Defining Two-Sided Markets

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Abstract

We propose a general definition of "two-sided markets," identify the conditions under which a market is indeed two-sided, and, finally, discuss why two-sidedness matters for business and public policies.

1 Introduction

There has been a recent surge of interest in two-sided markets. Two-sided (or more generally multi-sided[1]) markets are *roughly* defined as markets in which one or several platforms enable interactions between end-users, and try to get the two (or multiple) sides "on board" by appropriately charging each side. That is, platforms court each side while attempting to make, or at least not lose, money overall.

Examples of two-sided markets readily come to mind. Videogame platforms such as Atari, Nintendo, Sega, Sony Play Station, and Microsoft X-Box, need to

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[1]We focus on two-sided markets for expositional simplicity. Many markets or platforms are multi-sided, though. Consider a standard-setting organization attempting to convince a group of patent owners to join forces in order to establish a standard. It must obtain enough commitments from these owners (reasonable royalties, exact implementation of the technology, treatment of future innovation, etc.) in order to convince various potential users (eg. consumer electronics, and software companies) to invest in the technology, while also make it attractive for each and every intellectual property owner to get on board. The insights obtained for two-sided platforms apply more generally to multi-sided ones.

attract gamers in order to convince game developers to design or port games to their platform, and need games in order to induce gamers to buy and use their videogame console. Software producers court both users and application developers, client and server sides, or readers and writers. Portals, TV networks and newspapers compete for advertisers as well as "eyeballs". And payment card systems need to attract both merchants and cardholders. There are many other two-sided markets of interest,[2] only a few of which will be mentioned in this note.

But what is a two-sided market and why does two-sidedness matter? On the former question, the recent literature has been mostly industry specific and has had much of a "You know a two-sided market when you see it" flavor. "Getting the two sides on board" is a useful characterization, but, as we argue, it is not restrictive enough. Indeed, if the analysis just stopped there, pretty much any market would be two-sided, since buyers and sellers need to be brought together for markets to exist and gains from trade to be realized. Similarly firms could be viewed as two-sided markets to the extent that they bring together input suppliers (workers) and output users (consumers).

A more useful definition requires making a distinction between the *price level*, defined as the total price charged by the platform to the two sides, and the *price structure*, referring to the decomposition or allocation of the total price between the buyer and the seller.

Price levels in two-sided markets are determined by standard considerations, including demand elasticities and platform competition. By contrast, underlying the recent surge of academic interest in two-sided markets is the widespread belief among economists and public and private decision makers that the price structure affects profits and economic efficiency as well. Managers devote considerable time

[2]See, e.g., Armstrong (2002), Evans (2003) and Rochet-Tirole (2003).

and resources to figure out which side should bear the pricing burden, and commonly end up making little money on one side (or ever using this side as a loss-leader) and recouping their costs on the other side. Policymakers also seem to strongly believe in the importance of the price structure. The monitoring of termination charges in telecommunications (and soon the Internet) and antitrust involvement in the computation of interchange fees in payment systems reflect this belief: That the locus of intervention is the price structure proceeds from the premise that economic efficiency can be improved by charging more to one side and less to the other relative to what the market delivers.

Private and public decision makers on the other hand would be wasting their time if the price structure were neutral, that is, if a price reallocation between the two sides had no impact on economic outcomes. Non-neutrality, though, is not a foregone conclusion. Econ 101 students learn that for a given level of VAT, it does not matter who, of the merchant and the consumer, is charged for it: The transaction price between the two parties adjusts accordingly.

A necessary condition for a market to be two-sided is that the Coase theorem does not apply to the relation between the two sides of the markets: The gain from trade between the two parties generated by the interaction depends only on the total charge levied by the platform, and so in a Coase (1960) world the price structure is neutral. As we will see, the failure of the Coase theorem to apply is not sufficient for the price structure to matter, though. We accordingly identify the conditions that do make a market two-sided.

Conceptually, the theory of two-sided markets is related to the theories of network externalities and of (market or regulated) multi-product pricing. From the former, it borrows the notion that there are non-internalized externalities among

end-users.[3] From the latter, it borrows the focus on the price structure and the idea that price structures are less likely to be distorted by market power than price levels. The multi-product pricing literature, however, does not allow for externalities in the consumption of different products: To use a celebrated example, the buyer of a razor internalizes in his purchase decision the net surplus that he will derive from buying razor blades. The starting point to the theory of two-sided markets by contrast is that an end-user does not internalize the welfare impact of his use of the platform on other end-users.

This note is organized as follows: Section 2 introduces platforms, service providers and end-users as well as the general setting. Section 3 defines one- and two-sided markets. Section 4 identifies sufficient conditions for two-sidedness. Section 5 lists some pricing principles for two-sided platforms. Section 6 argues that the platforms' balancing act in general involves more than the choice of a price structure, in that platforms also regulate commercial interactions (price, identity of participants, and competition intensity) as they are led to (at least partly) internalize externalities among end-users. It also shows that policies adopted by two-sided platforms are radically different from those that are optimal under the "vertical view" of markets, in which the platform supplies an input to sellers who then deal with buyers (so the platform interacts with only one side of the market). Section 7 summarizes our main conclusions.

