) where supply is completely integrated into the intermediary platform and the input supplier (IS) where supply is totally disconnected from the intermediary platform. When professional firms vertically integrate they control the provision of the services and are directly responsible for them; in MSM mode (i.e., they consider examples such as Uber, Lyft, and Elance–oDesk.com) the suppliers of services retain responsibility for and residual control rights over the services. The fundamental trade-off in this strategic choice is between the coordination benefits that arise in a VI model and the benefits of motivating professionals' effort and getting professionals to adapt their decisions to their private information that arise in a MSM model. In the VI mode there is a possibility for professional efforts 'moral hazard'; on the other hand, in the M mode there can be information-related moral hazard by online platforms that can extract insights from the aggregate data generated by the interactions between contractors and customers on their sites—insights that are not known to any individual contractor. Apple hardware and Amazon Kindle are examples of VI: Apple and Amazon design and sell their own hardware. Apple iTunes however allows external suppliers to contribute software and content to the Apple platform. Microsoft Windows is an example of an IS structure: any hardware manufacturer can produce Windows-compatible hardware without a formal affiliation with Microsoft. Again, the degree of platform (dis)integration in VI and IS extension of the M/R model is driven by information asymmetries between different actors in the supply chain.

[Figure 3 here]

Hagiu & Wright (2015) put the first stepping stones for building a bridge between the fairly young MSM theory and the older theory of the firm. Their empirical work on the Amazon market place is driven by economies of scale and scope in logistics and therefore more in line with the drivers of integration in industrial organization models, not contracting theories of vertical integration. Still, they add a flavour of property rights theory to MSM economics when they discuss changes in residual control rights in the M and R modes. In the case of Amazon, this change seems to be

more driven by economies of scale and marginal cost advantages in logistics than by declining information costs.

4. Economies of scope in data

Information costs are not just costs; they also have a benefits side. A decline in information costs can lead to more information benefits. The shift from analogue to digital information technology led to a dramatic fall in information costs and the resulting increase in the supply of information creates new sources of friction in markets: search costs to find the best client-product match among a huge variety of products and clients. This can be reduced by means of search algorithms and other matching mechanisms such a price auctions. Search engine efficiency increases with more and better information about the parties that could make a potential match. Economies of scope in data can complement the contracting theory of the firm in explaining the boundary between firms and markets. For example, Google's acquisition of Nesta is driven by economies of scope in data; the two operate in very distinct and not directly related services markets. Similarly, the acquisition of WhatsApp by Facebook is about economies of scope in data, combined with a strategic decision to reduce potential competition.

Digital MSM or online platforms have an advantage over individual firms. The latter can only collect information about their own behaviour and their commercial relationship with clients. Platforms can collect and aggregate data across many firms and consumers that can generate more valuable information than the separate datasets that each firm and user observes on their own. This birds' eye view gives platforms a comparative advantage in overcoming frictions and more efficient matchmaking compared to individual firms[4]. Of course, this can be a Faustian deal for MSM users. Platforms can use this informational advantage to drive a wedge between the interests of two (or more) sides of the market to increase their own profits, for instance by manipulating the search rankings. In terms of the early MSM economics models, the network externalities that MSM generate for users constitute a business opportunity for platform operators who try to internalise and monetise at least part of the externalities (Rochet & Tirole, 2006). For example, Ursu (2015) shows how Expedia manipulates hotel search rankings to maximise its own profits. It could improve hotel rankings and increase consumer welfare (better quality hotels for lower prices); however, it would reduce Expedia revenue. Fradkin et al (2014) and Chen et al (2015) come to similar conclusions for AirBnB and Uber.

The underlying economic concept that enables platform operators to benefit from data aggregation is economies of scope in learning. Rosen's (1983) original analysis of economies of scope was focused on cost savings in learning that occur when non-separable skills are learned jointly rather than separately. Here we look at this from the benefits side. The joint study of complementary datasets usually provides more insights (benefits) for a given learning cost than studying them separately. Deriving insights or learning from datasets implies finding regularities in seemingly

[4] These informational advantages distinguish online MSM from more traditional offline MSM. A village chief can charge a market entry fee but to collect and aggregate detailed behavioural information about market users would be prohibitively costly in offline markets in the absence of electronic data formats.

complex and chaotic data. Regularities can be used to predict behaviour and are therefore economically valuable. For example, looking at the prices and revenue stream of each hotel separately will provide less insights - i.e. produce less observed regularities - than examining the joint set of revenue and price streams for a group of hotels in a city.

