

The Economics of Two-Sided Markets

Marc Rysman

At a local Best Buy, a child places a new Sony PlayStation 3 on the cashier's counter while the parents dig out their Visa card. The gaming system and the payment card may appear to have little connection other than this purchase. However, these two items share an important characteristic that is generating a series of economic insights and has important implications for strategic decision making and economic policymaking. Both video game systems and payment cards are examples of two-sided markets.

Broadly speaking, a two-sided market is one in which 1) two sets of agents interact through an intermediary or platform, and 2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality. In the case of a video game system, the intermediary is the console producer—Sony in the scenario above—while the two sets of agents are consumers and video game developers. Neither consumers nor game developers will be interested in the PlayStation if the other party is not. Similarly, a successful payment card requires both consumer usage and merchant acceptance, where both consumers and merchants value each others' participation. Many more products fit into this paradigm, such as search engines, newspapers, and almost any advertiser-supported media (examples in which consumers often negatively value, rather than positively value, the participation of the other side), as well as most software or title-based operating systems and consumer electronics. Malls which seek retailers and consumers, convention organizers which seek buyers and sellers, dating services which seek men and women, and *The Journal of Economic Perspectives* which seeks content and readership, all experience the economics of two-sided markets. The multi-sided nature of many Internet and high-technology markets, as well as

■ *Marc Rysman is Associate Professor of Economics, Boston University, Boston, Massachusetts. His e-mail address is <mrysman@bu.edu>.*

new payment systems and media outlets, suggest that two-sided and multi-sided markets are becoming increasingly important.

This paper seeks to explain what two-sided markets are and why they interest economists. I discuss the strategies that firms typically consider, and I highlight a number of puzzling outcomes from the perspective of the economics of two-sided markets. Finally, I consider the implications for public policy, particularly antitrust and regulatory policy, where there have been a number of recent issues involving media, computer operating systems, and payment cards.

What Defines a Two-Sided Market?

The literature on two-sided markets is distinguished by its focus on the actions of the market intermediary. Generally speaking, research in two-sided markets explores choices by market intermediaries, particularly pricing, when there is some kind of interdependence or externality between groups of agents that the intermediary serves. The externality could involve usage or membership. For instance, payment card users care about how many merchants are members of the same card network, not about how much any merchant transacts over the network. In contrast, in picking which networks to accept, merchants care more about which networks consumers actually use rather than which networks consumers hold cards on.

Of course, one-sided markets have intermediaries, too. For example, consider a farmer that sells a product to a grocery store once and does not otherwise interact with the grocer. The grocer then picks a retail price based on inventory and demand. In this one-sided market, the farmer collects the wholesale price and is then indifferent to the success of the grocer in actually selling the good. The distinguishing feature in this case is whether the seller is paid based on the success of the platform with the buying side.¹ Strikingly, one-sided and two-sided selling strategies exist side-by-side at Amazon.com. For some products, like certain new books, Amazon (basically) buys at a wholesale price and sells for a retail price, which is a one-sided model. But for many other products, Amazon provides a web portal for a producer that sets the retail price that a consumer would see. As this distinction often depends on the decisions of the intermediary rather than on purely technological features of the market, it may be better to use the term “two-sided strategies” rather than “two-sided markets.” Regardless, how Amazon

¹ Or should a grocery store be considered a two-sided market? Armstrong (2006, Section 5) provides a formal model of grocery stores as a two-sided market. In his model, the grocery store sets the price per consumer, and the wholesaler is paid based on how many consumers show up. That contrasts with my characterization of a grocery store, in which a wholesaler sells a product for a known sum, the retailer takes possession of the product and sells the product as it wishes, and the wholesaler has no concern for how many units the retailer is able to sell. In my view, a grocery store is in a one-sided market, but Armstrong would disagree.

makes this choice about whether to be one-sided or two-sided is an important question for this literature.

This definition of a two-sided market may seem very broad, or overly inclusive. That is not a problem in my view. The interesting question is often not whether a market can be defined as two-sided—virtually all markets might be two-sided to some extent—but how important two-sided issues are in determining outcomes of interest. For instance, if an auto manufacturer sells many products in a single neighborhood, local mechanics may develop expertise in that type of car, which encourages further sales by the manufacturer in the future. Hence, the market for autos could be viewed as two-sided because manufacturers must attract both consumers and mechanic expertise. At present, even if such a network effect exists, it seems of little importance either in the minds of market participants or in determining market outcomes. That is, although two-sidedness may exist in practically all markets, it is not always quantitatively important. But at times in the past, these sorts of two-sided issues may have been very important in the auto industry—perhaps when autos were first diffusing across the United States. Such networks could also become important in the next decade as the auto industry considers alternative engine configurations and new sources of fuel.

