TSE working paper series

11-223

Research Group: *Industrial Organization*

October, 2010

Revised March, 2011

Two-Sided B2B Platforms

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Prepared for

Oxford Handbook of Digital Economics, M.Peitz and J. Waldfogel eds.

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31 October 2010, revised 02 March 2011

Abstract

This chapter provides a roadmap to the burgeoning literature on two-sided markets with a specific focus on BtoB marketplaces. On-line intermediation involves two-sided network effects between buyers and sellers, and the implications for optimal BtoB platforms' tariffs are discussed. The chapter discusses first the monopoly case, drawing attention to the distinction between upfront registration fees and transaction fees. Then the competitive case is discussed, with different degrees of differentiation, the distinction between single-homing and multi-homing, and different business models. The last section is devoted to non-price issues such as sellers rivalry, tying, the design of the matching process, the ownership structure and sellers' investment.

1 Introduction

The development of digital technologies has led to drastic changes in the intermediation process, which combined structural separation of the physical and the informational dimensions of intermediation with major innovations in the latter domains. As discussed by Lucking-Reiley and Spulber (2000) e-commerce may be the source of several types of efficiency gains, including automation, better supply-chain management or disintermediation. This has led the way to the emergence of a new sector of activity on-line, where "info-mediators", building on traditional Electronic Data Interchange, offer a wide range of electronic services helping buyers and sellers to find trading

partners and conduct trade on-line.[1] As of 2005, European e-Business Report (e-Business W@tch), which follows 10 sectors in the European Union, estimates that 19% of firms were using ICT solutions for e-procurement while 17% to support marketing or sales processes (in shares of employment). They also recently pointed to a surge of e-business since 2005 after some period of stabilization and cost-cutting, as well as to the key role of information technologies for innovating products. In the US, the U.S Census Bureau[2] estimates that e-commerce accounted in 2008 for 39% of manufacturers shipments and 20.6% of merchant wholesalers sales, while e-commerce sales are modest for retailers (3.6% of sales in 2008) although increasing. For manufacturers, e-commerce is widespread among sectors, ranging from 20% to 54% of shipments, the most active sectors being Transportation equipment and Beverage and tobacco products.[3] A similar pattern arises for wholesalers although there is more disparity across sectors (from 7% to 60%), the most active sector being Drugs (60% of sales), followed by Motor vehicles and automotive equipment (47%).

BtoB intermediation platforms offers a wide and diverse range of services to potential buyers and sellers. One category of services pertains to what can be referred to as matching services. This amounts to help members of the platform to identify opportunities to perform a profitable transaction (to find a match). The second category concerns support functions that help traders to improve on the efficiency of trade. This may range from simple billing and secured payment service up to integrated e-procurement solutions. Indeed the flexibility of electronic services has created numerous possibilities for combining these services into e-business offers. While some sites are specialized in guiding clients in finding the desired product with no intervention on the transactions[4], others offer a full supply chain management service.[5]

In what follows I will be concerned primarily with the first dimension of the activity, namely the matching service. Moreover I will examine this activity from the particular angle of the two-sided market literature. The concept of a two-sided market refers to a situation where one or several competing platforms provide services that help potential trading partners to

[1] See the survey on electronic commerce in The Economist (February 2000).

[2] 2008 E-commerce Multi-sector "E-Stats" Report, available at http://www.census.gov/econ/estats/.

[3] The value is concentrated among six sectors: Transportation Equipment, Petroleum and Coal Products, Chemical Products, Food Products, Computer and Electronic Producst and Machinery Producst.

[4] Nextag or Kaboodle are examples of search engine proposing a comparison of products and prices over all funishers.

[5] Examples are Sciquest which provides procurement and supplier management processes.for life sciences, or BravoSolution a general provider of supply management.

interact. It focuses on the fact that these activities involve particular forms of externalities between agents, namely two-sided network externalities. The platform is used by two sides and the benefits that a participant derives depend directly on who participates on the other side of the market.[6] Most of the literature on two-sided markets has focused on the determination of an optimal price-structure for the services of the platforms in models where the mass of participants on the other side is a key driver of value for a participant, as will be explained below.

BtoB platforms clearly have a two-sided dimension. The two sides are buyers and sellers, and a key determinant of the value of the service is the number of potential trading partners that an agent can reach. Admittedly there are other dimensions that matter as well. For instance eBay's innovation in dealing with issues of reliability and credibility with an efficient rating system has been part of its success.[7] Also potential traders may care about the quality of the potential partners. The two-sided market perspective is partial but one that has proved to be extremely useful in providing new and original insights on the business strategies of platforms, and that leads the way for further inclusion of more sophisticated aspects in a consistent framework.

The objective of this chapter is to present the main insights of the literature in the context of electronic intermediation and to open avenues for further developments. After an introduction to two-sided markets, I will discuss the implications for optimal tariffs in the case of a monopoly platform, including the role of up-front payments and of contingent transaction fees. Then the competitive case is discussed, with different degrees of differentiation, the distinction between single-homing and multi-homing, and different business models. The third section is devoted to non-price issues such as tying, the design of the matching process and the ownership structure. The last section concludes.

2 An introduction to two-sided markets

Apart from BtoB, examples of two-sided markets include payment card systems (Rochet and Tirole (2001)), video games (Hagiu (2006)), music or video platforms (Peitz and Waelbrock (2006)), media (Anderson and Coate (2005) or Health care (Bardey and Rochet (2010)).[8] Telecommunication networks

[6] General presentations are Rochet and Tirole (2005), Jullien (2006) and Rysman (2009)

[7] See the chapter "Reputation on the Internet" by L. Cabral in this handbook.

