

Social networks and the firm

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1. INTRODUCTION

Individuals often base their decisions on what they observe in their neighborhood or peer groups. It can be, on the one hand, that individuals gather information from their peers' experiences: for example, a consumer will be more likely to adopt a given product if many of that consumer's friends report a positive experience with the product. On the other hand, it can also be that the advantages or benefits attached to an individual's decision directly depend on the decision of others in the individual's social network. For example, if we consider whether or not to acquire a mobile phone or subscribe to an online social network, our decision will ultimately depend on how many of our friends and peers have bought a phone or subscribed to the online social network.

Social networks are thus central to our decisions, and information on social networks has high value to firms wishing to foster the adoption of their product and maximize profit. In light of these observations, it is natural to ask what the effect of information on social networks is on firms' competitive behavior and strategy⁽¹⁾. In this short note, we seek to address this broad question. We first explore two main mechanisms through which social networks affect decision-making: information sharing and network externalities. We then discuss how information on social networks and these mechanisms impacts two of the key decisions made by firms in strategic settings: advertisement and pricing. We focus our discussion on recent work in this area and suggest future research questions.

2. SOCIAL NETWORKS, INFORMATION SHARING, AND CONFORMITY

In forming decisions, individuals make use of their own experience, but also rely on the experiences and decisions of others, e.g. experts and peers. This reliance has two important economic roots: information sharing and conformity pressures.

2.1. Information sharing

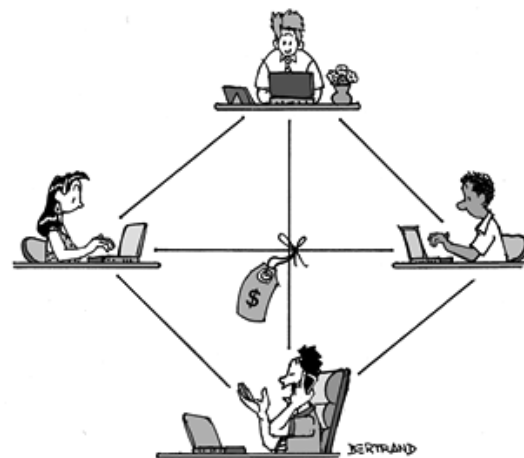
A key facet of most economic decisions is uncertainty. When buying a good, making investment decisions, adopting a new technology or choosing a career path, agents often only have partial information about the different

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dimensions of their decision. A straightforward way to manage that uncertainty is to learn from others.

In their seminal work on social communications, Elihu Katz and Paul Lazarsfeld (1955) found that a key feature of information sharing was that a very small fraction of the population, called “opinion leaders”, often serves as the primary source of information for the rest. More recent work has confirmed that this “law of the few” is a robust feature of communication on social networks⁽²⁾.

The presence of opinion leaders has important consequences for many economic phenomena. To see why, consider the following simple example. Suppose that individuals in a community can choose between an old, well-understood technology and a new but ill-understood one. Suppose also that the new technology is superior to the old one. As with many new technologies, repeated trials of the new technology may however be needed to ascertain its true quality – the adoption of the new technology thus ultimately depends on individuals’ sustained belief in its quality. Their belief depends not only on their personal experience, but also on what they observe or hear – in other words, it will also depend on their personal network of communication.

Consider now a community with opinion leaders. With positive probability, opinion leaders might all simultaneously be “unlucky” with the new technology and have a “bad trial”. Because everybody observes them (and because opinion leaders observe each other), their bad experience may translate into the whole community abandoning the new technology despite its superior quality. Conversely, consider a society without such opinion leaders. Since the new technology is superior, it will on average outperform the old technology and will create strings of individuals with “good trials”. Such strings insulate agents within those strings from premature information about possible bad experiences from others and insure that, in the long run, the better technology is adopted by all⁽³⁾.

The presence of “opinion leaders” thus have important implications for firms’ strategies, e.g. with respect to advertisement and seeding. Sponsored tweets are but one example of the ways firms can harness the power of social networks to diffuse information about their products.

2.2. Conformity pressures

In addition to information exchange, social interactions also give rise to conformity pressures or network effects. Network effects are present when the value of a good for a consumer depends on the patterns of adoption by other consumers. Network effects can be global – when they depend on the patterns of adoption in the whole population – or local – when, for a given consumer, they depend only on the patterns of adoption in that consumer’s social network.

A classic example of network effects is the telephone. The benefits attached to acquiring a phone depend directly on the

number of other people one can call. For example, if nobody else owns a phone in one’s community, then one could not call anybody even if one had a phone. Thus, buying a phone has no benefit. Another example is language: the benefits of learning a language are intrinsically linked to the number of people in one’s network one can speak it with.