Datasets come in two dimensions: the number of variables and the number of observations on each variable. Diminishing marginal returns occur in each dimension. Scattered empirical evidence suggests that in some cases diminishing returns may set in at a very early stage (Pilaszy & Tikk, 2009, on film selection) while in other cases it only arrives when the number of observations increases many orders of magnitude (Varian, 2014) or never (Lewis & Rao, 2015, on the efficiency of online advertising). Diminishing returns will occur in later stages in more complex datasets.

The cost savings and benefits from economies of scope do not only benefit platform operators; they also benefit society at large. They reduce information (search) costs for platform users. Moreover, they enable new markets to emerge that were previously not feasible because of prohibitively high transaction costs. Economies of scope add an additional integration force to the network effects in the first generation of MSM economics models (Caillaud & Jullien, 2003; Rochet & Tirole, 2005, 2006). However, they do not help to explain the newer generation of MSM models with a more narrow definition of MSM (Hagiu & Wright, 2015) and the emergence of new market places outside the firm that compete with vertically integrated firms. Large online retailers also benefit from economies of scope in data aggregation and analysis because they benefit from a bird's eye picture of the market.

Of course, information technology related costs are not necessarily the only source of firm integration. Classic diseconomies of scale in production may contribute too vertical disintegration too. Einav, Farronato & Levin (2015) find low fixed cost & higher marginal cost characteristics in the flexible supply of private P2P accommodation markets. Individuals can bring spare private accommodation capacity onto the market at low fixed costs - the real estate exists anyway - and compete with formal accommodation providers (hotels, B&Bs) that face high fixed costs - they would have to invest in more real estate. Private provider can be complementary service providers, especially when demand is highly variable, for instance because of seasonal variations. Similarly, P2P private transport provided through platforms like Uber, Lyft and BlaBlaCar offers a highly flexible supply of low opportunity cost labour that would otherwise be idle and can now be brought into the market at peak times. Hagiu & Wright (2015) explain how Amazon's market place is also characterised by vendors with a highly variable supply and variable demand for long tail products. Low fixed costs and high flexibility seem to be the driving economic forces of online market places. It is social welfare enhancing because it reduces opportunity costs on the supply side and increases benefits for consumers. These suppliers of these services are better off retaining property rights on the goods & services that they sell through the online platform.

MSM constitute the ultimate vindication of Coase's hypothesis that firms are a cheaper coordination device than markets. A platform is a firm that specialises in the production of coordination services that individual market users cannot produce. For example, Yelp and TripAdvisor provide information to travellers but offer no transport, catering and accommodation

services to travellers. Hybrid platforms combine market organisation with the production of goods & services. For example, Amazon produces logistics services for its online retail shop while its role is limited to a market organiser in its market place. The Apple iOS and Google Android app stores are mainly retailers because they provide very little data driven search & matching services in these stores. They are not re-sellers though because digital products like apps do not require the purchase of a physical inventory of products before sales.

5. Ex-post transaction costs and regulatory issues

Coase's original idea of the cost of doing transactions can be split in two components: ex-ante information costs prior to a transaction, such as search costs for products and trading partners, and ex-post costs after the transaction related to risks, hold-up costs and "haggling" that may occur after the deal is concluded (Williamson, 1979, 1985). Gibbons (2005) calls this "acquired quasi-rents": contracts put parties in a power position that they can exploit to increase their benefits. Since no contract is complete, they always leave room for "haggling".

Online exchange of a large variety of products & services among strangers creates risks. Transactions may not work out as expected, the service delivered may not correspond to the agreed service or to consumer expectations, or an accident happens in the course of service delivery. Economies of scope in large online shops may reduce ex-ante search costs. These ex-ante costs are known at the time of concluding a transaction; ex-post costs are by definition unknown at that time. Furthermore, we can distinguish between two types of ex-post risks. First, there are risks generated by asymmetric information between the contracting parties that were known ex-ante to one of the parties. In agency models this is referred to as moral hazard and adverse selection caused by incomplete and asymmetric information between the parties and opportunistic behaviour by one or more parties. Williamson (1985) labels this "opportunism with guile". Second, other risks may be totally outside the control of any party to the contract. Accidents and technical breakdowns, unexpected delays, etc. are typical examples. Parties can try to design a contract that reveals all relevant information and minimizes opportunism. There is no full-proof guarantee however. Negotiating and writing out more complete contracts is costly too. Hence the need for assigning property rights as a residual control rights (Grossman & Hart, 1986): all costs and benefits that are not explicitly assigned to another party by contract or by law, will belong to the owner. The first type of ex-post risks can be reduced by means of improvements in the institutional setting for market-based transactions. The second type can be handled through insurance markets. Both may require additional regulatory intervention in the market to avoid market failures.

