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The chilling effects of network externalities: Perspectives and conclusions☆

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1. Network externalities: a constraint, or added value to the consumer?

Both Rust (2010) and Gatignon (2010) question the extent to which the chilling effect is a universal phenomenon, arguing to the effect that it might be an artifact of the way the integration of network externalities and word of mouth is modeled in our paper. Rust suggests an alternative utility–additive model in which network effects create additional value to the customer and thus speed – rather than chill – the process.

To examine this point, one should go back to the definition of a network good. Conventional use of the term suggests that network effects (or externalities) exist when the utility an individual obtains from the product increases with the number of others using it. What is absent from this popular economic definition is the issue of absolute utility, with and without network effects (see for example Jackson, 2008).

The approach we take views the need for other users as a *constraint*, where with an increase in additional users, the constraint gradually dissipates. In a sense we could imagine a theoretical utility one could obtain if the network effects would not have existed at all, and that with each additional user, the product's realized utility moves closer to that upper bound. The distribution of thresholds is a function of the distribution of this upper-bound utility in the population.

We believe that our view is appropriate for nearly all the network products analyzed in the literature. Consider as an example a direct network effect product: a new type of fast-streaming cellular video that requires others to have the same technology to be able to engage in video chat with them. This is clearly a network good, as the number of others that have the technology increases a given user's ability to use it, and thus its utility. However, from the customers' point of view, this network effect is a constraint. S/he would clearly rather from start be able to engage in video chats with *all* other cellular users, and not wait until enough others adopt the specific technology. Similarly, when considering adopting an indirect network good such as the DVD, customers would rather there had been numerous DVD titles in stores to begin with, so that the number of titles did not have to depend on others' adoption. Therefore the wait for others chills the adoption process – not enhances it – which is also true for other “hardware/software” indirect network goods (e.g., see examples in Stremersch, Tellis, Franses & Binken, 2007).

The alternative to which Rust points models network externalities not as a constraint but rather as a source of additional utility over a non-network effect option. It implies that the greater the need for others, the greater the utility. While this implication does not seem feasible for most products, one may imagine certain status-based products for which it will be true, i.e., the more others are needed, the more status-based utility is attached to this brand (probably up to a limit). As indicated in our paper, our approach does not explore the case of status-based utility; yet modeling such growth along the lines suggested here is a promising topic for future research. One should also note that as we discuss in the appendix of our paper, the group of initial buyers with a threshold of zero – which is crucial to the takeoff of the innovation – is ill-identified in the additive model. This ill-identification renders it less appealing as a model for network externalities.

2. The chilling effect under competition

Tellis (2010) considers the chilling effect from another angle: the replacement of a network good by a new network good. He gives an example taken from Tellis, Yin, and Niraj (2009) where Microsoft, introducing the superior Word technology, was able to replace WordPerfect. The basic idea is that in a case where a superior product challenges an existing one in a network goods market, a small fraction of informed adopters can lead to rapid adoption of the new product by enhancing its utility to others. In such cases, Tellis argues, network effects enhance rather than hinder the adoption of the (superior) new product.

Tellis' explanation of how the local effect of a small expert group helps to overcome the existing lock-in of network effect is not only

☆ We are grateful for the insightful comments on our paper “The Chilling Effects of Network Externalities” provided by Hubert Gatignon, Roland Rust, and Gerard Tellis. Their comments provide an opportunity to further explore the chilling effect, and help set the agenda for additional research. In what follows, we select the issues on which we believe we can either further elaborate or offer a different perspective.

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intriguing, it is an important contribution to the lively debate in economics and marketing on the ability of a new entrant to overcome the network effect of existing players. However, we believe that it does not contradict the chilling effect, nor does it lead to the conclusion that "… network effects may be said to warm and not chill a budding market". While our paper does not explicitly model competitive effects, Tellis' remarks do shed some light on how the chilling effect fits such scenarios.

The first issue to consider in such a competitive case is the question of whose network effect is the focus of analysis. Building on the Microsoft Word example, consider two competing network effects: a) WordPerfect's and b) Microsoft Word's.