The emphasis on market intermediaries is the main distinction between the literature on two-sided markets and the literature on network effects, and on indirect network effects in particular. The definitions are similar: a good exhibits an indirect network effect if demand for the good depends on the provision of a complementary good, which in turn depends on demand for the original good (for example, Church and Gandal, 1992; Chou and Shy, 1990). Indeed, in a technical sense, the literature on two-sided markets could be seen as a subset of the literature on network effects.² However, papers on two-sided markets tend to focus on the actions of the market intermediary, particularly pricing choices, whereas papers on network effects typically focus on adoption by users and optimal network size. Also, the literatures differ somewhat in industry focus, with papers on two-sided markets focusing more on media, payments systems, and matching markets, and the networks papers focusing more on high-technology and telecommunication markets. However, the difference in industries is not crucial, and there are exceptions on both sides. Parker and Van Alstyne (2000) is an early two-sided markets paper that studies operating systems. Similarly, matching markets can be seen as two-sided in the sense that the matching “platform” (for instance, a dating service) is more

² My view is not universal. Rochet and Tirole (2006) provide a technical definition in which a market is two-sided if the total quantity transacted depends not only on the per-unit fee extracted by the intermediary, but also on how much of the fee is paid by buyers and how much is paid by sellers. Hence, if the incidence of a transaction fee depends on who the fee is levied on, the market is two-sided. Almost any market where agents pay a fixed fee is included in this definition, and so their definition includes markets that do not exhibit indirect network effects. However, among papers that identify themselves as studying two-sided markets, the overwhelming majority also study markets with indirect network effects. In this paper, I do not want to argue over definitions but only to raise the various issues in defining two-sided markets.

attractive as more participants sign up. Caillaud and Julien (2003) and Damiano and Li (2008) study matching markets from this perspective.

In the discussion that follows, I focus on three products that exemplify the different types of technologies and business models in which two-sided markets are important. The first product is newspapers, and media more broadly. Newspapers are a canonical two-sided market, where the newspaper provides a platform for communication from advertisers to consumers. Consumer prices depend on advertiser demand to reach those consumers. Advertising prices depend on consumer demand for advertising as well, with relatively low prices for advertisements that consumers more highly value (such as classified advertisements and some local advertisements). The straightforward set-up of newspapers makes them relatively easy to analyze.³

The second industry I discuss in depth is the payment card industry. Payment cards like Visa, MasterCard, and American Express are two-sided in the sense that they require consumer usage and merchant acceptance to be successful. Visa and Mastercard have been particularly controversial. They have historically been organized as associations of banks that provide a clearinghouse for transactions using their cards. When a consumer purchases a product with a payment card, the consumer pays the consumer's bank, which transfers money to the merchant's bank, which then pays the merchant. The merchant pays a fee to the merchant's bank, which is typically less than 3 percent. Of great controversy is that the merchant's bank must pay the consumer's bank an "interchange fee," a percent of each transaction. The merchant's fee is set to reflect this cost and is usually only slightly higher than the interchange fee. The interchange fee is set by the card association, and in this sense is set cooperatively by the member banks. (Visa and Mastercard also extract a fee for each transaction, which is used to fund their operations, but this fee is relatively small and has been uncontroversial in credit cards to date.) The interchange fee presumably explains why banks can offer generous rewards programs to consumers for using their credit cards.

The joint setting of the interchange fee raises the specter of collusion, and certainly the interchange fee appears to be high relative to any costs that are incurred on the merchant side or the consumer side. However, as Rochet and Tirole (2002) point out, if serving consumers and merchants is perfectly competitive, then the interchange fee does not affect the profits of the member banks. Rather, banks will compete the subsidy or cost away so that the card association and member banks do not earn a profit. In this scenario, the interchange fee primarily affects the terms that merchants and consumers face and the total volume of transactions. We can raise questions about whether this view of the market is overly simplified, and much of the progress in research on two-sided markets has been motivated by public policy toward card associations and the interchange fee. I take

³ Newspapers raise difficult welfare issues since advertiser preferences can distort the editorial content of a newspaper away from reader preferences. We do not address that issue here, but see Anderson and Gabzewicz (2006).

up some of these policy concerns in the final section of the paper. Note that Mastercard and Visa incorporated in 2006 and 2007 and so are organized as for-profit corporations rather than as associations or cooperatives. These changes do not appear to have led to a strategic change with respect to interchange policy.

The third product I discuss is operating systems. Operating systems provide an interface between hardware devices such as computer devices, cellular telephones, or video game consoles on the one hand and software applications such as word processors, ring tones, and video games on the other. A successful operating system requires consumer adoption as well as software development by software vendors. Some operating systems, like certain video game consoles, are inseparable from their hardware, whereas some, such as Microsoft Windows, require independent hardware production. Many papers that study operating systems identify themselves with network effects rather than two-sided markets so perhaps this example is less canonical, but as I have argued, the two literatures have a lot in common. As we shall see, these markets are particularly useful for exploring issues of openness.

Strategies

The two most important strategies that a potential platform firm chooses are price and openness. The pricing decision has been the subject of rigorous research; openness has so far proven more difficult to analyze. This section discusses pricing and openness, as well as several other strategic decisions that have received little attention to date.