Consider the following example. A customer used to book hotels offline via a travel agency. He selected well-known brand names with his preferred star ratings to reduce quality risks. Now a hotel booking website enters the market that offers a much wider variety of hotels. He can choose the same brand names or select an alternative that promises quality services, better location and lower prices for similar service quality. Without independent confirmation of the quality of these hotels the customer may be risk aversive and stick to the well-known brand names. Adding

customer reviews may provide sufficient information to confidently select a hotel that provides a better match to his preferences.

This is illustrated in Figure 4. The vertical axis represents ex-ante information costs and the horizontal axis the costs related to ex-post risks. The line a'-a" represents the trade-off between the two sources of transaction costs. The downward slope implies that more investment in ex-ante information reduces ex-post risks. Prior to the hotel booking platform the customer is in position A, characterized by high ex-ante information costs and relatively low ex-post or residual uncertainty. When the booking site arrives, information costs drop. He can shift to A* but he may not like this risks associated with that position. If he stays in position A market failure occurs: he cannot make full use of the benefits offered by the reduced information costs because this entails risks. The booking site can eliminate this market failure by introducing hotel ratings based on consumer reviews. This shifts the trade-off from a'-a" to b'-b". For a given amount of search time and information costs, the customer now ends up in point B* where he fully exploits the reduction in information costs while still not exceeding the level of ex-post risks that he feels comfortable with. Risk aversive customers can exploit this institutional quality improvement by moving to point B. They spend the information cost reduction on risk reduction.

[Insert Figure 4 here]

The introduction of consumer reviews is a market-based auto-regulation initiative by the hotel reservation platform. It leverages internally generated information and makes it available as a public good for all platform users, thereby generating a welfare improvement for consumers. Risk management in online exchanges has been a key challenge as well as a driver of success for many online platforms, both B2C platforms like Amazon and eBay, and collaborative economy platforms like Airbnb and Uber[5]. In order to get their platforms started and speeding up they need reputation mechanisms that enable all sides of the market to provide feedback. Collaborative platforms that facilitate direct interactions between individuals are even more prone to reputation risk issues since individuals usually don't have a well-known brand name to start with.

Going beyond the graphical explanation above, Piolatto (2016) presents a theoretical model to demonstrate how aggregation of customer reviews enhances total welfare in MSM for heterogeneous experience goods. The welfare effect passes through quality, quantity and price channels: 1) realised transactions are more valuable because the match between producers and consumers is more accurate; 2) more agents find a suitable product; 3) the equilibrium price weakly decreases for competition amongst firms is more intense. For example, Booking, TripAdvisor, Yelp and many other online MSM provide customer feedback information that can improve the choices of other consumers. These match-making qualities attract users on all sides of the market to the platform.

[5] Libertarians have used online review mechanisms to argue that centrally regulated quality standards can be abolished and replaced by decentralized rating systems. In practice there are several reasons why such ratings may not be fully reliable. Leaving an accurate rating is a public good and is likely to be under-provided. For a more detailed review of the quality of reputation ratings see Codagnone (2016).

The hotel booking example also illustrates the limits to self-regulation. Formal hotels offer some regulated guarantees with regard to accidents, such as fire escapes and accident insurance, etc. Who is responsible when a fire breaks out in an accommodation rented through AirBnB? The owner of the house, the intermediary who rents it out through AirBnB, AirBnB itself or the customer if his presence created the fire? This is an insurance-type risk that cannot be covered by customer review ratings. Platforms can take action to remedy this problem, for example by imposing insurance requirements on all service suppliers. It is in the interest of platforms to take collective action to overcome these risks in order to attract more customers. Unfortunately, platforms often limit themselves to explicitly disclaiming any responsibility for accidents, without specifying who is responsible.