2 Platforms, service providers and end-users

Suppose that there are potential gains from trade in an "interaction" between two end-users, whom for convenience we will call the buyer (B) and the seller (S). A

[3]The theory of network externalities has largely ignored price structure issues, as well as many of the themes of the two sided-market literature such as multi-homing (focusing on the design of converters by platforms rather), or the control of interactions among end-users.

platform enables or facilitates the interaction between the two sides provided that they indeed want to interact. We neglect the fixed costs incurred by the platform and normalize its per-interaction cost to zero. The interaction can be pretty much anything, but must be identified clearly. In the case of videogames, an interaction occurs when a buyer (gamer) plays a game developed by a seller, using the console built by the platform. Similarly, for an operating system (OS), an interaction occurs when the buyer (user) uses an application built by the seller (developer) on the platform. In the case of payment cards, an interaction occurs when a buyer (cardholder) uses his card to settle a transaction with a seller (merchant).[4] The interaction between a "viewer" and an advertiser mediated by a newspaper or a TV channel occurs when the viewer reads the add. The interaction between a caller and a receiver in a telecom network is a phone conversation and that between a website and a web user on the Internet is a data transfer.

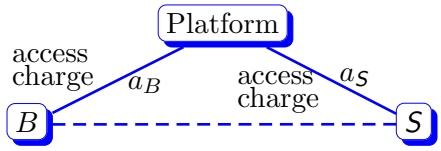

Figure 1: direct connections

As depicted in Figure 1, the platform charges a price or access charge a_S to the seller and a_B to the buyer for enabling the interaction. For example, American Express charges a merchant discount (say, 2% of the item's price for illustrative purposes) to the merchant, and so $a_S > 0$, while the buyer pays nothing for using the American Express card: $a_B = 0$.[5]

[4]The outside option for both users, which provides a benchmark for a surplus analysis, is to settle the transaction in cash or with a check.

[5]$a_B < 0$ if the customer receives frequent flyer miles or cash-back bonuses.

The benchmark described in figure 1 is too simplistic for several reasons:

- First, the platform may charge interaction-independent *fixed fees* $A_{\mathcal{S}}$ and A_B. For example American Express charges yearly fees to cardholders ($A_B > 0$). In the case of videogames, platforms charge game developers fees for development kits ($A_{\mathcal{S}} > 0$) on top of royalties per copy sold ($a_{\mathcal{S}} > 0$); they charge gamers for the videogame console ($A_B > 0$). For Windows, Microsoft charges a usage-independent fee to consumers ($A_B > 0$) but no variable fee ($a_{\mathcal{S}} = a_B = 0$). We will later argue that these fixed fees as well as the fixed investment costs incurred by the end-users (as for example the software development costs incurred by developers) are one of the major factors of non-neutrality.

- Second, end-users may connect to the platform through intermediaries or "service providers", depicted by $\mathcal{B}$ and $\mathcal{S}$ in figure 2. For example, Visa card or MasterCard holders and merchant affiliated to these two payment platforms are served by service providers called "issuers" and "acquirers", respectively. The merchant's bank, the acquirer, pays an interchange fee $a_{\mathcal{S}}$ to the cardholder's bank, the issuer, and so $a_{\mathcal{S}} = -a_B > 0$.[6] Now the interaction costs perceived by the end-users, $\hat{a}_B$ and $\hat{a}_{\mathcal{S}}$ in the figure, depend on the commercial conditions offered by the intermediaries, and coincide with a_B and $a_{\mathcal{S}}$ only under conditions of perfect competition among service providers.[7]

Figure 2: connection through service providers

[6] We here ignore "system fees", which are fees paid to the credit card associations in order to cover the associations' capital and operating costs. The reason why $a_{\mathcal{S}} = -a_B$ is that Visa and MasterCard are not-for-profit.

[7] Assuming the latter incur no per-interaction cost. If they do, add these costs onto a_B and $a_{\mathcal{S}}$ to obtain $\hat{a}_B$ and $\hat{a}_{\mathcal{S}}$ under perfect competition.

Another illustration of indirect connection through service providers is the organization of the telecommunications and the Internet industries. There, $\mathcal{B}$ and $\mathcal{S}$ should be interpreted as telecommunications operators in the case of telecommunications and, say, backbones in the case of Internet.[8] The similarity with the payment card associations requires some elaboration. In the telecommunications and Internet applications, there is no natural "buyer" and "seller". There is a flow of communication between a caller and a callee, or from a website to a web user. The object to study is the particular communication between the two end-users. One of them (the caller, the website) is technically at the origin of the connection and can, purely by convention, be labeled $\mathcal{S}$; the other (the receiver, the web user) is labeled B. To the extent that $\mathcal{S}$ and B are on two different but interconnected networks $\mathcal{S}$ and $\mathcal{B}$, the latter have an agreement for terminating the connection initiated on the former. This agreement specifies a (per minute or per megabyte) termination charge $a_{\mathcal{S}} = -a_B > 0$ to be paid by network $\mathcal{S}$ to network $\mathcal{B}$. The networks $\mathcal{B}$ and $\mathcal{S}$ then pass through this termination charge or revenue to the end-users in the form of per minute calling and receiving charges or outgoing and incoming traffic fees. Note that the "platform" in this case is entirely virtual, or else can be viewed as the mechanism recording off net traffic and operating settlements.