Pricing

Pricing looks unusual in two-sided markets. Consumers pay to receive most newspapers, but not a Yellow Pages directory or an Internet search engine. Consumers do not pay per advertisement in their newspaper but must pay to use more video games with their game console. Many consumers are in effect paid to use a credit card—with rewards programs such as contributions to frequent flyer plans. Theoretically, it is often hard to establish whether a given price in a two-sided market is higher or lower than socially optimal, or even whether greater competition would make the existing price rise or fall. What is going on?

Pricing in two-sided markets has received considerable attention in formal economic research. The main result is that pricing to one side of the market depends not only on the demand and costs that those consumers bring but also on how their participation affects participation on the other side and the profit that is extracted from that participation. In a one-sided market, we can characterize the price–cost mark-up in terms of elasticity of demand and the marginal cost. But in a two-sided market, pricing decisions will also include the elasticity of the response on the other side and the mark-up charged to the other side.

Since the platform faces a similar computation on the other side, prices on both sides of the market depend on the joint set of demand elasticities and

marginal costs on each side (Rochet and Tirole, 2003, 2006; Weyl, 2009). This result has important implications for prices. For instance, in any market, prices typically fall as the price elasticity of demand increases, but in a two-sided market the effect can be even larger: The low price on one side not only attracts elastic consumers on that side but also, as a result, leads to higher prices or more participation on the other side. The increased value extracted from the other side magnifies the value of having consumers on the first side, which leads to a yet bigger price decrease and quantity increase for the side that experiences the increase in elasticity.

Such seeming anomalies as price below marginal cost or even negative prices can easily arise in a two-sided market. For example, a platform might charge a price below cost on one side if those agents have a large price elasticity and their participation attracts a large number of participants on the other side who are relatively price inelastic (and hence have a high mark-up). Consider Microsoft, which makes it very easy to become a software developer for the Windows operating system and arguably subsidizes this activity with tutorials and supportive websites. Presumably, Microsoft has set the price to developers well below what the cost of serving them and their demand would imply in a simple one-sided model. However, consumers value developer participation, and consumers pay a mark-up over marginal cost that makes attracting the developers worthwhile for Microsoft, even at the expense of potential profits Microsoft could be making from the developer side.

If there are multiple competing market intermediaries, the effect of participation of one side on the other has even more bite. Consider two competing platforms pricing to consumers and sellers. As without competition, the consumer price depends on consumer demand, consumer cost, and the mark-up to sellers. But now, lowering the consumer price attracts consumers from the competing platform, which degrades the value of the competitor to buyers, and hence leads to a larger increase in buyer interest in the original platform. Hence, the “two-sidedness” of pricing can be more pronounced in competitive markets.

The extent of this effect is in part determined by the way in which agents move from one platform to another—do they shift only some usage from one platform to another or do they move all of their usage? In the real world, we observe both outcomes, often in the same market. Merchants typically accept payment on multiple networks—for example, Visa, Mastercard, American Express, and Discover—as well as via alternatives such as on-line debit cards and personal checks. Meanwhile, consumers typically stick to a single card for months at a time (Rysman, 2007a). At the level of a transaction, consumers almost never split payments across multiple options.

In fact, two-sided markets often seem to evolve toward to a situation where members of one side use a single platform and the other side uses multiple platforms; Armstrong (2006, Section 5) makes this point and provides formal analysis. Payment cards are one example. In markets with multiple newspapers, consumers typically read only one newspaper whereas advertisers appear in all of

them. This generalization is less true in video games, although even there consumers usually (but not always) buy only one console, and video games distributed for multiple consoles are becoming more common (Lee, 2008; Corts and Lederman, forthcoming).

Why does this issue matter? It is because the intermediary can be viewed as a monopolist over access to members that do not use other intermediaries. Hence, firms compete aggressively on the side that uses a single network in order to charge monopoly prices to the other side that is trying to reach them (Armstrong, 2006). As a result, competition between platforms can have large price effects on the side of the market that uses a single platform and little or no effect on the side that uses multiple platforms. This result might explain why payment card pricing has increasingly favored consumers over time rather than merchants (for instance, with the rise of rewards programs), since consumers and not merchants typically use a single network and competition among card networks has become more important relative to competition between card networks and cash.

Another important issue in a two-sided framework is price discrimination. In a situation of demand heterogeneity, standard price discrimination—for instance, by manipulating the prices for participation and usage—allows a platform to capture more of the surplus on the side with discrimination. Thus, discrimination increases the value extracted on one side, which leads to lower prices on the other side which has now become more valuable (Weyl, 2009). In addition, two-sided markets allow for a new form of price discrimination: discrimination based on heterogeneity in the attractiveness of an agent to the other side. For instance, supermarkets resisted accepting payment cards for a time, but they are highly desirable clients for payment card companies both because of their transaction volume and because regular consumer usage at supermarkets helps encourage consumer usage in other situations. Hence, payment associations offered supermarkets relatively low interchange fees, which led to low bank fees and ultimately to the adoption of payment card usage by supermarkets. Similarly, Sony and Microsoft have given Electronic Arts, the largest game manufacturer, advantageous contracts in order to attract games to their consoles (Eisenman, Parker, and Van Alstyne, 2006). Caillaud and Jullien (2003) show how an entering platform can use price discrimination to be successful even when market participants expect the entrant to fail.