[8] For detailed discussions, see the chapters in this handbook "Digitalization of Retail Payment" by W. Bolt and S. Chakravorti, "Home Videogame Platforms" by R. Lee,

and Internet are also instances of two-sided markets that have been the object of many studies and the source of many insights.[9]

The literature on two-sided markets is concerned with the consequences for business strategies of the indirect network externalities that generate a well known chicken&egg problem: an agent on one side of the market is willing to participate to the platform activity only if he expects a sufficient participation level on the other side. Platforms' strategies then aim at "bringing the two sides on board"[10] and account for the demand externalities in the price structure. Along this line, Rochet and Tirole (2006) defines a platform to be two-sided when the profit and efficiency depends not only on the price level but also on the price structure.[11]

The most influential analysis of two-sided markets has been developed by Jean Tirole and Jean-Charles Rochet (2003, 2006). Starting from the analysis of payment card systems, they developed a general theory of platform mediated transactions highlighting the two-sided nature of these markets. Transactions take place on the platform when supply meets demand, so that the total volume of transaction depends on the willingness to pay of the two sides, the buyer side and the seller side. Let t_b be the fee paid by a buyer per transaction and t_s be the fee paid by a seller per transaction. Then the maximal number of transactions that buyers will be willing to conduct is a function $D_b(t_b)$ that decreases with fee t_b. One may define similarly a transaction demand by sellers $D_s(t_s)$. For a transaction to take place, a match should be found between a buyer and a seller who are willing to conduct the transaction. Thus the total number of transactions will increase with both D_b and D_s. In the Rochet and Tirole (2003) formulation, as in most of the two-sided markets literature, the total volume of transaction is (proportional to) the product of the demands $D_b(t_b) D_s(t_s)$. This is the case for instance when each agent has a utility per transaction that is random, $D_i(t_i)$ is the probability that a randomly selected agent is willing to trade and all trade opportunities are exhausted. This is also the case under random matching.

For every transaction the platform receives a total fee $t = t_b + t_s$ and

"Software Platforms" by A. Hagiu and "Advertising on the Internet" by S. Anderson.

[9] See the survey by Armstrong (2002) and the chapter "Mobile Telephony" by S. Hoernig and T. Valletti in this handbook.

[10] The alliance between Cornerbrand and Kazaa described by Peitz and Waelbroeck (2006) is a good example of such a strategy, as each side benefits from it.

[11] Since there has been notorious difficulty to provide a consensus on a formal general definition of a two-sided market, I shall not try to do so here.

supports a cost c. Therefore the revenue of the platform is given by:

$$(t-c)\,D_b\,(t_b)\,D_s\,(t_s)\,.$$

Maximizing the platform profit then yields the optimality conditions

$$t_b + t_s - c = -\frac{D_b\,(t_b)}{D_b'\,(t_b)} = -\frac{D_s\,(t_s)}{D_s'\,(t_s)}.$$

Under reasonable assumptions, this yields a unique solution. Thus optimality results from a balancing of the charges imposed on the two sides. While the total margin depends on some measure of aggregate elasticity, the contribution of each side to the profit depends negatively on its demand elasticity.

For our purpose, we can reinterpret the formula as a standard monopoly Lerner index formula with a correct interpretation of the opportunity cost of increasing the fee on one side. For every agent on side i who is willing to transact, the platform is gaining not only the fee t_i but also the fee t_j that the other side pays. Thus every transaction of an agent on side i induces an effective cost $c - t_j$ along with the revenue t_i. Thus we can rewrite the formula as

$$t_i - (c - t_j) = -\frac{D_i\,(t_i)}{D_i'\,(t_i)}.$$

With this formulation we see that the fee on side i is the monopoly price for this side, but for an opportunity cost that accounts for the revenue generated on the other side by the participation of the agent. As we shall see this generalizes to a more complex set-up.

The price theory of two-sided markets is thus one of balancing the contributions to profit of the two sides. While the Rochet and Tirole (2003) model has been very influential in promoting the concept of two-sided market, its applicability to the issue of BtoB intermediation is limited for two reasons. The first reason is that it assumes that all potential buyers and sellers are participants to the platform and, in particular, that there is no fixed cost to participating. The second is that transactions conducted through BtoB platforms involve a transfer between the transacting parties. Whenever buyers and sellers bargain over the distribution of the surplus from transaction and are fully aware of each other transaction fees t_b and t_s, they will undo the price structure so that the final distribution of the surplus depends only on the total transaction fee $t = t_b + t_s$.[12] For instance, in the case of a monopoly

[12]The statement is valid for a large class of bargaining models, including models with asymmetric information (see Rochet and Tirole (2006)).

seller, the total price (price plus buyer fee) paid by the buyer depends only on the total fee t and not on the fee structure since the seller will adjust its price to any rebalancing of the fees between the two parties. According to the definition of Rochet and Tirole (2006), the market would then not be a two-sided market.

Armstrong (2006), as well as Caillaud and Jullien (2001, 2003) developed alternative approaches based on the idea of indirect network effects and membership externalities.[13] In these models, agents are considering the joint decision (possibly sequential) of participating to the platform and transacting with the members from the other side with whom they can interact on the platform. The models focus on one dimension of heterogeneity on each side, namely the costs of participating to the platform (time and effort devoted to the registration and the activity on the platform), and assume a uniform (but endogenous) benefits from transactions within each side. Some progress toward more dimensions of heterogeneity are made by Rochet and Tirole (2006) and more recently Weyl and White (2010).

3 A model for commercial intermediation

Let us consider a platform that intermediates transactions between buyers and sellers, where the service consists in identifying the profitable trade opportunities . To access the platform, the two types of agents are required to register. Once this is done they can start to look for trading partners. Suppose that prior to his participation in the identification process for profitable matches, an agent on one side considers all agents on the other side as equally likely to be a trading partner. In other words a buyer has no ex-ante preference about the identity of the sellers who participate. Suppose also that there is no rivalry between members of the same side. In particular sellers' goods are non-rival, sellers have no capacity constraints and buyers have no financial constraints. In this set-up the willingness to participate of a buyer depends solely on the prices set by the platform and on the anticipated total value of the transactions performed. Moreover if the matching technology is neutral and the same for all, the total value of transactions is the product of the number of sellers and the expected value per seller (where the latter is itself the probability that the transaction occurs times the expected value of a successful transaction).

In this context, we wish to discuss how the allocation resulting on the platform is affected by the level and the structure of the prices set by the platform.

[13] See also Gaudeul and Jullien (2001) for a monopoly model along the same lines.

There is a variety of pricing instruments that an intermediary may rely upon for generating revenues from the transactions occurring on its platform. Describing this diversity of situations is beyond the scope of this chapter. For the purpose of discussing the two-sided nature of the intermediation activity, it is sufficient to distinguish between two types of prices. The first category includes fees that are insensitive to the volume of activity and are paid up-front by any user who whishes to use the platform services. I will refer to these as *registration fees (*they are sometime referred to as membership fees in the two-sided market literature). The registration fees will be denoted r_b and r_s for the buyers and the sellers respectively. Usually participation to the platform can be monitored so that registration fees can be imposed on both sides but they may be too costly to implement, in particular in BtoC or CtoC activities.