Again, the social network of interactions will have far-reaching implications on the patterns of economic behavior in the presence of network effects. Suppose for example that individuals decide to adopt a given good (e.g. a telephone) only if at least q of their peers adopt the good. Since this rule holds for all individuals, adoption can only take place in the population if it contains a group of individuals who have at least q links with other individuals in the group⁽⁴⁾.

A firm wishing to boost the adoption of a good exhibiting network effects would thus have an incentive to foster the early adoption by enough consumers for adoption to spread in the network. A typical example of this phenomenon would be Dropbox. Dropbox is a file hosting service that enables, among other things, the storing and sharing of documents online. To make use of these externalities, Dropbox offers implicit discounts (e.g. free storage space) to consumers who invite their friends or peers to open a Dropbox account.

3. SOCIAL NETWORKS, ADVERTISING AND PRICING

In the classical product market framework, firms choose prices, advertising strategy and quality taking heterogeneous consumer preferences as given (Tirole, 1994). A key underlying assumption of this framework is that individuals are anonymous and make decisions in isolation of each other. As discussed above, the role of peers in shaping consumer choice has however been shown to be important in many settings. In the past, the practical use of such social influences for advertising or pricing was limited due to the absence of good data on networks. The availability of large amounts of data on online social networking along with the other advances in information technology have led to an exciting new research program on ways that economic actors can harness the power of social networks to promote their goals. Practical interest has centred on questions such as: what are the relevant aspects of networks for marketing and competition? How much should a firm be willing to pay to acquire information about social networks?

Galeotti and Goyal (2009) propose a model of large directed networks to address these questions. In particular, they study a monopoly’s advertising strategy when consumers interact on a network. Social interactions among consumers have two dimensions: level and content. The level of interaction refers simply to the number of people an agent talks to: changes in the degree distributions can be studied using standard concepts e.g. stochastic dominance⁽⁵⁾. The content of interaction captures the two main mechanisms presented above through which networks may affect individual incentives: social learning and

conformity pressures. In particular, in case of word of mouth communication about goods' characteristics, the presence of a single informed neighbor leads to product awareness and possibly purchase. In other cases (e.g. language learning), adoption depends on the number or proportion of agents in one's network who also adopt the good.

Galeotti and Goyal (2009) show that the use of network information reduces waste in resources and generates greater sales. The effectiveness of social influence campaigns can be further increased by using more detailed information — such as the connections of different individuals in the social network. They also find that that in the word of mouth context, it is optimal for the monopoly to target individuals who are poorly connected to others. By contrast, in the case of network effects where a consumer's benefits from adopting one good depends on the proportion of her neighbours who adopt the good, it is optimal to seed the most connected individuals as they are otherwise unlikely to adopt the good (as attaining their "adoption threshold" necessitates a higher number of players who adopt the good than for players with lower degree).

Galeotti and Goyal (2009) finally show that the effects of networks on profits depend on the content of the interaction. In the word of mouth context, an increase in connectivity enables greater spread of information: this increases sales and profits. On the other hand, if the product exhibits network externalities, an increase in connectivity makes it harder to satisfy players' threshold of neighbors' adoption. Thus, an increase in social interaction in the presence of adoption externalities lowers profits.

Galeotti and Goyal (2009) focus on the case with one firm and with one step, mechanical diffusion of advertisement. The monopoly's only decision is the level of advertising. Current research expands the scope of the analysis significantly to include multiple firms, dynamics of spreading information (see e.g. Campbell, 2013; Goyal & Kearns, 2012). The use of social networks for optimal diffusion of information remains a very active field of research in economics.

In a related line of work, researchers have explored the use of optimal pricing in social networks. In the industrial organization literature consumer value, and hence, pricing is conditional on the number of consumers who adopt different products (Farrell & Saloner, 1986; Katz & Shapiro, 1985). Network externality often arises through the use of common products or services in personal interaction. So it is reasonable to suppose that the value of adopting a product to a consumer

should depend on how many of her neighbours adopt the same product. This observation motivates the new strand of research on optimal pricing in networks.

Fainmesser and Galeotti (2016), in a recent paper, explore how knowledge of the network may impact firms' pricing behavior. In particular, they model a monopoly choosing a pricing scheme for a network good. Consumers interact on a network and the utility they derive from the monopoly's good is increasing in the consumption of the players they observe. Consumers are heterogeneous with respect to the extent to which they are influential (measured by their in-degree, or numbers of agents who observe them) and susceptible (measured by their out-degree, or number of agents whom they observe). Agents only know their in- and out-degree⁽⁶⁾.