Two-sided markets raise questions for dynamic pricing as well. Penetration pricing, such as when an intermediary lowers price early in the product life cycle and raises it after having established a base, is a natural outcome in two-sided markets. For instance, the independent Yellow Pages publisher “Yellow Book” has a policy of offering advertisement for free in the first year it enters a new city. This strategy makes sense because Yellow Book recognizes that doing so will generate usage, which Yellow Book can capitalize on in the future. Similarly, it is common to establish a technological standard through free distribution of a basic product (for instance, Adobe’s free distribution of Reader popularizes the PDF standard) and then profit on peripheral products (such as Adobe Acrobat).

Openness

In the literature on two-sided markets, openness refers to two specific strategic issues. The first is the number of sides to pursue: a potential platform firm must choose whether to be one-sided, two-sided, or multi-sided. The second is how to relate to competing platforms: platforms may seek incompatibility, compatibility, or some sort of integration.

As an example of the decision over how many sides to pursue, consider operating systems. Apple produces both its computer hardware and its computer operating system, whereas Microsoft controls only the operating system and counts on independent manufacturers to supply hardware. In this sense, Microsoft is more open than Apple. This choice is somewhat akin to a choice over vertical integration, although the relationship between hardware and operating systems is not strictly vertical. Rather, to the extent that a platform does not integrate, it often introduces another side to the multi-sided market calculation. That is, we can characterize Microsoft as managing a three-sided market between consumers, software providers, and hardware providers, whereas Apple manages only a two-sided market between consumers and software providers.

A platform may decide to change its strategy toward integration as its market evolves. For instance, Microsoft has controversially included software applications in its operating system that were also supplied by third party suppliers, such as browser software, media players, and video editing. To the extent that doing so eliminated an independent software market, Microsoft apparently viewed it as worthwhile to reduce the number of sides in its business model.⁴

Incorporated in this decision over openness is the decision of whether to be two-sided or one-sided. Being one-sided is in effect an extreme move away from openness where a firm integrates to the extent that there is no longer a two-sided market interaction. Perhaps it is more natural to observe firms begin with a one-sided model and switch to a two-sided model as they become more established. Doing so allows potential platforms to overcome the “chicken-and-egg” problem by first providing complementary goods themselves (sometimes requiring daunting capital expenditures). For example, Amazon first established itself as a fairly standard on-line book retailer before introducing its “marketplace” options where sellers set prices and interact with consumers.

Thus, it may be better to discuss two-sided “strategies” rather than two-sided “markets,” because two-sidedness is an endogenous choice in some markets, not a technologically determined outcome. The Palm group of products provides an example. When the Palm personal digital assistant was first introduced, Palm

⁴ From different perspectives, the same business may have different numbers of sides. For instance, it is common to think of Microsoft as managing a three-sided market between consumers, software developers, and hardware manufacturers. However, in evaluating some strategies—such as Microsoft’s approach to the browser market—it may be more useful to recognize Microsoft as a many-sided market between, for instance, spreadsheet software providers, word processing software providers, browser providers, business consumers, home consumers, laptop and desktop manufacturers, printer manufacturers, and others.

produced its own hardware, operating system, and applications software. Hence, it followed a one-sided model. Palm eventually pursued independent software application development, but only after it had sold millions of units (Eisenmann and Hagiu, 2007). Still, the Palm devices all ran the Palm operating system, and Palm licensed very few non-Palm devices to do so. That business pattern changed recently when Palm divested itself into an operating system company and a hardware company. The hardware firm has recently introduced the first Palm device that runs a Windows operating system, and the operating system is currently attempting to attract widespread device production.

Up to now, we have discussed openness in terms of operating systems but we have not mentioned payment cards or newspapers. These markets seem much less flexible in terms of the choice of two-sidedness. Some payment cards and media are clearly one-sided. For instance, store cards and gas cards are payment cards that allow the consumer to use payment card features at a single company. Since all uses of the card are at a single company, they represent a one-sided approach to payments. Similarly, some media does not take advertising and is largely supported by subscriptions, such as *Consumer Reports* and *Cook's Illustrated*. However, outside of some particular cases, the basic model of payment cards and media is a two-sided one. In other words, the technology of these industries is such that adding or eliminating sides to their markets is not an important option.

Whereas the first meaning of openness refers to whether to be multi-sided, the second meaning of openness refers to the decision over compatibility and inclusiveness toward rival platforms. If the first meaning of openness is similar to the choice over vertical integration, this second meaning is akin to choosing horizontal relationships. Compatibility refers to the ability of a consumer using one platform to reach a seller using another. Compatibility need not be a “zero-one” decision. A bank that signs up with a network of automatic teller machines (ATMs) can interact with depositors that use any ATM associated with the network, but surcharges make ATMs owned by other banks more or less “compatible” with a given bank’s ATM system (Knittel and Stango, 2008; Hannan, Kiser, Prager, and McAndrews, 2003).