The second category of pricing instruments includes those that are variable with the number and/or value of the transactions. Transaction fees are commonly used in BtoB activities and can take complex forms. For example, eBay.com charges sellers an "insertion fee" plus a "final value fee" paid only if the item is sold which depends on the closing value. Of course this requires the ability to monitor transactions which may depend on the nature of the transaction and the contractual agreements with the buyer or the seller. For instance, if the match between a buyer and a seller triggers multiple transactions, they may avoid paying fees to the platform by conducting the transaction outside the platform. In this case implementing fees proportional to the value of transaction requires a commitment by one party to report the transactions, either contractual or through long-run relationship and reputation effects.

When feasible, the intermediary may thus charge fees t_b and t_s per transaction for respectively the buyer and the seller. As pointed above, with commercial transactions, the buyer and the seller negotiate a transfer so that we can assume that only the total fee $t = t_C + t_P$ matters for determining whether a transaction occurs and how the surplus is shared.

Notice that while registration fees and transaction fees are natural sources of revenue for BtoB platforms, they also rely on alternative sources of revenue. First advertising is a way to finance the activity without direct contribution of the parties. In so far that advertising is a way to induce interactions between potential buyers and advertisers, this can be can be analyzed with the toolkit of two-sided markets.[14] Advertising will not be considered here, but it is worth pointing that electronic intermediation has also dramatically

[14]See Anderson and Gabszewicz (2006), Anderson and Coate (2004), Crampes et al (2004) and the chapter "Advertising in the Internet" by S. Anderson in this handbook.

affected advertising by allowing direct monitoring of the ads impact through the click-through rate. Unlike banner advertising, it is difficult to draw a clear line between BtoB intermediation and click-through advertising. Indeed in both cases the platform adapts its response to the customer requests and behavioral pattern so as to propose some trade to him, and is rewarded in proportion to its success in generating interactions.

Other revenues generating strategies subsume to bundling the service with some information goods. This is not only the case for most search engines that act as portals, but also for many support services that are offered by BtoB platforms, such as billing, accounting or any other information services for BtoB. Bundling may be profitable because it reduces transaction costs or exploits some forms of economy of scope.[15] Bundling may also be part of an articulated two-sided market strategy, an aspect that we will briefly address. Notice that in some cases bundling can be embedded into prices by defining prices net of the value of the good bundled.[16] For instance if a service increases the value of any transaction by a fixed amount z at a cost c_z for the platform, we can redefine the net transaction fee as $\tilde{t} = t - z$ and the net cost per transaction as $\tilde{c} = c - z + c_z$, then the profit per transaction is $\tilde{t} - \tilde{c} = t - c - c_z$.

3.1 Membership externalities

In the simplest version of the model, there is no transaction fee. For any pair of buyer and seller, let us normalize the expected value of transactions for a pair of buyer and seller to 1. We can then denote by α_b the expected share of this surplus for a buyer and by $\alpha_s = 1 - \alpha_b$ the expected profit of a seller per buyer registered. Notice that α_s and α_b don't depend on the mass of sellers or buyers, which reflects the assumptions made above and which was the case in most of the two-sided market literature until recently (see however the discussion of externalities within sides below). This is in particular the assumption made by Armstrong (2006) and Gaudeul and Jullien (2001).

Let us denote by N_b and N_s the number of buyers and the number of sellers on the platform. Then the expected utility from transactions that a buyer anticipates can be written as $\alpha_b N_s$. As a result, the number of buyers registering is a function of $\alpha_b N_s - r_b$ that we denote $D_b\left(r_b - \alpha_b N_s\right)$, where D_b is non-increasing. Notice that this demand function is similar to the demand where quality is endogenous and measured in monetary equivalent. The term $\alpha_b N_s$ can thus be interpreted as a measure of quality that depends

[15] A particular form of economy of scope for electronic goods is a reduction in demand uncertainty (see Bakos and Brynjolfson (1999)).

[16] See the chapter "Bundling Information Goods" by J.P. Choi in this handbook.

on the other side's participation level. Following this interpretation, the participation of sellers can be viewed as an input in the production of the service offered to buyers. As noticed in Jullien (2000), from the platform perspective agents have a dual nature: there are both clients buying the service and suppliers offering their contribution to the service delivered to the other side. This intuition then makes clear that since the price charged to one side will have to balance these two effects, it will tend to be lower than in one-sided markets. This is then no surprise that the price on one side may even be negative.

Following a similar reasoning, the expected utility from transactions of a seller is $\alpha_s N_b$ leading to a level of registration $D_s(r_s - \alpha_s N_b)$. With these demand functions, we obtain what can be seen as a canonical model for registration to the platform. The participation levels for registration fees r_b and r_s solve the system of equations

$$\begin{aligned} N_b &= D_b(r_b - \alpha_b N_s), \\ N_s &= D_s(r_s - \alpha_s N_b). \end{aligned} \tag{1}$$

Under some reasonable assumptions the system of demand defines unique quantities $N_b(r_b, r_s)$ and $N_s(r_b, r_s)$ given the registration fees. Notice that the model involves a network externality between buyers: although buyers are not directly affected by other buyers, in equilibrium, each buyer creates a positive externality on the others through its impact on the sellers' participation. This type of externalities is what is referred to in the concept of indirect network effects.

Remark 1 *When the demand is not unique, the price structure may matter for selecting a unique demand. Suppose for instance that $D_i(x)$ is zero for x non-negative but positive for x negative. Then zero participation is an equilibrium at all positive prices. However if one price is negative (say r_b) and the other positive, the demands must be positive since $D_b(r_b) > 0$.*

The platform profit is then given by (for clarity we set the cost per transaction to zero from now on, $c = 0$)

$$(r_b - c_b) N_b(r_b, r_s) + (r_s - c_s) N_s(r_b, r_s),$$

where c_b and c_s are the registration costs on the buyer side and the seller side respectively. Thus the two-sided platform profit and the monopoly prices are similar to those of a multi-product seller, where the products are the participations on each side. An intuitive derivation of these prices can be obtained as follows.

Consider the following thought experiment: the platform reduces marginally the fee r_b and raises the fee r_s by an amount such that the participation of sellers remains unchanged. This is the case when the change of the fee r_s is proportional to the change in buyers participation: $dr_s/dN_s = \alpha_s$. Then, since the sellers participation remains unaffected, the change in buyers participation is $dN_b/dr_b = D_b'(r_b - \alpha_b N_s)$. Following this logic, the effect on profit of this "neutralized" change in price is $(r_b - c_b) D_b' + D_b + \alpha_s N_s D_b'$. At optimal prices the change should have zero first-order effect implying that the optimal fee r_b solves (the symmetric formula holds for the sellers side):

$$r_b - (c_b - \alpha_s N_s) = -\frac{D_b}{D_b'}. \tag{2}$$

The interpretation is then that the registration fee is the monopoly price for the participation demand but for an opportunity cost $c_b - \alpha_s N_s$. The opportunity cost is the cost c_b net of the extra revenue that the platform can derive on the other side from the participation of the agent, which corresponds here to an increase in the registration fee by α_s for each of the N_s sellers.[17]

Monopoly prices exhibit several interesting properties. First the presence of two-sided externalities (α_b positive) tends to generate a lower price than without externality, very much like it is the case of direct network effects. The size of the effect on buyers' registration fees depends, however, on the level of participation on the other side.