Better regulatory data may also lead to new forms of market failure. For example, car insurance companies can now collect detailed data on their clients' driving behaviour that enables them to adjust insurance pricing accordingly. Prices may decline for cautious drivers but less cautious drivers may be confronted with prohibitively high insurance costs. That increases the risk of underinsurance for those categories that need it most. Personal data collection puts pressure on a basic principle of insurance: the pooling of risks in larger groups. If individual risks can be identified and separated in the pool, the pool fragments and risks of underinsurance increase. Similarly, health insurance companies can trace consumer behaviour, including food, drinking and smoking habits and involvement in more risky professional and leisure activities may affect insurance pricing and push those who need it most out of the insurance market.

Meta-regulatory supervision and complementary public sector regulation may still be required. The balance between self-regulation and government oversight should be carefully reconsidered in the context of these innovative technologies and the new market conditions that they create. That re-examination may also be an opportunity to eliminate regulatory capture by special interest groups. Regulation should not protect incumbent business models but support welfare-enhancing innovative business models.

6. Property rights and regulatory issues

We discussed regulatory issues with respect to consumer protection, including the balance between self-regulation and public regulation of platforms, in the section on ex-post transaction costs. In this section we turn to production factor markets, in particular labour markets, where another regulatory debate is raging: should service suppliers to market places be considered as independent workers or as employees of the online platform? Are platforms circumventing labour market regulation and thereby gaining an unfair competitive advantage over established firms that provide similar services? A well-known example is Uber, the ride hailing platform. Apart from the question whether Uber should be allowed to enter the market and compete with traditional taxi companies, there is a regulatory question about the status of Uber drivers as independent workers or employees. The rise of online labour market platforms has extended this debate far beyond Uber into many sectors where these platforms are active. In the EU, labour law usually considers that workers who are regularly employed by a firm that sets the wage rate and decides on their

tasks should be considered as employees, not independent workers. This implies that the employer has obligations towards the workers, including paying a minimum wage rate and social security contributions.

We can reformulate this question in terms of property rights: who should have residual decision making rights on labour inputs, the workers or the platform? Going beyond labour inputs into the platform, the question can be put more generally as follows: Should residual rights be allocated to the goods & services suppliers to the platform or to the platform operator? In the Coase-Williamson or Gibbons integrated model of vertical integration, the allocation of property rights is endogenous and depends on relative transaction costs between firms and markets. Regulators can of course overrule this endogenous outcome and impose an exogenous allocation. Any deviation from the endogenous outcome will however result in increased social costs and a reduction in transaction effectiveness. Imposing a regulatory regime that turns online market places back into vertically integrated firms and retailers reduces flexibility and increases the cost of supply.

Regulators may propose in-between solutions that partially extend existing regulation to online market places. For example, hotel regulation is applied to online accommodation services when they operate more than 60 days per year, or ride service drivers are considered as independent workers if they do not work more than 15 hours per week. These may be genuine attempts not to block innovation while keeping a minimal regulatory oversight. Nevertheless they segment the market and are not based on an economic rationale for regulation.

In the EU, the liability of online platforms is defined in the e-Commerce Directive (2000). They are not liable for the content that they transmit, store or host, as long as they act in a strictly passive manner. The active-passive criterion goes back to pre-digital postal and telecom regulation that protected service providers against liability for the content that they transmitted and recognized that they acted as "mere conduits". Checking content would have been prohibitively costly for pre-digital service providers. Today however online platforms can in many cases easily check the nature of the content that they transmit or facilitate. They are no longer passive mere conduits and take an active role in collecting and analysing information to reduce ex-ante and ex-post transaction costs and facilitate exchanges between users. A Communication on the Collaborative Economy (European Commission, 2016) illustrates the difficulties that regulators face in dealing with online platforms. It refers to the EU Services Directive (2001) and makes distinction between electronic “information society services” and the underlying service. Information society services are not subject to authorizations or any requirements that target the underlying service. However, the Communication argues that in certain circumstances a platform may also be a provider of the underlying service and could be subject to the relevant sector-specific regulation. In other words, the regulator may decide whether data analytics and content services are provided by a vertically integrated firm or through a decentralised market place with independent suppliers - and whether they are subject to a single or two separate regulatory regimes.

The active-passive criterion and the information-versus-content services criterion have deep roots in law and regulation but are not necessarily a good economic basis for regulation of platforms and market places. Gibbon (2005) endogenizes that outcome as a function of relative transaction

costs. Overruling that endogenous allocation would be welfare reducing. It would fold service suppliers back into vertically integrated hierarchical firms while a decentralised market-based arrangement would be more effective. There can of course be cases where the property rights divide is not necessarily a sharp vertical line as in Fig 2; it can be a wider grey zone where property rights allocations are not so clear-cut.