This aspect of openness is important for payment cards and newspapers. The Visa payment system is open in the sense that any bank can join, but it is closed to nonbanks—particularly American Express. For newspapers, compatibility may seem impossible; a consumer reading one newspaper cannot see the advertisements in another newspaper. However, newspapers can pursue horizontal integration through merger. When the *New York Times* purchased the *Boston Globe*, one justification was the ability to sell newspaper advertisements throughout the northeastern United States. These joint sales represent a form of compatibility to the advertising buyer, who used to have to negotiate with two separate sellers. Also, media outlets can bundle sales without outright merger. For instance, Yellow Pages publishers maintain a trade association that sells advertisements in all books simultaneously with national campaigns.

Providers of platforms often prefer incompatibility on the grounds that it locks in current customers and locks out competitors. For instance, there has been no

movement toward cross-brand compatibility in the video game market. But agents can circumvent incompatible platforms by using multiple platforms. A consumer that uses the Discover card cannot purchase from a store that only takes Visa, so many stores choose to accept both. Such actions can quickly undo any benefits that a platform may seek from resisting compatibility. In response, platforms encourage exclusive membership or usage. Payment cards use rewards programs to encourage exclusive usage on the part of consumers. Similarly, game console manufacturers will sometimes contract with developers to write exclusive games (Corts and Lederman, forthcoming; Lee, 2008). If one side of the market can be made exclusive, there is usually little reason to seek exclusivity on the other side. As argued above, if members of one side use only one platform at a time, the platform can charge monopoly prices to the other side for access.

What determines when markets with platform competition evolve to a “winner-take-all” standard, or when they evolve toward coexisting platforms, or when markets fail altogether? Here, I mention three possible issues that determine whether “tipping” occurs. First, if standards can differentiate from each other, they may be able to successfully coexist (Chou and Shy, 1990; Church and Gandal, 1992). Arguably, Apple and Microsoft operating systems have both survived by specializing in different markets: Microsoft in business and Apple in graphics and education. Magazines are an obvious example of platforms that differentiate in many dimensions and hence coexist.

Second, tipping is less likely if agents can easily use multiple standards. Corts and Lederman (forthcoming) show that the fixed cost of producing a video game for one more standard have reduced over time relative to the overall fixed costs of producing a game, which has led to increased distribution of games across multiple game systems (for example, PlayStation, Nintendo, and Xbox) and a less-concentrated game system market.

Third, the ability of providers of complementary goods to differentiate themselves after picking a platform makes tipping more likely (Ellison and Fudenberg, 2003; Augereau, Greenstein, and Rysman, 2006). Hence, movie producers provide a differentiated product and so are willing to coordinate on the same standard, which was an element in the successful coordination on the VHS standard in the video cassette-recorder market. If the sellers cannot differentiate aside from adopting a standard, they must differentiate by choosing separate standards, which leads to the adoption of multiple standards (Ellison and Fudenberg, 2003) or even adoption failure (Augereau, Greenstein, and Rysman, 2006; Kretschmer, 2008). The lack of opportunities for differentiation is a common explanation for the failure of many websites that were meant to facilitate business-to-business sales. Sellers see little benefit to listing their services on a website in which they are placed in practically perfect competition. For example, Rust and Hall (2003) provide a quote from a steel broker in which the broker questions what he would gain from marketing himself through such a website. Firms that do participate in such websites turn out to be very creative in separating themselves from their competi-

tors, for instance by withholding crucial information until the consumer has clicked from the platform website to the vendor website (Ellison and Ellison, 2009).

Other Strategies

Common strategies in one-sided markets like innovation, advertising, and quality investment can take on added dimensions in a two-sided market. I discuss such strategies briefly in this section, as well as some strategies that are specific to two-sided markets.

Many businesses in two-sided markets rely on new technology, and so a primary concern for any such firm is how much to invest in innovation. Video game consoles have exhibited enormous technical progress, processing eight bits of information at a time in the mid-1980s as compared to 128 bits at a time in the most recent systems. Alongside direct improvement of the platform, firms that interact over the platform can innovate with their products. For instance, computational innovations allow game developers to leverage the technological architecture of any given gaming system into more attractive software. Progress in processing speed by consoles and associated programming techniques by developers explains the improvements in graphic quality and play experience in video games. In many examples, the platform firm and the providers of complements invest in the same issue. For instance, Visa invests in fraud prevention and so do member banks.

Platform or intermediary firms recognize that their policies can affect the level of innovative investment by participating firms. In theory, a platform firm could subsidize improvements or offer discounts for improvements, but such an approach is unusual and hard to implement since the degree or existence of at least some improvements may be hard to verify. More commonly, the platform can shape the market structure in a way that encourages investment. For example, a platform can control market structure through fees, barriers to access, or the direct exclusion of some firms and thus affect incentives for innovation. The exact market structure that maximizes innovation is subject to a long debate (for instance, Aghion, Bloom, Blundell, Griffith, and Howitt, 2005). In the context of two-sided markets, Boudreau (2007) studies the market for operating systems for mobile devices such as personal digital assistants and cellular telephones. He argues that allowing a large number of software developers encouraged incremental innovation, but that large systemic innovation—such as that associated with a new version of the operating system—was better accomplished by operating systems with a relatively small set of software vendors. This point appears relevant for the many innovations associated with the largely technologically closed iPhone.