• Third, and to the extent that end-users use service providers, these service providers (e.g., $\mathcal{P}_2$ in Figure 3) may in some instances connect two end-users ($\mathcal{S}$ and B_2), without needing to interact with other service providers (such as $\mathcal{P}_1$). Such interactions are called "on us" interactions in the case of payment cards and then correspond to the case in which the same bank is both the customer's issuer and the merchant's acquirer. Similarly, a telephone operator may serve both the caller and the callee, and the backbone serve the website and the web user; the

[8] In fact, there are often multiple layers of intermediaries, for example an ISP between the end-user and the backbone.

traffic is then said to be "on net".

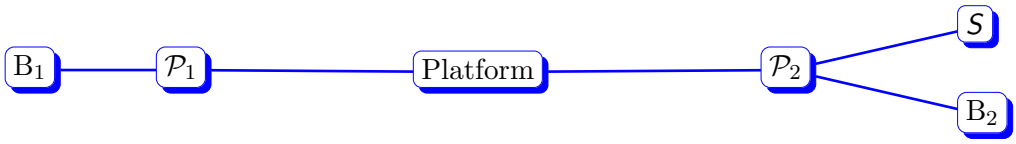

Figure 3: "on us" or "on net" interactions

A similar situation arises when the seller of a house sells through a real estate agency (the platform), but keeps the right to sell the house independently. There is then a chance that the interaction between the buyer and the seller does not occur through the platform.

• Fourth, there may be multiple non-interconnected platforms. For example, in the absence of common listing, the seller of a house may want to enter non-exclusive arrangements with multiple real-estate agencies in order to reach a wide range of potential buyers; alternatively the buyers may deal with multiple real estate agencies. Videogame developers may port their game to several game platforms. More generally, software developers often multi-home to competing but incompatible software platforms. Or, because different payment card systems are not interconnected (a Visa cardholder cannot use her card at a merchant that accepts American Express or MasterCard, but not Visa), merchants often accept and consumers often hold multiple cards. More generally, multi-homing by at least one side of the market is necessary for gains from trade to be reaped when platforms are incompatible or not interconnected.

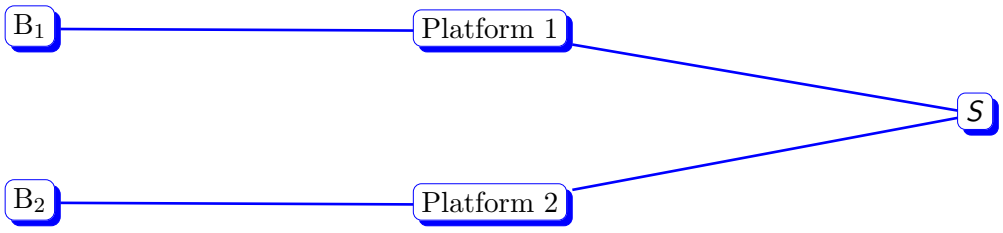

Figure 4: multi-homing

Finally, we should distinguish between for-profit and not-for-profit platforms. The latter must balance their budget and so charge per-interaction fees a_B and a_S such that $a_B + a_S = 0$. This applies to a payment card association for example, and, as we have seen, in a more subtle way to telecommunications and Internet interconnection arrangements, which can be analyzed as a special case of a not-for-profit (fictitious) platform.

3 One- and two-sided markets

3.1 A definition

In a first step, we restrict attention to the case in which the platform levies *linear*, i.e., per transaction, charges.

Definition 3.1 *Consider a platform charging per-interaction charges a_B and a_S to the buyer and seller sides. The market for interactions between the two sides is one-sided if the volume D of transactions realized on the platform depends only on the aggregate price level*

$$a = a_B + a_S,$$

i.e., is insensitive to reallocations of this total price a between the buyer and the seller. If by contrast D varies with a_B while a is kept constant, the market is said to be two-sided.

3.2 Examples of one-sided markets

It is easy to see that not all markets in which a platform stands in between the two interacting sides are two-sided. This subsection provides a few illustrations.

a) *VAT.* A government levying a value-added or excise tax on a transaction between a merchant and a consumer can be viewed as a platform (with the specificity that

the use by end-users of the platform is not motivated by the platform's enabling or facilitating their trade, but results from the State's coercive power). It is well known that the allocation of the tax between the seller and the buyer (think for example about taxes on real estate transactions) is economically irrelevant. If the government increases the tax on the seller side and reduces that paid by the buyer by an equal amount, the price charged by the seller increases by this amount, whether or not the market is perfectly competitive.