Within that grey zone, a good rule of thumb may be to assign responsibility to the party that has the best information to implement legal or regulatory standards at the lowest cost. Because of its central position as data collector and information exchange, the platform operator is often best-placed for monitoring and surveillance of the market. For example, AirBnB is best-placed to know who rents out real estate in a city and how much revenue from that activity should be declared to the local tax authorities. It is not well-placed to check if the place meets fire safety standards but it could signal the need to check it up to the competent authorities. Another example is traditional taxi licenses that often create a costly entry barrier into taxi services and a source of regulatory rents for incumbents that translate into high consumer prices and lower service quality. Online ride hailing services have much lower entry costs and operate at lower prices with more availability. At the same time, rating systems for drivers provide users with continuous service quality monitoring rather than one-off licensing systems. However, ride apps are not in a position to check the safety and roadworthiness of the car; that requires traditional regulatory intervention.

7. Conclusions

This paper examined the impact of digital information technology on the Coasian boundary between transactions that are decided in hierarchically organised firm and in decentralised markets. In Coase's (1937) view the boundary is determined by relative transaction costs in firms and markets. Modern theories of the firm have refined the transaction cost mechanism and added property rights and other contractual theories of the firm. We used Gibbons (2005) integrated framework that combines all these theories. The impact of information-cost reducing digital technology on this boundary is a-priori ambiguous. It can reduce transaction costs in firms and in markets and shift the dividing line in both directions, leading to either further integration or disintegration. Anecdotal evidence suggests that both trends exist simultaneously. Many new market places are emerging in the digital economy for a wide variety of services, from travel and accommodation, to second hand markets, labour markets and financial markets. At the same time they facilitate market entry for many small services suppliers. This dual trend is consistent with a decline in transaction costs and the presence of economies of scope in data collection and analytics in platforms.

These new online market places trigger considerable regulatory debates. They are often perceived as circumventing existing regulation for firms and distorting the level playing field in competition. Attempts to bring these market places back into the firms' regulatory fold would overrule the endogenous property rights allocation that emerges from the relative transaction cost forces and could therefore be welfare reducing. Since online market places design their own regulatory set-up, they can leverage their data collection capacities to build institutions that can overcome

market failures, at least to some extent. Public regulators should reconsider the balance between public and private market regulation in the case of these online platforms. There may be remaining market failures that still need to be addressed through public regulation because the platform has no means or no incentives to address them. This implies that a straightforward extension of existing regulation from the offline economy to online platforms is not necessarily a good solution.