Other important strategic choices are advertising and quality. While these have been well studied in one-sided markets, they become newly interesting in a two-sided market because the choice on one side of the market affects the price on the other. What would be the effects of advertising? Advertising on one side raises participation and usage on that side, which raises demand on the other side, and so advertising on one side can lead to higher prices on the other. In addition, there

is a more subtle effect through mark-ups: advertising to one side that raises the mark-up on that side leads to lower prices on the other side, and vice versa. For instance, suppose that advertising to consumers by Sony for the PlayStation 3 raises sales. As a result, demand by game developers increases, which allows Sony to increase royalties it collects from developers. However, suppose that the advertising also causes consumers to be less price sensitive and hence causes Sony to increase the price to consumers further. As a result, the benefits of attracting a game developer are higher since the resulting consumers are more valuable, which causes Sony to lower the royalty rate, or at least moderate the increase that came from higher demand. If advertising had attracted more price-sensitive consumers, the effect would have been to *raise* the royalty rate an additional amount.

We often distinguish between “persuasive” advertising that raises the utility of all consumers for a product and “informative” advertising that informs consumers about a product’s existence or features. Persuasive advertising most often increases the mark-up a firm may charge by raising utility, whereas informative advertising can reduce the mark-up by attracting relatively low-demand consumers. Thus, persuasive advertising on one side can lead to lower prices on the other side, whereas informative advertising on one side leads to higher prices on the other. Similarly, the effects of quality investment will depend on whether it generates relatively price-elastic or -inelastic consumers on the margin, and on whether it attracts consumers that are more or less responsive to participation on the other side.

Also, a platform firm must be concerned not only with its own quality and advertising, but also that of the vendors who operate over its network. For instance, a franchisor operates a two-sided market in the sense that it attracts consumers to its brand and franchisees to operate outlets—similar to how an operating system attracts consumers and software vendors. Franchising contracts typically specify numerous “investments” in advertising and quality, such as advertising by the franchisor and cleanliness, and possibly also local advertising, by the franchisee.

Certain more subtle strategies are more common in two-sided than in one-sided markets. In some markets, the platform controls the way suppliers are presented to consumers, and the platform can make it easier or more difficult to search and switch across firms (Hagiu and Julien, 2008). For instance, a web portal presenting multiple sellers of a given product may or may not present the shipping costs associated with the purchase. In other markets, the seller controls how platforms are presented to consumers. For instance, Visa limits the ability of merchants to promote other payment types (like debit cards). In operating systems, an issue in the Microsoft antitrust case was Microsoft’s control of the appearance of the desktop and the place that Microsoft’s browser had in it.

The organization of the platform firm itself offers one more set of strategic choices. In many cases, the platform firm takes on the standard corporate form owned by investors; examples include Microsoft, Sony, and most newspapers. But in a surprising number of cases, the platform firm is owned by market participants. For instance, Visa and Mastercard were until recently associations of member

banks. Similarly, the Multiple Listing Service, which must attract housing buyers and sellers, is a cooperative owned by real estate agents. The American Society of Composers, Artists and Publishers (ASCAP) mediates between music producers and music users (such as radio stations) and is an association of music producers. The type of organization greatly affects public policy toward the entities. When large platform corporations run into accusations of anticompetitive behavior, it typically involves charges of monopolization. In contrast, associations often face questions about whether internal policies facilitate collusion. An interesting challenge is to predict which markets will organize in which ways, and the consequences of their choices.

Public Policy

The economics of two-sided markets are important for a wide variety of public policy issues. In this section, I discuss the impact on some parts of antitrust and regulation, and discuss some important cases.

Antitrust

Two-sided markets typically have network effects and as such are likely to tip toward a single dominant platform. As a result, it is not surprising that these markets are of interest to antitrust authorities. Given that pricing can look very different in two- than in one-sided markets, it is important that authorities can properly evaluate the outcomes we observe.

The economics of two-sided markets provides insights primarily into pricing and so is likely to be particularly important for the parts of antitrust enforcement that focus on pricing issues. For instance, there is a growing interest in using merger simulations to evaluate the impact of mergers on prices and outcomes. Naturally, if we were to analyze the merger between two platform firms, we would need to account for complex two-sided issues that arise. For example, consider that the Department of Justice has allowed for joint operating agreements between competing newspapers in some towns, which allows for joint price-setting but with independent editorial control. Evaluating such an agreement requires an analysis of how prices to both consumers and advertisers will change, which are interrelated. In Rysman (2004), I offer another example with Yellow Pages directories.