b) *Neutrality in payment systems.* The choice of an interchange fee paid by the merchant's bank, the acquirer, to the cardholder's bank, the issuer, is irrelevant if the following conditions are jointly satisfied: First, issuers and acquirers pass through the corresponding charge (or benefit) to the cardholder and the merchant.[9] Second, the merchant can charge two different prices for goods or services depending on whether the consumer pays by cash or by card; in other words, the payment system does not impose a no-surcharge-rule as a condition for the merchant to be affiliated with the system. Third, the merchant and the consumer incur no transaction cost associated with a system of double prices for each item.[10]

c) *Bilateral electricity trading with injection and withdrawal charges.* Consider an electricity market run by bilateral contracts between generators and customers (large industrial customers and load-serving entities), and in which generators pay a variable (per MWh) fee for injecting their power in the transmission system and customers pay a variable (per MWh) fee for withdrawing electricity from the system. Such fees are used to cover the fixed cost of running the transmission system. This description is a rough approximation of the current electricity market in Eu-

[9] This is also true if the issuer and the acquirer charge two-part tariffs to their customers, as long as the variable price reflects their per-interaction cost one-for-one.

[10] An early result along these lines is in Rochet-Tirole (2002). The broad generality of the proposition has been demonstrated by Gans and King (2003).

rope.[11] As in the case of the VAT, a buyer and a seller, when bargaining for a bilateral energy trade, should then take into account only the total fee paid to the transmission system.

d) *Telecom charges when caller and receiver side-contract.* A caller and a receiver who could operate side transfers among themselves would choose the length of their communication solely as a function of the total per minute charge levied on them by their service providers. If the two end-users are connected to two different platforms or more generally if they face different per minute charges (say, because they have selected different plans), they must further be able to bargain on who will call, so as to minimize the total variable charge. By contrast, if say the communication between a fixed link and a mobile phone is mainly paid by the mobile customer, and no side transfer is possible, then the latter will be reluctant to disclose his number[12] and will keep conversations short.

e) *Firms.* Last, we address the subtle question of whether firms are two-sided platforms. As noted earlier, firms can be viewed as bringing together input suppliers and output consumers. Consider a competitive widget industry, in which one unit of labor is required to produce one widget. A firm then chooses $a_{\mathcal{S}}$, the "workers' access fee" to the platform, that is minus the wage of the workers, and a_B, the per-unit price of its widgets. According to our definition 3.1, the firm is indeed a two-sided platform: If it lowers its wage and reduces its widget price by the same amount, its customers will not be able to redeem their cost saving and compensate the workers[13] (the end users do not meet, let alone bargain!). We would argue,

[11] End-users also often pay fixed (volume-insensitive) connection charges, though.

[12] Except to family and close acquaintances, with whom such side transfers (usually non-monetary ones) do exist.

[13] Similarly, a university must decide on how to allocate its budget between hiring prestigious, but expensive faculty and focusing more on student-related expenditures; the outcome of this cost allocation is unlikely to be neutral.

though, that, at least in competitive environments, firms are often *de facto* one-sided platforms, in that there is little "wriggle room" for them to manipulate the price structure: If they lower the wage, workers will leave, and if they raise their price, consumers will go to other suppliers.[14]

4 Relationship to the Coase theorem and conditions for two-sidedness

The Coase theorem states that if property rights are clearly established and tradeable, and if there are no transaction costs nor asymmetric information, the outcome of the negotiation between two (or several) parties will be Pareto efficient, even in the presence of externalities. Coase (1960)'s view is that if outcomes are inefficient and nothing hinders bargaining, people will get together and negotiate their way to efficiency. Because in the context of buyer-seller interaction mediated by a platform, the gains from trade between the two end-users depend on the price level, but not its allocation, the latter has no impact on the volume of transactions, the platform's profit, and on social welfare in a Coasian world. *The business and public policy attention to price structure issues is then misguided.*

The Coase theorem is a useful benchmark. In practice, though, various factors make it unlikely that the two parties will reach an efficient agreement from their perspective (so efficiency refers to their joint surplus, and not to social surplus: In the applications at hand, it does not include platform profit or externalities on other end users, say). As Section 4.1 shows, the following two statements are not equivalent:

(1) The end-users cannot reach an efficient outcome through bargaining.

(2) The platform's price structure choice is non-neutral.

[14] If w and p are the market wage and price, then the constraints $|a_S| \geq w$ and $a_B \leq p = w$, together with the non-negative-profit condition $a_S + a_B \geq 0$ do not allow the firm to manipulate the price structure.

That is, (1) is necessary, but not sufficient for (2).

4.1 Asymmetric information

One standard reason for why the negotiation between two parties may break down despite the existence of gains from trade is that parties have different views as to the size of these gains from trade. Parties to a negotiation try to get the best for themselves, and under imperfect information about what the other side can bear, may prove too greedy.[15]

Asymmetric information often implies a suboptimal volume of trade.[16] Yet it per se does not imply that the market is two-sided. Actually, unless at least one of the other assumptions underlying the Coase theorem is relaxed, the platform's price structure is still neutral. This can be easily seen in a model of bilateral trade à la Myerson-Satterthwaite (1983). When the seller's access charge is increased by Δa and the buyer's access charge is reduced by the same amount, the bargaining strategies of the two parties remain the same, except that they are "shifted by the constant Δa". When making offers the seller demands an amount equal to what he was demanding earlier in similar circumstances (an amount that depends on the seller's actual cost of selling to the buyer and on the history of the bargaining process), augmented by Δa. Similarly, the buyer shades his price offers systematically by Δa.[17] Bargaining is inefficient, but the market is one-sided nonetheless.