The side that values the other side's participation the least should have (everything being equal otherwise) lower prices than the other side. This is because it is the most value enhancing for the platform which can leverage participation on the other side. Of course, this effect has to be combined with standard cost and demand elasticity considerations.

A striking conclusion is that the optimal price can be negative on one side, if the cost is low. In many cases negative prices are hard to implement in which case the registration fee will be zero, possibly complemented with gifts and freebies. The theory thus provides a rational set-up to analyze the behavior of free services as the result of profit maximization. For this reason it is a natural tool in the economics of Internet and media, where free services are widespread.

[17] With a cost c per transaction, the opportunity costs is $c_b + cN_s - \alpha_s N_s$ which may be larger or smaller than c_b.

3.2 Transaction fees

The canonical model abstract from transaction fees and it is important to understand the role that such fees can play. While registration fees are neutral to transactions (apart for their effect on participation to the platform), transaction fees may have a direct effect on transactions. This is always the case if the benefits from trade are variable across transactions. Indeed, under efficient bargaining, a transaction occurs only when its total value is larger than the transaction fee.

To start with, suppose that transaction fees are non distortionary so that the volume of transaction is not affected. Assuming a constant sharing rule of the transaction surplus between the seller and the buyer, transaction fee t leads to expected benefits $\alpha_b (1-t)$ for a buyer and $\alpha_s (1-t)$ for a seller. The expected revenue from transactions of the platform is then tN_sN_b, proportional to the number of transaction. In the case of distortionary transaction fee, we can similarly write the respective expected benefits per member of the other side as $\alpha_b v(t)$ and $\alpha_s v(t)$ with $v(0) = 1$. Then $v(t)$ is the net surplus of a pair of buyer and seller from a transaction and the probability that a pair of buyer and seller transact is $v'(t)$.[18]

In the case of distortionary transactions fees, the total expected surplus for a pair of buyer and seller is $v(t) + v'(t)\, t$. A classical argument for two-part tariffs shows that when the platform can combine a transaction fee with registration fees, then the optimal transaction fee maximizes this total surplus (Rochet and Tirole (2006), Jullien (2007)). The general intuition is that the platform can always rebalance the prices so as to increase the surplus from transactions and maintain participation levels, implying that the welfare gains generated are captured by the platform. To see that, notice that demand functions are given by

$$\begin{aligned} N_b &= D_b\left(r_b - \alpha_b v(t) N_s\right), \\ N_s &= D_s\left(r_s - \alpha_s v(t) N_b\right). \end{aligned} \tag{3}$$

Using $r_i = D_i^{-1}(N_i) + \alpha_j v(t) N_j$, we can write the profit in terms of quantities as

$$\left[\left(D_b^{-1}(N_b) - c_b\right) N_b + \left(D_s^{-1}(N_s) - c_s\right) N_s\right] + \left(v(t) + v'(t)\, t\right) N_b N_s.$$

With this formulation we see that the profit can be decomposed into two parts. The first part is a standard profit function for selling quantity N_b on

[18] To see that let u be the value of a transaction and $F(u)$ its cdf. Then $(\alpha_b + \alpha s)\, v(t) = \int_t^{+\infty} (u-t)\, dF(u)$ which derivative is $1 - F(u)$ the probability that the transaction occurs.

the buyer side and N_s on the seller side . The second part is a term capturing the strategic dimension of the externality. From the profit formulation it is immediate that for any participation levels on each side, the platforms should set the fee at a level that maximizes the total expected surplus $v(t)+v'(t)t$.[19]

As mentioned above the conclusion that transaction fees should aim at maximizing the surplus generated by the activity of agents on the platform is reminiscent of similar results in two-part tariffs. From this we know that it has to be qualified when applied to a more general context. For one thing the conclusion relies on the assumption that agents are risk neutral. If a participant faces some uncertainty on future transactions, then transferring some of the platform revenue from fixed payment (registration fees) to transaction fees is a way to provide some insurance. The risk on the final utility of the agent is reduced which may raise efficiency when the agent is risk averse.[20] Second, the conclusion relies on the assumption that the expected benefits from transactions are uniform across buyers or across sellers (see below).

Hagiu (2004) points to the fact that the level of transaction fees matters also for the platform incentives to foster transactions. In his model there is insufficient trade so that total surplus is maximized by subsidizing trade. Running a deficit on transactions fosters more efficient trades by members of the platform, however it may hinder the platform incentives to attract new participants in a dynamic setting. Indeed once a significant level of participation is reached, any new participant raises the volume of transactions of already registered members and thus the deficit that the platform incurs on these transactions. Conversely positive transaction fees raise the gain of attracting a new member. The ability of the platform to commit on its future strategy then matters for the conclusion. A lack of commitment may lead the platform to opt for positive transaction fees.

3.3 Welfare

Two-sided markets provide not only a framework to analyze platforms pricing strategies but also a convenient and insightful framework for analyzing welfare issues. Socially optimal pricing rules are derived in Jullien and Gaudeul (2001) and Armstrong (2006). These prices follow from standard arguments in welfare economics applied to networks. To discuss this, consider the

[19] This conclusion extends to duopoly with single-homing.

[20] As an illustration, while in 2005, the leading automotive e-procurement portal, Covinsint, was relying on membership fees, its smaller competitor Partsforindustry was relying most extensively on volume related payment (Jullien (2006)).

case without transaction fees. Recall that the participation of an additional buyer generates an average value α_s for every seller on the platform. Like for any other externality (pollution or congestion, for instance), since the buyer makes his decisions based on his own benefits solely, his participation decision is efficient when he faces a price that internalizes all the costs and benefits for other agents in the society. In the case of a two-sided market the net cost for society is the physical cost diminished by the value of the externality created on the other side, $c_b - \alpha_s N_s$. A similar argument on the other side shows that the allocation is efficient only when both sides face (total) prices $p_b = c_b - \alpha_s N_s$ and $p_s = c_s - \alpha_b N_b$.