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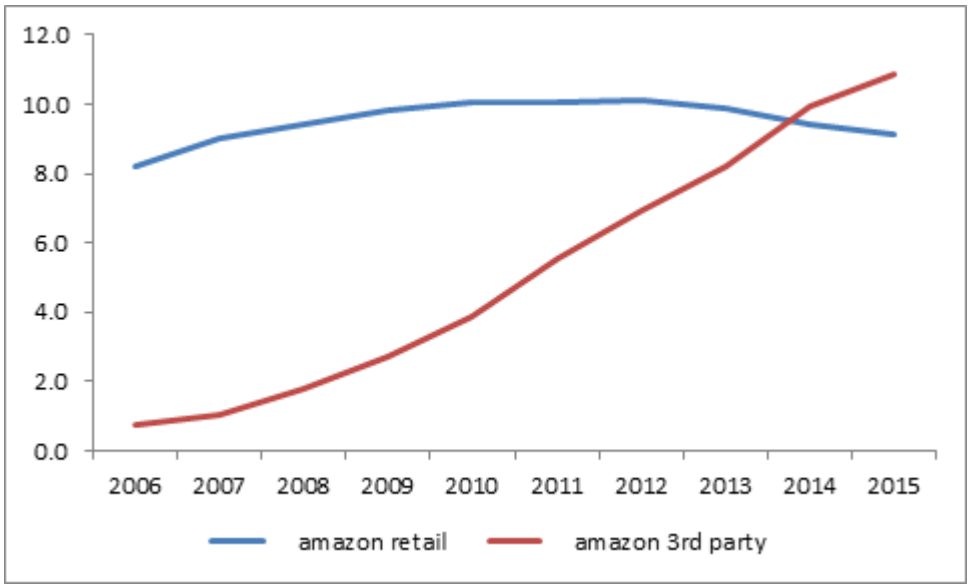
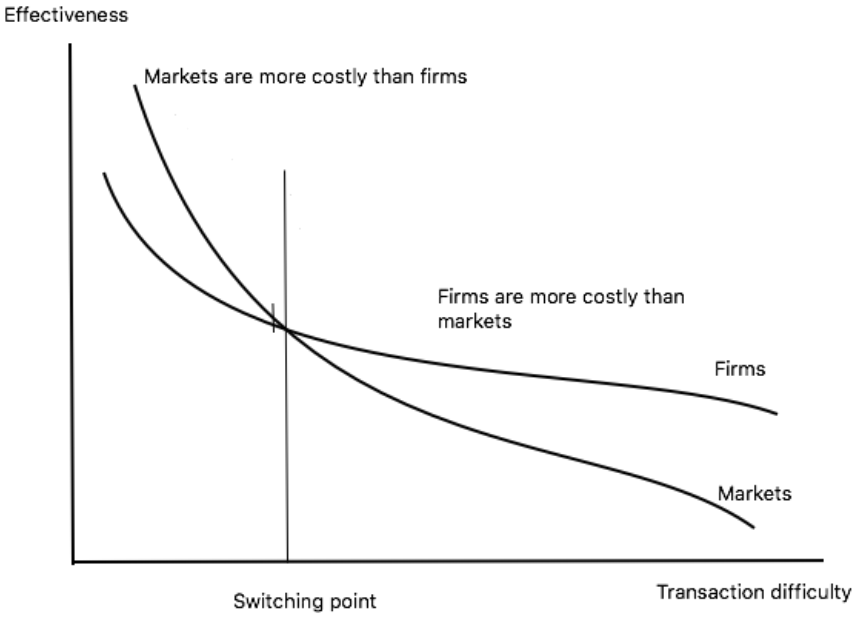
Annexes

Figure 1: Amazon's share in total online sales by retail and marketplace



Source: Euromonitor

Figure 2A: The balance between the market and firm as a function of transaction costs



Source: Adapted from Gibbons (2005)