[15] This is the same reason why monopoly pricing in general imposes a deadweight loss. Under imperfect information about consumers' individual preferences, the monopoly trades off efficiency (a high volume of trade) and rent appropriation (through a high mark-up).

[16] See the literature on bargaining under asymmetric information as well as Myerson-Satterthwaite (1983). Farrell (1987) discusses institutional implications of a failure of the Coase theorem due to informational asymmetries.

[17] Technically, consider a general sequential bargaining game between the buyer and the seller, in which the two parties make offers to each other and respond to these offers in a specified order, and in which the transaction occurs only when one party has accepted the other party's offer. Then, the set of perfect Bayesian equilibria in the game indexed by access charges $(a_S + \Delta a\,,\, a_B - \Delta a)$ is isomorphic to the set of perfect Bayesian equilibria of the game with access charges $(a_S\,,\, a_B)$ in that an equilibrium in the former game and the associated equilibrium in the latter game yields the same economic allocation (including expected payoffs and expected discounted volume of trade): (history- and type-contingent) offers are

4.2 Transaction costs

For an increase in the share allocated to the seller, say, to matter, it must be the case that the seller cannot pass the increase in his cost of interacting with the buyer through to the buyer. This is obviously the case for standard telecom networks, where there is no monetary transaction between the caller and the receiver. In other cases monetary transactions are technically possible but transaction costs may hinder this pass-through. Consider for example an arrangement in which websites pay for their (mainly) outgoing traffic.[18] As the variable charge for outgoing traffic increases, websites would like to pass this cost increase through to the users who request content downloads. A problem with this is that downloads are requested by thousands or millions of users, and that the corresponding payment by the end user would be very small, for example not sufficient to vindicate the costs for the website to set up a credit-card-payment system and especially for the user to give the credit card number and necessary information and to experience anxiety about potentially fraudulous use of the card by unknown people. Such concerns of course do not arise if most of the download is already part of commercial transactions, as in the case of the licensing of a music file. By contrast, an increase in their cost of Internet traffic could induce websites that post content for the convenience of other users or that are cash-strapped, to not produce or else reduce the amount of content posted on the web, as they are unable to pass the cost increase onto the other side.

translated upward by Δa for the seller and downward by Δa for the buyer and the (history- and type-contingent) acceptance / rejection decisions are unchanged provided that new types are defined (so a seller of cost c in the latter game has fictitious type $c + \Delta a$ in the former game, and similarly for the buyer).

A more limited result along similar lines can for example be found in Tirole (1986), in which a seller bargains with a buyer under the constraint that the seller will have to pay a cancellation fee to the buyer in case of non-delivery.

[18] They currently do, but the charge is for the moment limited by the fact that the backbones have for the most part not charged each other for terminating traffic. Such "bill-and-keep" agreements (in the notation of figure 2, $a_B = a_S = 0$) reallocate the cost of Internet traffic somewhat from those who request downloads to those whose content is downloaded.

Another illustration of the impact of transaction costs is provided by countries in which merchants are not prohibited by credit card systems from charging different prices for cash and card payments (for example, US merchants can offer "cash discounts", although they cannot impose "card surcharges"!). In practice, very few differentiate their prices despite their repeated complaints (and lawsuits such as the recent Walmart case) that interchange fee are excessive.

4.3 Transaction-insensitive end-user costs

4.3.1 Non-neutrality

A key source of non-neutrality of the price structure is the existence of transaction-insensitive end-user costs. These include fixed fees levied by the platform as well as technological fixed costs on the user side. For example, a software developer incurs both a fixed payment for the development kit and attendance at trade shows and a fixed cost of developing the software. The dividing line between the two transaction-insensitive costs is sometimes a bit unclear: A software platform may try to attract software developers by charging a low price for the development kit (a fixed fee) and/or by giving away software development support or designing developer-friendly APIs. On the other hand, only the total transaction-insensitive cost matters for the end-user, and so we need not be concerned by our making this artificial distinction between fixed fees and fixed technological costs.

Thus under transaction-insensitive costs, the allocation of fixed fees between buyers and sellers matters unless small changes in fixed fees leave memberships (the set of end-users who decide to incur the transaction-insentive costs) invariant on both sides, a rather unlikely situation. There is no way in which an increase in the buyers' fixed fee A_B, say, can be passed through to the sellers. When the two sides transact ex post, fixed costs are sunk and therefore irrelevant. This implies

for example that an increase in A_B compensated by a decrease in A_S computed so as to keep the platform's profit constant in general changes the volume of trade and social welfare. Fewer buyers will find the platform attractive, although this effect is somewhat alleviated by the prospect of being able to transact with more sellers; and conversely for the sellers.