Thus socially efficient prices are below marginal cost, a conclusion that is in line with the conclusions for direct network effects. One may then interpret these prices as "social opportunity costs". Notice that they coincide with the platform's opportunity costs. This is due to the fact that the expected benefits from transactions is uniform within each side. If it were not the case, the two opportunity costs would differ by a factor reflecting the traditional Spence distortion: the platform would care about the externality on the marginal member while social welfare would require to care about the externality on the average member (see the discussion of Weyl (2010)).

This being understood, one can apply standard intuition to these opportunity costs. For instance, optimal tariffs under budget balanced conditions can be derived as Ramsey prices for the two segments that constitute the two sides, whereby the mark-up over the opportunity cost is proportional to the inverse elasticity of participation (Gaudeul and Jullien (2001)).

Similar conclusions can be derived when transaction fees can be used (see Jullien (2007)). Clearly, social welfare is maximized when the transaction fee maximizes the expected trade surplus. Therefore, subject to the caveats discussed above, there is no divergence between privately optimal (monopoly) and socially optimal transaction fees. Given the transaction fees, the analysis of socially optimal registration fees is the same as above but accounting for the fact that the externality induced by the participation of an agent on one side includes not only the value created for members on the other side but also the profit created for the platform.

3.4 Usage heterogeneity

There is little contribution on optimal tariffs when both the benefits from transactions and the costs of participation are heterogenous.

A noticeable exception is Weyl (2010) which provides a remarkable analysis of tariffs with heterogeneity in the transaction values α_s and α_b. Then

participation demand on side $i = s, b$ for the case with no transaction fees takes a non-linear form $D_i(p_i, N_j)$ that depends on the joint distribution of the participation cost and the benefit α_i. The intuition developed above concerning the opportunity cost of adding one more member to the platform extends. In particular, he characterizes the increase $\tilde{\alpha}_j$ of the revenue per member of side j that a platform can obtain with one more member on side i, keeping the participation N_j constant on side j. The opportunity cost of selling to side i is then as above $c_i - \tilde{\alpha}_j N_j$. Weyl then shows that monopoly pricing follows standard Lerner index formulas for these opportunity costs:

$$r_i - (c_i - \tilde{\alpha}_j N_j) = -\frac{D_i}{D_i'},$$

where the elasticity term is with respect to the price.

He also extends the welfare analysis by showing that socially optimal registration fees are equal to a social opportunity cost derived as follows. For one more member on side i, let $\bar{\alpha}_j$ be the mean increase of the utility of members who are registered on the other side. Then the social opportunity cost can be defined as $c_i - \bar{\alpha}_j N_j$.

Weyl identifies two distortions associated with the exercise of market power in two-sided markets. One is the standard monopoly mark-up over marginal cost. The second is reflected in the fact that $\tilde{\alpha}_j$ may differ from $\bar{\alpha}_j$, which corresponds to the standard distortion in the provision of quality by a monopoly. Indeed, as already pointed, participation on one side can be viewed as a quality dimension on the other side. When deciding on the price on one side, the monopolist accounts for the effect on the marginal member on the other side and ignores infra-marginal members. By contrast, a social welfare perspective requires to account for the average member.

4 Competing platforms

Competition between platforms is shaped by the chicken&egg nature of the activity, as the driver of success on one side is success on the other side. As pointed in Jullien (2000), each user of a platform is both a consumer of the service and an input for the service offered to the other side. Platforms' pricing strategies then reflect the competition to sell the service, but also the competition to buy the input. As we shall see, this dual nature of competition may generate complex strategies using cross-subsidies and a departure of prices from marginal costs.

Key determinants of the competitive process discussed below are whether platforms obtain exclusivity from their clients or not, how differentiated they

are and what tariffs they can use. The situation where agents can register with several platforms is usually referred to as multi-homing. In discussing the competitive outcome, I devote the first part to the case of exclusive dealing by buyers and sellers (single-homing), and then I discuss multi-homing.

4.1 Overcoming the multiplicity issue

One issue that is faced when dealing with platform competition, that is akin to competition with network effects, is the issue of multiplicity. There may be different allocations of buyers and sellers compatible with given prices, which complicates the equilibrium analysis. There are at least three ways to address this issue. Caillaud and Jullien (2003) develop a methodology to characterize the full set of equilibria, based on imposing specific conditions on the demand faced by a platform deviating from the equilibrium (using the notion of pessimistic beliefs discussed below). Another approach consists in focusing on situations where multiplicity is not an issue. Along this line, Armstrong (2006) assumes enough differentiation between the platforms for the demand to be well defined. Armstrong's model has proven to be very flexible and is widely used by researchers on two-sided markets.[21] Ongoing work by Weyl and White (2010) relies on a particular type of non-linear tariffs introduced in Weyl (2010), named "insulating tariffs". These tariffs are contingent on participation levels of the two sides and designed in such a way that participation on one side becomes insensitive to the other side's participation, thereby endogenously removing the source of multiplicity.

The last approach is to choose among the possible demands one particular selection. For instance, Ambrus and Argenziano (2009) imposes a game theory selection criterion (coalitional rationalizability) that can be interpreted as some limited level of coordination between sides. Jullien (2000) and Hagiu (2006) introduce the concept of pessimistic beliefs that assumes that agents always coordinate on the least favorable demand for one pre-determined platform. Jullien (2000) notices that, since which demand emerges depends on agents expectations, one platform will be at a disadvantage if agents view the competing platform as focal. The concept of pessimistic beliefs captures this idea in a formal way and allows to study the effect on competition and entry of the advantage derived from favorable expectations.

Beyond the technical difficulty, this multiplicity issue reminds of the importance of agents expectation in the outcome of competition between platforms. There has been little work on the role of reputation in the dynamics of BtoB marketplaces, an issue that should deserve more attention (Jullien

[21] The Rochet and Tirole (2003) model has also a unique equilibrium in duopoly.

(2000) and Caillaud and Jullien (2003) can be interpreted as addressing these issues).

4.2 Competition with exclusive participation

The main contributions on competition between platforms are Armstrong (2006) and Caillaud and Jullien (2001, 2003).[22] Exclusivity refers to the fact that agents can be active only on one platform. Whether this applies to BtoB platforms depends on the concrete context. For example an industrial buyer that relies on the platform for its supply-chain management would typically have an exclusive relationship with the platform, while his suppliers may not. More generally e-procurement may require the buyer to deal exclusively with the platform.

One lesson from the literature is that the nature of competition may be drastically affected by factors such as complementary services offered by the platform and whether the platforms are perceived to be differentiated or not. To illustrate this we can contrast several contributions in the context of competition with registration fees only.