Merger analysis balances the market power and cost reductions created by a merger. In a two-sided market, if the merger reduces cost on one side, that has implications for price on the other side. Also, a merger could increase market power on both sides of the market and still lead to a price decline on one side. An alternative evaluative tool to merger simulation is to use regression analysis: for instance, regressing price on the number of firms in a market. In a two-sided market, we should consider multiple prices and, potentially, different measures of competition for each side. For example, newspapers compete with billboards for

advertising, but not for consumer readership. Video games compete with a host of leisure activities for consumer attention, but not for game developer attention. In Rysman (2007b), I discuss these issues further.

At a more fundamental level, determining the relevant market is a crucial ingredient in constructing most antitrust cases. Antitrust authorities typically use the size of cross-price elasticities to determine what products should be included in a relevant market. If two-sidedness is important, we must account for the endogenous variation in other prices in response to any one price. For instance, suppose we consider whether a price increase to consumers using platform A causes consumers to switch to platform B, which would place the platforms in the same market. We must recognize that the response by A's consumers will also affect participation of A's sellers, which may affect the sellers that B sees and lead to an effect on B's consumers over and above the standard substitution effect from A's consumer price change. Evans and Noel (2005) explore this issue in greater detail.

Several other areas of antitrust analysis use price behavior intensively. For instance, computing damages often involves computing counterfactual prices, such as the price that would have arisen if firms had not colluded. Such a computation could easily be influenced by whether a market is two-sided or not. Similarly, the design of remedies for antitrust violations might be affected. For instance, a judge would probably not want to break up a platform into its constituent parts. Evans (2003) provides a more complete discussion of two-sided markets and antitrust.

It seems clear that the economics of two-sided markets is highly relevant for pricing analysis in antitrust. But that does not mean that it is important for all aspects of antitrust analysis. Although inefficient pricing is the hallmark of the economic criticism of monopoly power, inefficient pricing is not an antitrust violation by itself. Monopolization and vertical contracting cases typically hinge on whether a firm has excluded competitors from the market in a way that did not benefit consumers or reduce costs. The actual prices charged in such a situation are seen as incidental, and without entry barriers, transient in the face of competition. That is, determining the difference between optimal and equilibrium prices has little role in establishing the legality of an action in a monopolization case (although it may have an important role in determining the requisite question of whether a firm has market power). Still, one could well imagine that two-sided market economics could make a contribution here. For instance, exclusive dealing enforces usage of a single platform. In our discussion of the strategy of pricing, we saw that when agents on one side use a single platform in a multi-platform context, price competition between platforms is particularly intense on that side. Similarly, tying the purchase of one product to the purchase of another may allow for a form of price discrimination, which increases value extraction on one side and, in a two-sided market, leads to lower prices on the other. Thus, exclusive dealing and tying potentially have added benefits in a two-sided market that might be

important counterpoints to the standard antitrust criticism that they may create entry barriers.⁵

As a concrete example of where two-sided markets seem to matter and where they do not, consider interchange fees, which (as discussed earlier) determine how much revenue a consumer's bank collects from a merchant's bank on any transaction. The interchange fee is set collectively by member banks, which raises questions about collusion. This issue is governed by the treatment of joint ventures, in which collective action is legal if the joint venture is necessary to make a product available, since more products are presumed to make a market more competitive. The U.S. antitrust case that dealt most directly with these issues is *National Bancard Corp. (Nabanco) v. Visa U.S.A., Inc.* (779 F.2d 592 [11th Cir. 1986]). In the court's view, the alternative to the collective setting of the interchange fee was to have independent bilateral negotiation between banks serving merchants and consumers, in which case, consumers and merchants must know whether their banks had an agreement before attempting a payment. The court deemed that system unworkable, and hence the collectively set interchange fee was legal as it was necessary to provide the Visa card.

In this paper, I do not seek to reargue or revisit the question of whether the interchange fee should be treated as an anticompetitive violation. Rather I wish to draw attention to the ambiguous role of the economics of two-sided markets. On one hand, the court recognized the value of a centralized platform for payments. Also, its final decision may have been influenced by the idea of the potential efficiency of an interchange fee in a two-sided market. However, the technical legal question was about cooperation and the nature of the Visa association, not about two-sided markets. Once the court established that setting an interchange fee is legal, it did not inquire into whether Visa set the optimal interchange fee. Hence, the price-measurement issues associated with two-sided markets had a limited role.

This approach contrasts with a similar case in Europe. In December 2007, the European Commission ruled that the interchange fee at MasterCard (for cross-border transaction) is collusive and illegal. Why this difference? The EC considered the alternative to a jointly set interchange fee to be an interchange fee that was regulated to be zero (rather than bilateral negotiations). Since MasterCard can exist with a zero-interchange fee, the exemption to the joint behavior was eliminated. However, in making the decision, the EC explicitly recognized that a zero-interchange fee is probably not optimal, a point that can be derived from models of two-sided markets. Moreover, the EC stated that a comprehensive study of the market establishing the efficiency of MasterCard interchange rates would be a sufficient defense. Although conducting such a study is a daunting prospect, it

⁵ Price calculations are extremely important for prosecuting predatory pricing. However, U.S. courts have set an extremely high standard for proving predatory pricing at least since *Brooke Group v. Brown & Williamson Tobacco Corp.* (509 U.S. 209 [1993]). As such, it is unlikely that the theory of two-sided markets will have much effect here, although there is some movement to make predatory pricing easier to prosecute (Brodley, Bolton, and Riordan, 2000).

would clearly involve two-sided issues. Hence, two-sided market issues become important when the court includes price computations in questions of legality. For a more comprehensive discussion of international policy toward payment cards, see Weiner and Wright (2005) and Bradford and Hayashi (2008).