The non-neutrality of fixed fees is most dramatically illustrated by the following extreme but telling example, due to Wright (2003): Suppose that consumers all derive some per transaction surplus v from the convenience of paying merchants by card rather than by cash; and that merchants are discouraged neither by transaction costs nor by a card system's non-discrimination rule from charging different prices for card and cash payments. Consider a merchant (a monopolist, to simplify the exposition) selling a merchandize with value V (when purchased by cash) to consumers. It is optimal for this merchant to charge V for cash payments and $V + v$ for card payments. Thus a cardholder obtains no transaction-specific surplus from holding a card. If she must pay a yearly fee or incurs a transaction cost from applying for a card, she does not want to hold a card in the first place; the corresponding "investment" is then "held up" ex post by the merchants' surcharge (to use Williamson (1975)'s terminology).[19]

[19]By contrast, the allocation of the variable fees a_B and a_S keeping the total variable fee $a = a_B + a_S$ constant is still neutral, provided that there are no transaction costs that install grains of sand in the pass-through mechanism. First, the volume of ex post transactions is insensitive to the variable-fees allocation for given membership levels. Second, the split of the total end-user surplus between the two sides can be shown to be unaffected by the allocation of the total variable fee; membership on either side is therefore unchanged.

4.3.2 Platforms' motivations for charging fixed fees

In practice, platforms have several motivations to recoup their costs (and perhaps make a profit) by levying fixed fees.[20]

a) *Not taxing the interaction is a response to an agency cost on the platform's side*

The platform may shy away from proportional pricing if the latter gives it perverse incentives. Real estate agencies usually charge a percentage of the sale price. Apparently, such pricing seems to fit in the variable-pricing, transaction-specific category. Except that the "interaction" does not correspond to the actual service provided by the real estate agency: The latter's mission is to find potential matches for the buyer (and possibly the seller who may care about the identity of the buyer for solvency, environmental, or other reasons), and to show and provide information about these matches. Charging an overall fixed fee cum a per-visit charge would therefore seem to make more sense, since the service provided by the real-estate agent is not the sale per se. On the other hand, such a pricing structure would create moral hazard (or adverse selection) concerns for the end-users. Under a fixed fee, the real estate agency might put too little effort into finding good matches. Under a "per visit fee", the real estate agency would probably show houses that are of low interest to the buyer. Charging the buyer and the seller on the basis of a proxy of quality rather than the service itself is an attempt to alleviate the end-users'concern.[21]

[20] This, together with the fact that end-users often incur fixed technological costs, implies that non-neutrality is the rule more than the exception even in the absence of transaction costs or platform-designed constraints.

[21] See Schwartz-Werden (1996) for another illustration of how an agency problem on the manufacturer side can affect pricing strategies. In that paper, the manufacturer of a durable good charges for usage rather than the purchase of the initial equipment, solely to signal to its customers that they will like the product and therefore use it much.

b) *The platform is unable to tax the interaction properly*

The interaction between the end-users may not be perfectly observed, as illustrated by the case of a dating club. More generally, even if a transaction is observed, it may not be the entire transaction. Buyers and suppliers may find each other and trade once on a B2B exchange, and then bypass the exchange altogether for future trade. Or they can underreport the trading price and operate side transfers. The platform's ability to tax transactions depends on how much anonymity it can impose on trades. Another case in point is advertising. The actual "transaction"-namely whether the reader carefully reads the ad, thereby generating potential sales- is not observed.[22] The media's purchase price and the advertizing fees can be viewed as fixed costs relative to such individual transactions.

c) *Fixed fees may be an efficient way of taxing end-users*

As is well-known from the price discrimination and Ramsey pricing literatures, it is often efficient (both privately and socially) to recoup the platform's fixed cost (say, the cost of writing the platform's software) through charges on both the variable use of the platform and on general access to the platform.

d) *Fixed fees may enable the platform to capture end-user surplus*

Suppose that a software platform is concerned with independent developers' exercising market power over platform users (Hagiu 2004). The platform can reduce the price of applications through a proportional subsidy on applications. This policy, while encouraging efficient trade, is costly to the platform and may leave large surpluses to both application developers and consumers. Fixed fees levied on both sides are ways of capturing the end-user surpluses and of enabling subsidization.

[22]To be sure, there have always been attempts at measuring these. For example, the seller may ask the buyer to refer to the newspaper or magazine where the buyer learnt about the product. On the web, there have been some attempts at measuring the "eyeball"'s path of clicks ; and referral payments are now common.

4.3.3 Are network externalities required for two-sidedness ?

Fixed end-user costs not only make the platform's pricing structure non-neutral; they also give rise to a network externality: A buyer is more likely to pay his fixed cost if more sellers are present on the other side, and conversely. But two-sidedness is a broader concept than network externalities. It is more generally about situations in which externalities are not internalized and a platform can play with the price structure so as to limit the impact of the externalities.

That network externalities are not required for two-sidedness is illustrated by a mature telecommunications market in which everyone has a phone, but caller and receiver charges matter because the callers and receivers don't get to bargain efficiently to determine the charge allocation between themselves, and so the use of the system depends on the price structure. Similarly, payment systems may be mature, but give rise to externalities. In such examples, the externality is at the level of individual transactions, rather that in the overall decisions of whether to connect to the platform.