Fainmesser and Galeotti (2016) then study how variations in the monopoly's knowledge of the network structure affect its optimal pricing scheme. They show that at equilibrium, the price that the monopoly sets for each consumer can be decomposed in three elements: (i) the optimal price without network information, common to all players; (ii) a price premium that increases with a consumer's susceptibility; and (iii) a price discount that increases with a consumer's influence on others. The intuition is that the monopoly is willing to "subsidize" influential players to boost network effects and, thus, adoption of the good. Conversely, highly susceptible consumers are "prisoners" of their susceptibility, and the monopoly can extract larger surplus from such consumers. They also show that the price discounts and premium increase in the average level of network effects and their variance: hence knowledge of the network is particularly valuable in networks with high and dispersed network effects.

4. CONCLUDING REMARKS

The literature on social networks in product markets is motivated by practical concerns. The models incorporate asymmetric/incomplete information and network externalities. The analysis brings out the advantages of using networks to define optimal targets for advertising and also in shaping optimal pricing. The analysis also highlights the ways in which networks can amplify small differences in resources between competing players. It is clear that consumer search and their word of mouth communication interacts with firm advertising; it would be important to develop a common framework that incorporates all three elements. ♦

NOTES

(1) A large and growing industry now specializes in the analysis and packaging of information obtained from online social networks like Facebook, Instagram, and Twitter. These services are largely viewed as having profound effects on the decisions of firms across industries: "Social media promises

to accelerate innovation, drive cost savings and strengthen brands through mass collaboration. Companies across every industry are using it to hype new products and services, and also monitor what people are saying about their brand" (Schramm, 2015).

NOTES

- (2) See e.g. Galeotti and Goyal (2010).
- (3) For a formalization of this argument see Bala and Goyal (1998).
- (4) This maximal such group in any network is defined as the “q-core” of a network (see Bollobás, 1984; Gagnon & Goyal, 2015).
- (5) Empirical work has produced data on degree distributions across product categories and has

studied their relation to individual and demographic characteristics. See e.g. Keller, Fay, and Berry (2007) and Leskovec, Adamic, and Huberman (2007).

- (6) Other related work includes Bloch and Querou (2013) and Candogan, Bimpikis, and Ozdaglar (2012). A major difference between these papers and Fainmesser and Galeotti’s model (2016) is that the former assume that agents have full knowledge of the network (instead of only in- and out-degree distributions).

REFERENCES

- Bala, V., & Goyal, S. (1998). Learning from neighbours. *Review of Economic Studies*, 65, 595-621.
- Bloch, F., & Querou, N. (2013). Pricing in social networks. *Games and Economic Behavior*, 80, 263-281.
- Bollobás, B. (1984). *The evolution of sparse graphs. Graph theory and combinatorics* (Cambridge, 1983). London: Academic Press, 35-57.
- Campbell, A. (2013). Word-of-mouth communication and percolation in social networks. *American Economic Review*, 103(6), 2466-2498.
- Candogan, O., Bimpikis, K., & Ozdaglar, A. (2012). Optimal pricing in networks with externalities. *Operations Research*, 60(4), 883-905.
- Fainmesser, I.P., & Galeotti, A. (2016). Pricing network effects. *Review of Economic Studies*, 83(1), 165-198.
- Farrell, F., & Saloner, G. (1986). Installed base and compatibility: Innovation, product preannouncements, and predation. *American Economic Review*, 76, 940-955.
- Gagnon, J., & Goyal, S. (2015). *Networks, markets, and inequality*. Cambridge INET Working Paper 2015/06.
- Galeotti, A., & Goyal, S. (2009). Influencing the influencer: A theory of strategic diffusion. *RAND Journal of Economics*, 40(3), 509-532.
- Galeotti, A., & Goyal, S. (2010). The law of the few. *American Economic Review*, 100(4), 1468-1492.
- Goyal, S., & Kearns, M. (2012). *Competitive contagion in networks*. STOC. Retrieved from <http://cs.nyu.edu~stoc2012/default.htm>
- Katz, E., & Lazarsfeld, P.F. (1955). *Personal influence: The part played by people in the flow of mass communications*. New York: The Free Press.
- Katz, M., & Shapiro, C. (1985). Network externalities, competition and compatibility. *American Economic Review*, 75(3), 424-440.
- Keller, E., Fay, B., & Berry, J. (2007). *Leading the conversation: Influencers impact on word of mouth and the brand conversation*. The Keller Fay Group, Word of Mouth Marketing Research Symposium.
- Leskovec, J., Adamic, L.A., & Huberman, B.A. (2007). *The dynamics of viral marketing*. ACM TWeb, 1.
- Schramm, C. (2015). *Capitalize on social media with big data analytics*. Forbes. Retrieved from <http://onforb.es/1ngpxnQ>
- Tirole, J. (1994). *The theory of industrial organization*. Cambridge, MA: MIT Press.

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