The famous case that the U.S. Department of Justice brought against Microsoft also exemplifies these issues. As is standard in monopolization cases, the government first attempted to establish that Microsoft had market power. Here, pricing issues were crucial and two-sided market concerns were relatively important. For instance, Microsoft argued that its price was well below what a monopoly would charge given reasonable assumptions on demand and marginal cost. The government countered that much of the profit was collected in the applications market, which is an issue involving two-sided markets. However, once market power was established, the case hinged on whether tying the browser to the operating system created an entry barrier into the operating system market. The importance of two-sided markets here is ambiguous. The government claimed that Microsoft's motivation for tying relied on two-sided thinking: Microsoft's tie reduced Netscape's importance, which prevented Netscape from easily entering the operating systems market with a compatible browser. However, the legal issue was to compare the consumer benefits from Microsoft's integrated product to the losses resulting from a weakened Netscape. Pricing was not a primary issue in this calculation, and it is unclear that two-sided market economics offers much guidance.

In general, my prediction is that two-sided analysis will grow in importance in areas where pricing analysis is important, whereas the effect will be more limited in exclusionary conduct cases such as monopolization and conditional sales.

Regulation

Pricing issues are the main thrust of a great deal of economic regulation, and as such, the economics of two-sided markets can make a large contribution. Classic price regulation involved large regulatory commissions with research staffs trying to measure marginal cost and demand in an attempt to determine optimal prices. One could imagine such a staff attempting to determine optimal prices in a two-sided market as well, where the staff would have to investigate demand and cross-price elasticities on both sides, as well as cost.⁶

If there is no antitrust violation in setting interchange fees but the equilibrium outcome diverges from the social optimum (as in Rochet and Tirole, 2002), then price regulation may be a reasonable solution. Several countries have followed this approach. In Australia, legislation supports the direct determination of the interchange fee at bank associations (Visa and Mastercard) by the Reserve Bank of Australia. Numerous other countries have moved in this direction.

⁶ For a concrete example, consider the policy of "net neutrality," which restricts pricing by Internet service providers to content providers on the Internet. The Internet service providers can be seen as platforms matching Internet users to content providers and hence, the concept of net neutrality is often evaluated from the perspective of two-sided markets. See Lee and Wu in this issue for more on these issues.

Economic theory suggests that any determination of the optimal interchange fee should consider the marginal costs of serving both consumers and merchants as well as price elasticities of demand and interaction elasticities of demand to usage on the other side of the market. Further considerations might be the government (or total social) costs of alternative payment systems that consumers would use. For instance, cash is more costly to process than credit card payments, whereas electronic debit is cheaper (Reserve Bank of Australia, 2007). In fact, the Reserve Bank of Australia (2006) sets interchange fees based on the average cost of banks serving consumers (as explained at http://www.rba.gov.au/MediaReleases/2006/Pdf/mr_06_02_creditcard_standard.pdf). The interchange fees imposed in Australia may or may not raise social welfare, but the process for determining the fee surely diverges from the prescription of the economics of two-sided markets. The economics of two-sided markets can play an important role in guiding the determination of the optimal fee, although it does not appear to have done so to date.

An interesting contrast in the treatment of banking fees is in the market for automated teller machines. A network of ATMs is two-sided in the sense that it is more valuable to consumers if it can reach more banks and more valuable to banks if more consumers use it, which is often a function of how many locations a network reaches. While early networks of ATMs were proprietary, banks recognized the value of compatibility early on, and formed networks that served groups of banks. These often involved interchange fees, so that the consumer's bank paid the owner of the ATM for each transaction. In addition, the owner of the ATM could charge a consumer a surcharge for using the machine. These surcharges were federally regulated to zero early in the industry's development but were deregulated in 1996. What followed was a massive increase in the number of ATMs. Knittel and Stango (2008) argue that deregulating surcharges for ATMs had a major role in causing the expansion. Hence, fees were deregulated in this market, in contrast with the current trend toward regulation in payment cards. Furthermore, increased prices led to more consumer usage rather than less because ATMs were much more conveniently located.

Conclusion

The literature on two-sided markets is developing rapidly. To this point, the major focus of the economic research on two-sided markets has been to address how the intermediary (or "the platform") sets prices for both sides of the market simultaneously. A great deal more could be done on this topic. Less well studied are a number of other important choices, like the choice over how open to be, or how many sides of the market to allow. The literature has important policy implications for pricing analysis, an important feature of regulation and a large part of antitrust analysis.

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