Regarding the former, clearly the WordPerfect network externalities created a chilling effect on MS Word that is very similar to the one we described in the paper. Initially few people were willing to switch, because the number of others using MS Word did not surpass their individual thresholds. However, as others began moving over to MS Word, more people passed the threshold, and at some point in time, a strong takeoff was expected. While not modeled explicitly, we expect the overall effect on Microsoft Word's profits to be a chilling one compared to a case wherein WordPerfect *would not have network effects installed*. Of course, the higher the quality of Word, the lower we can expect WordPerfect users' thresholds to be, and the weaker the chill. Thus, the chilling effect analysis helps us to explore how much money Microsoft would have saved if it would have made Word compatible with WordPerfect, or to what extent it should have invested in partial compatibility.

A second source of chill stemmed from MS Word's own network effects. Tellis suggests that by imposing its own network externalities, MS Word could have helped mitigate the chill created by the WordPerfect network effect. The dynamics described are interesting and deserve a close analysis. We believe a better understanding demands individual-level modeling, e.g., an agent-based model that will take up where the aggregate-level work of Tellis et al. (2009) left off. Regarding the overall financial effect of the second entrant's network externalities, the final justification for additional network effects is unclear. While MS Word's network externalities could have helped at some point to begin a bandwagon, initially they would have also slowed down the transition of some users who appreciated the quality of MS Word, yet hesitated because of the new network effects. If MS Word could have achieved at least partial compatibility (as it did in practice), it is possible that a network effect-free product would have helped to accelerate the speed of diffusion. Of course, eventually Microsoft benefited from Word's own lock-in, which may be an independent reason for an imposed network effect. An agent-based analysis will help to untangle some of the complexity of the situation.

3. On agent-based modeling

Gatignon raises a number of interesting issues regarding the use of agent-based models, particularly the validity of the individual-level assumptions. One should note that the implicit assumption of the Bass model and most of its extensions is that the social system is homogenous and fully connected. Yet the extensive research on social networks conducted recently reveals that social networks are neither homogenous nor fully connected (see for example Van den Bulte & Wuyts, 2007). In order to deal with the complexity of heterogonous individuals in a partially connected network, the models have to be constructed at the individual rather than the aggregate level. Thus the basic assumptions made in agent-based models in marketing are in response to the rather severe constraints of aggregate-level analysis.

We believe that individual-level models are the key to the future directions of diffusion modeling: combining individual-level perspective into diffusion theory can be an effective tool in solving many of the questions still left open in marketing of new products. Specifically, these models can contribute to incorporating heterogeneity into the diffusion framework, and separating the effects of word-of-mouth, signals, and network externalities.

One way of adding a reality check to the models is to use actual network structures on the communication patterns of individuals, and then use an agent-based framework to model the growth of the innovation. Thus if the agent-based models construct a "would-be world", an agent-based model that builds on an existing structure of an actual social network represents "would-be growth" of an innovation in that network (see for example Libai, Muller, & Peres, 2009b).

4. Price, quality and other variables

Both Tellis and Gatignon reflect on the need to consider additional variables in the analysis. Tellis focuses on the variables of price and quality and their expected impact on the chilling effect. However, after decades of research into the diffusion of innovation, the roles of social interactions such as word of mouth, network effects, and imitations have been well established as major drivers of growth (see Peres, Muller, & Mahajan, 2009 for a recent review). Hence, while price and quality certainly play a role in the growth of new products, accepting them as the sole drivers of the dynamics of growth would not be supported by the majority of research to date. Take the example of markets for cellular phones mentioned by Tellis, where social interaction dynamics have been used and documented in numerous research studies to explain growth. In a recent example, Libai, Muller, and Peres (2009a) show how consumer communications dynamics help to explain the growth of cellular brands in Western Europe. Interestingly, across-countries price played but a minor role in the dynamics.

The question remains whether the omission of price and quality biases the chilling effect we report. As Tellis rightly points out, in most markets the dynamics are such that price goes down and quality goes up with time. Nevertheless, the implication is that it is harder to "sell" the new product early on. In such situations, it becomes less common for consumers to overcome their thresholds and adopt, *and so the chilling effect will be stronger*. Indeed, in the paper we find that externalities have a stronger effect on profitability early in the product life cycle than they do in later periods. The chilling effect can therefore aid in motivating price reductions early on.

We agree that the more specific effect of dynamics in price/quality on the chilling effect, as well as the relationship to other network structure variables Gatignon suggests, are worthwhile subjects of study. Future research can take advantage of the flexibility of agent-based models to further examine the interaction of additional variables, as well as to explore additional novel ways to separate network externalities, word of mouth, and other social effects. We hope that our work has been but the beginning of such journey.

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