Armstrong (2006) assumes that the platforms provide enough services for the demand to be always positive ($D_i(0)$ is positive in our model) and that these services are differentiated across platform. More precisely, Armstrong's model extends the framework of section 2 by assuming that two symmetric platforms are differentiated à la Hotelling on each side, with large enough transportation costs and full coverage of the market. With differentiated platforms, the residual demand of one platform is well defined and the intuition on opportunity costs applies. Suppose that each platform covers half of the market on each side, and one platform decides to attract one more buyer away from its competing platform. This raises its value for sellers by α_s but at the same time this reduces the value of the competing platform for sellers by α_s since the buyer is moving away from the competitor. Therefore the platform can raise its registration fee r_S by $2\alpha_s$ with unchanged sellers' demand. Given that it serves half of the market, the platform increase its profit on the seller side by $2\alpha_s \times 1/2$ when it attracts one more buyer. The opportunity cost of attracting a buyer is then $c_b - \alpha_s$, and by the same reasoning it is $c_s - \alpha_b$ for a seller. Armstrong shows that the equilibrium registration fees are the Hotelling equilibrium prices for these opportunity costs: $r_i = c_i - \alpha_j + \sigma_i$, where σ_i is the equilibrium Hotelling mark-up

[22] The literature on competition between mobile telecommunication networks has introduced many of the relevant concepts (see Armstrong (2002) for a review). See also the chapter "Mobile Telecommunications" by S. Hoernig and T. Valletti in this handbook.

(the transportation cost). The conclusion is thus that prices are reduced on both sides when the markets are two-sided compared to the one-sided case ($\alpha_s = \alpha_b = 0$) and that the strongest effect is on the market that induces relatively more externality for the other side, a conclusion in line with the lessons from the monopoly case.

Caillaud and Jullien (2001), by contrast, analyze the case of non-differentiated platforms that provide pure intermediation service to homogenous buyers and sellers. Suppose there is a mass 1 on each side and that when N_j^k members of side j register with platform $k = A, B$, a member of side i obtains a utility $\alpha_j N_j^k$ with no other value attached to the platform's services. In this context, demands are not well defined. If the absolute value of the price differential on each side is smaller than the average value α_i of transactions, then there are two possible equilibria: one where all buyers and sellers join platform A and one where they all join platform B. To fix ideas, assume that platform B faces "pessimistic beliefs" which here imposes that in the above situation all agents register with platform A. Then the most efficient competitive strategy for platform B takes the form of a "divide&conquer" strategy. When platform A offers prices $r_i \leq \alpha_i$, a strategy for platform B consists in setting fees $r_s - \alpha_s - \varepsilon < 0$ for sellers (divide) and $\alpha_b + \inf\{0, r_b\}$ for buyers (conquer). The platform subsidizes the sellers at a level that compensates them for being alone on the platform, thereby securing their participation. This creates a bandwagon effect on the other side of the market. Hence buyers are willing to pay α_b to join the platform if $r_b > 0$ (since platform A has no value without sellers) or $\alpha_b - r_b$ if $r_b < 0$. A divide&conquer strategy then subsidizes participation on one side and recoups the subsidy by charging a positive margin on the other side. The mirror strategy subsidizing buyers can be considered. Caillaud and Jullien (2001) then show that platform A serves the whole market and obtains a positive profit equal to the difference between the values of transactions $|\alpha_s - \alpha_b|$, and Caillaud and Jullien (2003) show that more generally when no restriction is imposed on the demand system (except some monotonicity condition), the set of equilibria consists in one platform serving the whole market and making a profit between 0 and $|\alpha_s - \alpha_b|$.

Armstrong (2006) and Caillaud and Jullien (2003) thus lead to very different conclusions and equilibrium strategies, where the difference lies mostly in the intensity of the impact of indirect network effects on demand. In Armstrong's model, the demand is smooth and externalities raise the elasticity of the residual demand, as in Rochet and Tirole (2003) canonical model. In Caillaud and Jullien (2001,2003) externalities generate strong band-wagon effects and non-convexities.

The model of Caillaud and Jullien has also the particularity that all the

value is derived from pure intermediation. Surprisingly it is this feature that allows the active platform to generate positive profit. Jullien (2000) considers the same model but assumes that there is an intrinsic value to participating on a platform even if no member of the other side is present. If this "stand-alone" value is large enough, then the analysis of divide&conquer strategy is the same except that the "conquer" price is $\alpha_b + r_b$ instead of $\alpha_b + \inf\{0, r_b\}$ (the reason is that buyers would pay $r_b > 0$ even if there is no seller on the platform). This simple twist has a drastic implication since it implies that with homogenous competing platforms, there doesn't exist a pure strategy equilibrium. The reason is that for any profit $r_b + r_s$ that a platform can obtain in equilibrium, its competitor can obtain $r_s + r_b + |\alpha_s - \alpha_b|$ with an adequate divide&conquer strategies.

What to retain from this? First, as it is often the case with network effects, the existence of indirect network effects in the BtoB marketplaces tends to intensify competition, at least when intermediation is only one part of the activity of platforms. A difference with the monopoly case is that the opportunity cost of attracting a member on the platform has another component than the value created on the other side: it is the "competitive hedge" due to the fact that attracting a member from the other platform deprives the latter from the very same value. Thus in a competitive context the effect of network externalities is doubled, which is what explains the inexistence result of Jullien (2000).

Second, where the business models are fundamentally based on pure intermediation activities, it may be very difficult to compete with well established platforms that benefit from reputation effects. This conclusion for instance shades some light on the high degree of concentration that characterizes the market for search engines (however this should be pondered by multi-homing considerations discussed below).[23] New entrants may then rely on alternative strategies involving horizontal differentiation and multi-homing by some agents, as discussed below.

Caillaud and Jullien (2001, 2003) also illustrate the fact that the pattern of prices in two-sided markets may exhibit implicit cross-subsidies. As a result, even two sides that have similar characteristics may face very different prices, a feature that is referred to as price skewness by Rochet and Tirole (2003).[24] Unlike the case of a one-sided market where competition tends to align prices with marginal costs, competition between two-sided platforms

[23] See the chapter "Product and Price Comparison Sites" by J. Moraga and M. Wildenbeest in this handbook.

[24] This conclusion is corrobated by Jullien (2000)'s treatment of a general competitive game between multi-sided platforms.

tends to exacerbate the skewness of prices and leads to permanent departure of prices from marginal costs (or even from opportunity costs as defined before). The reason is that it raises the incentives to gain a competitive advantage by courting some side.