4.4 Prohibition or constraint put by the platform on the pricing of transactions between end users

Another situation in which end users fail to haggle or set a price for their transaction arises when the platform prohibits them from doing so. A prominent case in point is a non-discrimination rule imposed by a payment system (the merchant's price must be the same whether the customer uses cash or a card).

In fact, this rule is just an illustration of the many ways in which platforms regulate the interactions between end-users. We postpone to section 6 the discussion of the associated issues.

5 Pricing principles for two-sided platforms

This section briefly reviews a few factors that affect prices charged to end-users and stresses the departures from standard business strategies that result from the platform's internalization of the other side's welfare (the linkage between the two sides from the platform's viewpoint). This linkage is most apparent when the platform makes no or loses money on one side. For example, media platforms usually give away newspapers or free TV programs not to prey on rival platforms, but to be able to charge higher markups to advertizers.

a) *Elasticities.* In Rochet-Tirole (2003) we show that demand elasticities on both sides of the market are an essential determinant of the pricing policy of platforms.[23] A factor affecting elasticities on a given side is the size of the installed base of end-users on that side. When, say, the number of captive buyers increases, the buyer price a_B naturally increases, and the seller price a_S decreases as attracting sellers yields a higher collateral profit on the buyer's side.

b) *Relative market power of service providers*: If end-users are served through intermediaries (as in figure 2), the platform may try to "undo" the intermediaries' market power by charging lower access charges. So, for example, if service providers charge an important markup to buyers, the platform ought to reduce a_B so as to limit double marginalization on that side, and increase a_S (as offering surplus to buyers by enlisting sellers becomes relatively less attractive).

c) *Surplus created on the other side*: Attracting one side by lowering access fees is particularly profitable for the platform if this side creates substantial externalities on the other side. For example, "marquee buyers" are courted as they allow platforms

[23] Surprisingly at an interior solution, monopoly platforms should charge more to the more elastic side. Bolt and Tietman (2003) show that the reverse may be true for corner solutions.

to charge high prices to sellers.[24]

d) *Platform competition and multi-homing.* Platform competition may have ambiguous consequences on the price structure. Suppose for example that a fraction of buyers multi-home (connect to multiple platforms). On the one hand, the elasticity of buyers' demand for a given platform increases, due to their ability to switch to a competing platform. On the other hand, the elasticity of sellers' demand is corrected by what Rochet-Tirole (2003) calls the "single-homing index". Roughly speaking, buyers' multi-homing allows platforms to "steer" sellers, i.e., to induce them to opt out of the competing platforms. The smaller the single-homing index of buyers, the higher the incentive for platforms to steer sellers. Platform competition thus creates downward pressure on prices on both sides of the market, and the impact on relative prices is ambiguous.[25] In particular, platform competition does not necessarily lead to an efficient price structure.

e) *Bundling.* Platforms offering several types of interaction services may benefit from bundling them. For example, payment card associations Visa and MasterCard offer both debit and credit cards and, until recently, used to engage in a tie-in on the merchant side through the so-called honor-all-cards rule. In Rochet and Tirole (2004) we show that the motivations for tying in two-sided markets are different from the usual ones in classical markets (e.g., price discrimination or entry deterrence). In a two-sided market, tying may allow platforms to perform better the balancing act between buyers and sellers, and is not necessarily detrimental to social welfare.

[24] See Rochet-Tirole (2002) for details.

[25] For linear demands, though, platform competition does not alter the price structure; so, for example, competition among not-for-profit associations (for which the break-even-constraint fixes the price level) does not alter prices under linear demands.

6 The regulation of interactions between end-users

We have seen that payment card platforms often try to discourage merchants from charging cardholders for card usage; and that a platform may want to subsidize sales of applications built around the platform (Hagiu 2004). This section documents how platforms more generally woe end-users not only through the tariffs $\{a_i, A_i\}_{i=1,2}$ they charge them,[26] but also by regulating interactions between these end-users. That is, platforms must perform a balancing act with respect to their price structure as well as other policy dimensions; quite generally, they encourage positive externalities and discourage negative ones and to do so usually constrain one side to the benefit of the other.

In reviewing platform regulation of interactions among end-users, it will prove useful to compare platform choices with those that would prevail under a more standard *vertical view*, in which the platform would interact with only one side (say, the seller side) and have no direct interaction with the other side (say, the buyer side): see figure 5.

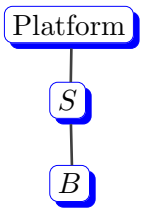

Figure 5: vertical view

[26] In matching markets, the platform can also alter the distribution of the surplus between end-users through the choice of auction design. On this, see Bulow-Levin (2003) and Damiano-Li (2003).

6.1 The platform as a price regulator

While asymmetric information and the concomitant rent extraction concerns keep the platform's price structure neutral (section 4.1), it is nonetheless a source of sub-optimal trade among end-users. Thus, if the seller side, say, has market power over the buyer side as in Wright (2003) and Hagiu (2004)'s papers, buyers derive too small a surplus from joining the platform. The platform then has an incentive to cap (Wright) or alter through a subsidy (Hagiu) the price charged to buyers so as to boost buyers' surplus and their willingness to join the platform. It then behaves pretty much like a public utility commission that addresses a market power problem by setting a price cap or by subsidizing some services through a fund levied from other services.