Figure 2B: Firms become relative more effective than markets

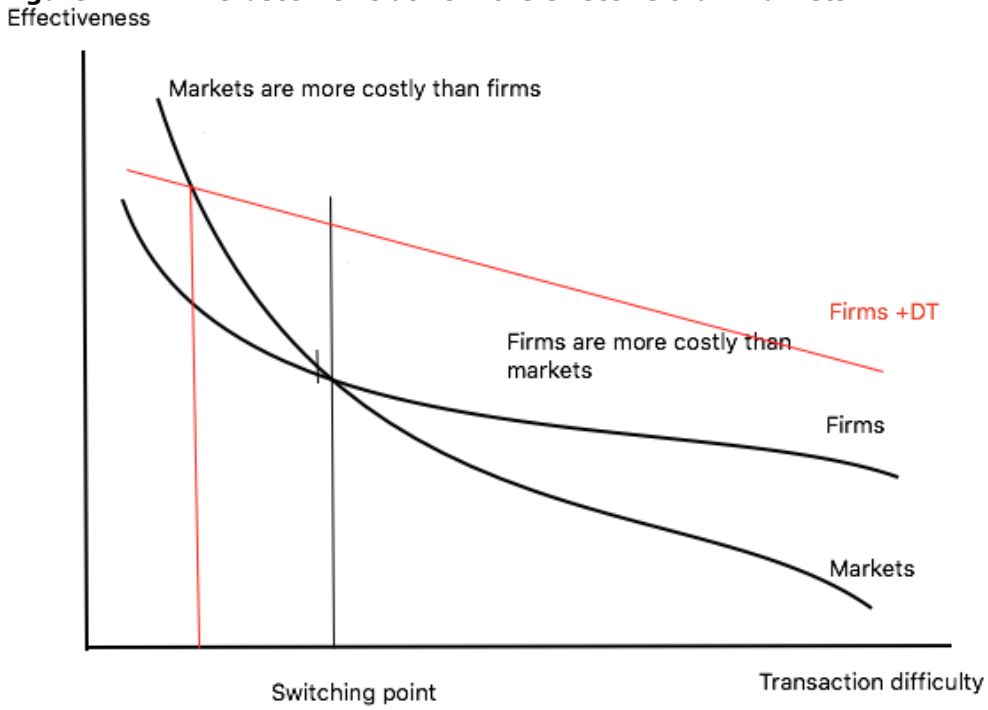


Figure 2C: Markets become relatively more effective than firms

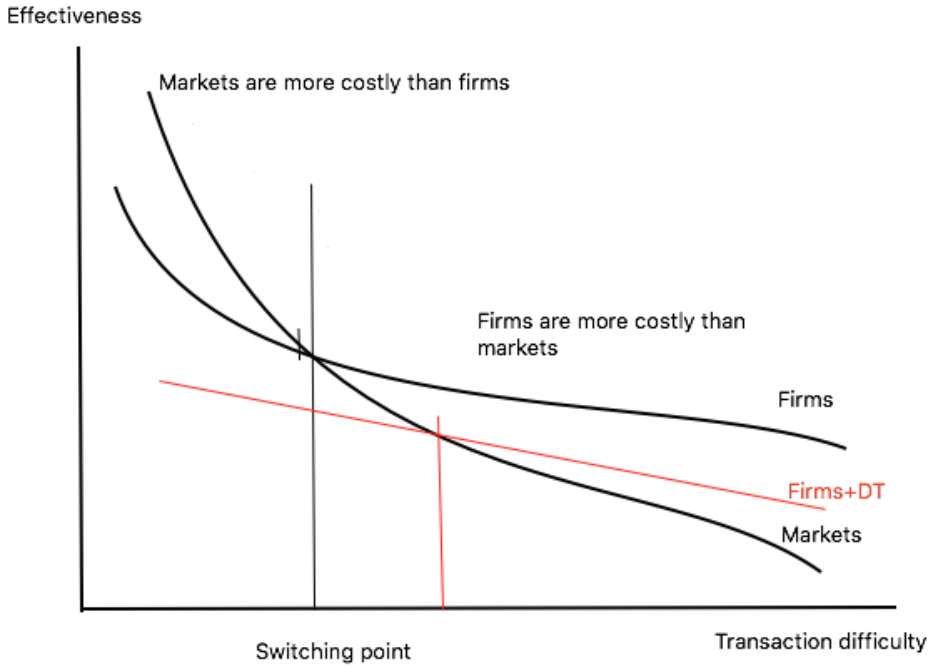
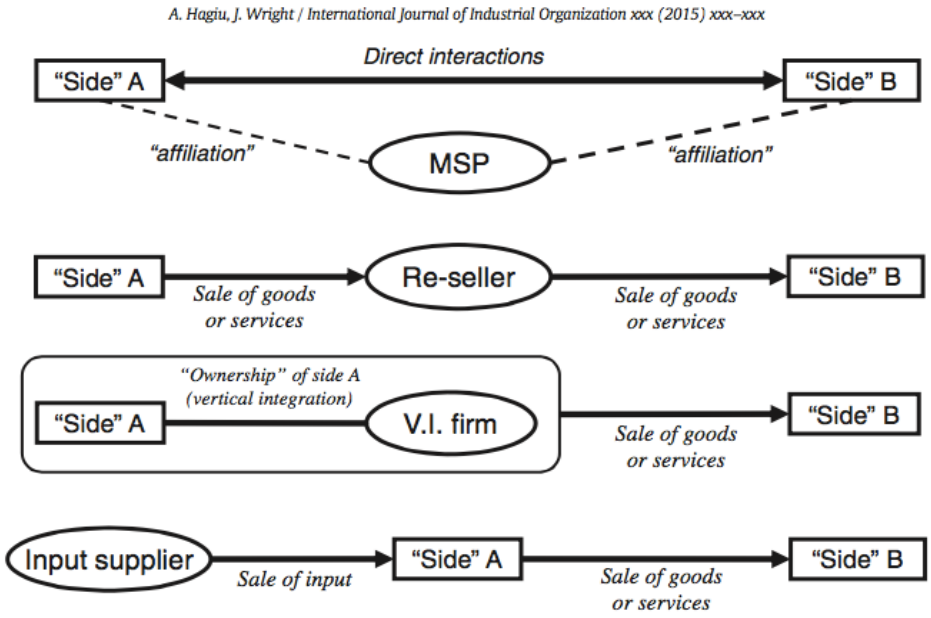


Figure 3: Market places versus alternative firm structures



Source: Hagiu & Wright, 2015.

Figure 4: The trade-off between ex-ante information costs and ex-post risk