Finally, it is worth mentioning that there is much to learn for the case where the value of transactions is heterogenous within each side.[25] Ambrus and Argenziano (2009) provides the insight that when agents differ in their usage value, then size on one side may act as a screening device on the other side. This opens the possibility of endogenous differentiation whereby multiple platforms with very different participation patterns coexist, the equilibrium allocation being supported by endogenous screening.

4.3 Multi-homing

The previous discussion assumes that agents register only to one platform which appears unrealistic for many BtoB platforms. For instance, in e-tendering, typically buyers single-home but sellers may be active on several platforms simultaneously. More generally, platforms offering supply-chain management may have only one side single-homing depending on which end of the supply-chain is targeted by the platform's process.

When one side can register to both platforms and not the other one, then a particular form of competition emerges that is referred to as "competitive bottleneck" by Armstrong (2006), where the term is borrowed from the debate over termination charges in mobile telecommunications. Indeed platforms do not really compete to attract multi-homing agents as the "products" offered to them are non-rival. To see that suppose sellers are multi-homing and not buyers. Then a platform can be viewed as providing an exclusive access to its registered buyers: from the perspective of sellers it is a bottleneck. Thus it can charge sellers the full value of accessing its population of registered buyers. There is no rivalry on the sellers' side as access to one platform is not substitutable with access to another platform.[26] The profit on the seller side is however competed away on single-homers. Indeed following the logic developed in the previous sections, the opportunity cost of attracting a buyer discounts the profit that the buyer allows to generate on the seller side. The equilibrium prices on the buyer side will thus be lowered to an extent that depends on the rate at which costs are passed on to buyers in equilibrium. This effect, according to which higher revenue per user on one side translates into lower prices on the other side, is what is referred to

[25] See the on-going work by Weyl and White (2010).

[26] This assumes away any resource constraint or other diminishing returns for sellers.

as the waterbed effect in the telecommunication literature and sometime as the seesaw effect in the literature on two-sided markets.[27]

Notice that in comparison to single-homing, multi-homing leads to higher prices for the multi-homing side, there is no clear comparison on the single-homing side. The reason is that while the revenue that is generated by an additional single-homing agent is higher, the additional "competitive hedge" effect discussed in the previous section disappears with vanishing competition on the multi-homing side. Both Armstrong (2006) and Caillaud and Jullien (2003) however concludes that profits are higher when there is multi-homing on one side. Armstrong and Wright (2007) shows that a competitive bottleneck may emerge endogenously when differentiation is low on one side, but its sustainability is undermined by the possibility to offer exclusive contracts to multi-homers.

4.4 Transaction fees

The results discussed so far concern competition with registration fees, which apply to some marketplaces but not all. Caillaud and Jullien (2003) analyze the outcome of Bertrand type competition with transaction fees in a context where transaction fees are non-distortionary. Much remains to be done for situation where transaction fees have distortionary effects.

One main insight follows from the remark that transaction fees act as a form of risk sharing between the platform and the agents, because the payment is made only in case of a transaction while the platform would support the full cost in case no transaction occurs. Therefore they are natural tools for competing in situations involving the chicken&egg problem that characterizes two-sided markets. It is easier to attract a member facing uncertainty on the other side's participation if this member's payment is contingent on the other side's participation.[28]

In the context of Bertrand competition with single-homing, platforms would charge maximal transaction fees and subsidize participation. The competitive effect is then sufficient for the equilibrium to be efficient with zero profit.[29]

In the context of multi-homing, the conclusions are more complex. Typically multi-homing modifies the analysis of divide&conquer strategies. Indeed

[27] In the context of the Hotelling model discussed by Armstrong (2006), there is a one-to-one waterbed effect so all profits from sellers are competed away on buyers.

[28] The same insight holds for Weyl's concept of insulating tariff, which may help to provide credibility to this concept for competitive situations.

[29] With distortionary transaction fees and Bertrand competition, efficiency would not be achieved but there would still be zero profits (see Jullien (2007)).

it is easier to convince an agent on one side to join since it does not need to de-register from the other platform. But there is a weaker band-wagon effect and it becomes more difficult to convince the other side to de-register from the competitor. In this context transaction fees play two roles. First, they raise the subsidy that can be paid up-front in order to attract an agent by deferring the revenue to the transaction stage. Second, they are competitive tools since agents may try to shop for the lowest transactions fees. As a consequence two alternative strategies can be used by platforms to conquer the market, depending on the prices of the competing platform. One strategy aims at gaining exclusivity through low registration fees or subsidies and generating revenue with high transaction fees. The other strategy consists in inducing multi-homing but attracting transactions with low transaction fees.

To summarize, the fact that multi-homing agents try to concentrate their activity on the low transaction fee platforms creates two levels of competition. Intermediaries compete to attract registrations, and in a second stage they compete to attract transactions by multi-homers. This competition tends to reduce transaction fees. One should thus expect platforms to charge lower transaction fees if there is a large extent of multi-homing. In the context of Bertrand competition analyzed by Caillaud an Jullien (2003) the consequence is that an efficient equilibrium exists and involves zero profit if the intermediation technologies are identical.[30] With different and imperfect technologies however, profits will be positive unlike the single-homing case.[31] Moreover, this efficient equilibrium may coexist with inefficient competitive bottleneck equilibria.

5 Design and other issues

While the two-sided market literature has to a large extent focused on pricing issues with indirect network effects, there are clearly other important dimensions for BtoB platforms. The literature is still in its infant stage, but some contributions address some other issues.

[30] By this it is meant that if one platform fails to generate a particular transaction, the other will fail as well.

[31] With an imperfect intermediation technology, a third strategy always generates positive profits: it consists in focusing on agents who failed to perform a transaction on the competing platform, by charging a high transaction fee, exploiting the last resort position.

5.1 Sellers rivalry

Concerning the pricing strategies of a platform, the first obvious issue is that most of the literature abstracts from externalities between members of the same side. In the context of BtoB marketplaces the assumption is questionable as sellers of substitutable products will compete on the market, which generates negative pecuniary externalities. An analysis of two-sided markets with negative network effects within sides and positive externalities between sides is provided by Belleflamme and Toulemonde (2009) where they show that when they are neither too large or too small, negative externalities within sides impede the ability of divide&conquer strategies to overcome the chicken&egg problem. This suggests that it may be more difficult for a potential entrant to find his way to successful entry. Baye and Morgan (2001) focus more explicitly on BtoB platforms and show that when sellers are offering substitutable goods and are the source of revenue of the platform, the platform will restrict entry of sellers so as to reduce competition on the platform and preserve a positive margin for sellers (see also White (2010)).[32] Hagiu (2009) shows that, as a result of reduced sellers' competition, an increase in consumers' preference for variety raises the relative contribution of sellers to a monopoly platform revenue.[33] The paper by Nocke, Peitz and Stahl (2007) discussed below also allows for sellers rivalry.