Two remarks here. First, the rationale for constraining the price charged by the seller to the buyer would vanish if the industry were organized according to the vertical view: Were the platform not to deal directly with buyers, the platform would want to provide sellers with the maximal profit and therefore would grant them maximal commercial freedom.[27] It is only because the platform can extract surplus on the buyer side that it is willing to "displease" the seller side by constraining it.

Second, given that interactions between end-users often exhibit monopoly or monopsony power, it is perhaps surprising that platforms do not always attempt to regulate transaction prices between end-users. There are, however, good (and standard) reasons for laissez-faire as well: The platform may not be able to price discriminate as well as the price-setting end-user. Or, in situations in which an end-user, e.g., an application developer, sinks a substantial investment cost and in

[27]The reader may here object that under the vertical view the platform may impose resale price maintenance on the sellers so as to avoid double marginalization. But RPM is then (at least under symmetric information between platform and sellers) only a substitute for a missing non-linearity of the tariff charged to the sellers, and therefore is not an intrinsic feature of the relationship between platform and seller.

which the efficient transaction price varies substantially among applications and so price between end-users should not be fixed by the platform, a laissez-faire policy by the platform is a commitment not to hold up the application developer's investment through an expropriatory price cap on the sale of the application to platform users.

6.2 The platform as a licensing authority

End-users often care not only about the price (that they pay to the platform and to the other side), but also about the quality of the interaction. In some industries, the platform is therefore concerned about the identity of participants, as the latter creates externalities on the other side: Supermarkets do not auction off shelf space to the highest bidder, since the resulting outcome might not bring the desired diversity of brands to the average shopper.[28] Nightclubs, dating agencies, conferences and exchange markets try to avoid rowdy or undesirable types. Medias put at least minimum constraints on advertisers and advertisements so as not to offend their audience. In this respect, platforms resemble regulatory commissions (for example, in banking, finance, electricity or telecommunications) that impose minimum standards on operators in order to spare consumers negative externalities (as when the operator goes bankrupt).

Again, such non-price discrimination would be meaningless under the vertical view: A platform that would not internalize buyer welfare would have no incentive to be picky in the selection of sellers.[29]

[28] Another issue in this case is that a seller's willingness to pay for shelf space depends on how much shelf space and prominent display is purchased by rival brands. So at the very least such auctions should be combinatorial.

[29] At least in a static context. In a repeated purchase context, the platform might care about the impact of seller behavior on its reputation.

6.3 The platform as a competition authority

When price regulation (Section 6.1) is complex or inefficient, the platform may still make itself attractive to one side of the market by encouraging competition on the other side. Competition on the other side brings prices closer to marginal cost, and the volume of interactions closer to the efficient volume; it also protects against the hold up of one's specific investments.

Accordingly, a two-sided platform benefits from allowing competition on a given side as it can at least partly recoup the associated benefits on the other side. Like a competition authority, it therefore cares about the benefits associated to competition (Belleflamme-Toulemonde 2003, Ellison et al 2003). Note, again, that it would not internalize these benefits if he contracted with only one side. In an illustration of the vertical view, a patent owner (the platform) in general grants licenses to one or a small number of licensees (sellers) who then market a final good to consumers (buyers).[30] Were the patent owner able to control access to the final goods and thereby charge consumers for their indirect use of the patent, she would grant licenses much more generously because she could recoup the consumer benefits of competition among licensees. One should therefore expect less foreclosure in a two-sided market than in a vertical environment. This example provides yet another demonstration that the application of standard economic institutions developed in vertical contexts to two-sided markets is misleading.

7 Summary

Let us summarize this note's main points:

a) Because all markets involve transactions between two (or more) parties and therefore could be two-sided markets, it is useful to circumscribe the scope of two-

[30] See Rey-Tirole (2003) for an overview of foreclosure theory and practice.

sided-markets theory. The first objective of the paper has been to propose such a definition: A market is two-sided if the platform can affect the volume of transactions by charging more to one side of the market and reducing the price paid by the other side by an equal amount; in other words, the price structure matters, and platforms must design it so as to bring both sides on board.

b) A necessary (but insufficient) condition for a market to be two-sided is that the Coase theorem does not apply to the transaction between the two sides. That is, the relationship between end-users must be fraught with residual externalities.

c) Factors conducive to two-sidedness include transaction costs among end-users; transaction-insensitive end-user costs (including fixed fees charged by the platform, whether motivated by platform agency problems, unobservable end-user transactions, platform fixed cost recovery, or end-user surplus extraction); and platform regulation of interactions between end-users.

d) Because pricing to one side is designed with an eye on externalities on the other side, standard pricing principles often do not apply. In particular, platform competition does not necessarily lead to an efficient pricing structure.

e) Platforms must perform the balancing act between the two sides along various policy dimensions and not only with respect to the price structure. They therefore often regulate the terms of the transactions between end-users, screen members in non-price related ways and monitor intra-side competition. In all instances, they sacrifice profit by constraining one side to boost attractiveness for and recoup losses on the other side.

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