5.2 Tying[34]

Traditional business strategies need to be reconsidered in the context of two-sided markets. For instance, tying has raised some attention, in part as a consequence of the debates over the recent antitrust procedures surrounding Microsoft's tying strategies. First, the traditional analysis of tying as an exclusionary practice (Whinston (1990)) needs to be reconsidered as the underlying strategic effects are complex (Hagiu and Farhi (2008), Weyl (2008)). Second, tying may have beneficial effects specific to two-sided markets.[35] For instance, Choi (2010) points to the fact that with multi-homing, tying may raise the level of participation by inducing more agents to multi-home, raising

[32] See the chapter "Product and Price Comparison Sites" by J. Moraga and M. Wildenbeest in this handbook.

[33] Results are more ambiguous for competing platforms, for reasons similar to Belleflamme and Toulemonde (2009).

[34] See the chapter "Bundling Information Goods" by J.P. Choi in this handbook.

[35] See Rochet and Tirole (2004b) for a similar view on tying between two payment card sytems.

the global volume of transactions in the market.[36] Amelio and Jullien (2007) view tying as a substitute for monetary subsidies when the latter are not feasible, thereby helping the platform to coordinate the two sides and to be more efficient in a competitive set-up, and analyze the strategic implications.[37]

5.3 Designing intermediation services

Tying is one instance of strategic decisions by platforms that relates to the design of the platform architecture as well as pricing strategies. The development of BtoB marketplaces has led to a burgeoning of innovation in design and clearly design is an integral part of the business strategies adopted by the platform. Despite a large literature on matching design, there is little contribution on the interaction between design and pricing.[38] Still this seems to be an important avenue for future research as the incentives of a platform to improve the efficiency of the intermediation process will depend on its ability to generate revenue from the improvement. Hence pricing models interact with technical choices in a non-trivial way. For instance Hagiu and Jullien (2007) provides several rationales for an intermediary offering directed matching services to direct buyers toward sub-optimal matches, and analyze the impact of pricing models on this phenomenon. Eliaz and Spiegler (2010) and de Corniere (2010) identify a mechanism in a sequential search model whereby a degradation of the quality of a pool of listed sellers leads to higher prices charged by sellers, more clicks and more revenue for the platform. For search engines, White (2009) analyzes the optimal mix of paying and non-paying listed sellers, when there are pecuniary externalities between sellers. All these contributions provide micro-foundations for design choices by platforms that affect the perceived quality of the intermediation service by each side in different ways. At a more theoretical level, Bakos and Katasamas (2008) point to the effect of vertical integration on the incentives of a platform to bias the design in favour of one side or the other.

[36] An interesting example of efficient bundling is the ability to solve the issue of buyers moral hazard by bundling a well designed payment system with the matching service (see for example the BtoC website PriceMinister).

[37] Bundling may of course serve more traditional price discrimination purposes. The reader is refered to Jullien (2006) for an informal discussion of bundling in the context of e-procurement.

[38] A noticeable exception is Damiano and Li (2008).

5.4 Vertical integration and ownership

Vertical integration is a common feature of BtoB platforms and one that is important for two reasons.[39] First, vertical integration is one way to reach a critical size on one side, thereby gaining enough credibility to convince other agents to join the platform. Second, vertical integration leads to internalization of the surplus of the integrated buyers or sellers. It thus affects the pricing strategy of the platform and may lead them to be more aggressive in attracting new members.[40] Moreover entry by integrated platforms may be more difficult to deter than entry by independent platforms, as shown for instance by Sülzle (2009). Another issue relates to the distribution of ownership which is discussed by Nocke, Peitz and Stahl (2007), where it is shown that for strong network effects, an independent concentrated ownership dominates in terms of social welfare dispersed ownership as well as vertical integration with a small club of sellers.

5.5 Sellers' investment

While most contributions assumes the products are exogenous, some discuss the link between the platform's strategy and that sellers' quality choices. Belleflamme and Peitz (2010) analyze sellers pre-affiliation investment with two competing platforms. They compare open access platforms with for-profit pay platforms and conclude that investment incentives are higher in the latter case whenever sellers' investment raises consumers surplus to a sufficient extent (the precise meaning of "sufficient" depends on the single-homing/multihoming nature of participation on both sides). Hagiu (2009) shows that charging transaction fees may help a platform fostering sellers' pre-affiliation investment incentives (the argument follows from Hagiu (2004) discussed in section 3.2). Hagiu (2007) argues that a two-sided platform may outperform traditional buy-and-resell intermediation when sellers must invest to raise consumers utility after the affiliation/wholesale decisions are made.

6 Conclusion

On-line intermediaries can be seen as platforms where trading partners meet and interact. The literature on two-sided markets provides a useful perspect-

[39] This is usually referred as biased marketplaces, see Kaplan and Sawheny (2000). As an example *Covisint* is jointly owned by car manufacturers Daimler, General Motors, Ford and Renault-Nissan.

[40] See Yoo et al. (2007).

ive on the business strategies by focusing on two-sided network externalities and their implications for tariffs and competition. Beyond the overall price level, it is the entire price structure that matters and the literature helps understanding how the prices are affected by indirect networks effects. A key lesson is that prices should and will involve some form of cross-subsidy. Typically, the platform should court more the low externality side than the other. Moreover, unlike one-sided activities, competition exacerbates the tendency to cross-subsidy. Multi-homing may improve efficiency, but has the potential adverse effect of softening competition.

Much remains to be understood about competition, in particular due to the lack of a tractable well articulated model of dynamic competition. In particular the literature so far does not provide a clear view on barriers to entry. While the analysis of divide&conquer strategies suggests that there are opportunities for new entrants, these strategies may be excessively risky and not sustainable. Moreover issues of reputation and coordination point to the existence of barriers to entry akin to those encountered in network competition.

As pointed out by Jullien (2000), the intensification of competition generated by indirect network effect suggests that there are particularly strong incentives for platforms to escape competition through differentiation and excessive market segmentation, although little is known about the determinants and the nature of platform's product design. And among the various topics for future researches mentioned in the text, the most exciting and novel concerns the linkage between design and business models.

To conclude, while the literature has been concerned with antitrust implications, it has delivered few concrete recommendations for policy intervention. One of the challenge for the coming years will then be to develop models helping policy makers to deal with mergers and other antitrust issues in two-sided markets.

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