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Commentary on Jacob Goldenberg, Barak Libai and Eitan Muller's "The chilling effects of network externalities"

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ABSTRACT

This commentary builds on the paper by Goldenberg, Libai, and Muller (2009) and on the areas of the contribution it makes to the field: the distinction between word-of-mouth and network externality effects, agent-based simulations and extensions of the Bass model for aggregate models including word-of-mouth and network externalities. It reflects on some of the issues raised by this paper and provides directions which the author thinks would be beneficial for future diffusion modeling efforts.

Even after several decades of research attempting to explain the speed and shape of growth of new products, our Marketing modeling efforts remain strongly based on the Bass model (Bass, 1969) with its multiplicity of extensions. Within this research stream, Goldenberg, Libai, and Muller (2009) address the important issue of distinguishing between two well known phenomena, the word-of-mouth effect on the one hand, and network externalities on the other hand. In this commentary, we will first discuss this particular issue. We will then make a few remarks concerning their modeling approaches which include agent-based simulations as well as their Bass model extension with a variable market potential.

1. Distinguishing word-of-mouth from network externality effects

Goldenberg et al. (2009) suggest a solution for separating the impact on product growth of interpersonal communications and of network externalities, as pointed out by Van den Bulte and Stremersch (2004). Network externalities concern the utility of the innovation; this utility is explained, in part, by the extent to which the innovation has already been adopted. Word-of-mouth does not directly affect the product's utility (although it may do so indirectly). The word-of-mouth process is complex; not all adopters have the same opportunity to equally influence a potential buyer (i.e., the global vs. local issues discussed in Goldenberg et al., 2009). Indeed, closeness of ties leads to greater communication, but, at the same time the strength of weak ties has been demonstrated (Burt, 1973; Granovetter, 1983). The distinction between word-of-mouth and network externalities in Goldenberg et al. (2009) is due to the definition of a specific utility function derived from the existence of a threshold: the utility from the network only comes after the network has reached a certain size (Eq. (1) in Goldenberg et al., 2009). This behavioral process appears quite plausible and is certainly worth investigating.

The approach of developing an individual model and deriving its consequences on the diffusion pattern follows the tradition of economic diffusion models such as Stoneman (1981), Jensen (1982) or Feder and O'Mara (1982), as reviewed in Gatignon and Robertson (1986). Although Goldenberg et al. (2009) use a different adoption process, the distribution of the key factor – the threshold level – across the population presents similarities with the model of Feder and O'Mara (1982). Indeed, in Feder and O'Mara (1982), the prior utilities of the current technology are distributed across the population to explain different times of adoption. Instead, in Goldenberg et al. (2009), it is the utility of the innovation which varies depending on the threshold level which is itself distributed throughout the population.

The particular pattern emphasized in Goldenberg et al. (2009)'s title concerns the "chilling" or slowing down effect of network externalities. However, the network externalities modeled in their paper are characterized by a very specific pattern which requires a threshold of existing adopters to exhibit an effect on the utilities of those who have not yet adopted (0 probability of purchase if less than threshold, according to Eq. (1) in Goldenberg et al. (2009)). The model certainly distinguishes between a global effect of the size of the base of adopters and the effect of such a base that is subject to a threshold. However, is it the case that the first type can be clearly identified as being a word-of-mouth effect while the latter is a type of network effect? Furthermore, the existence of the "chilling" effect is determined by the presence of a non-zero probability of zero utility or no purchase in the case of the presence of a threshold. In other words, Eq. (1) constrains the adoption probabilities in the case of a threshold,

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which is not the case otherwise as only the top equation applies in this case with probability 1.

The role and formation of the network structure are clearly identified in the article as critical issues. The modeling approaches that Katona and Sarvary (2008) or Zubcsek, Chowdhury, and Katona (2008) propose could serve as a basis for developing further the impact of such structures beyond the four parameters varied in the simulation experiments, i.e., external influence, internal influence, mean and standard deviation of the threshold distribution.

2. Agent-based simulations

Although, as mentioned above, there is a tradition dating from the 1980's of modeling individual (or firm) adoption behavior, the complexity of the model was typically limited by the ability to track the aggregate-level diffusion. Agent-based modeling allows the development of more complex behavior which can be simulated to assess the aggregate diffusion pattern. As indicated by Goldenberg et al. (2009), this has been a tradition in many other fields like sociology or epidemiology. A number of questions can be raised, however. For example, to what extent does the chosen individual level process correspond to a reasonable process? Even if the interest is more analytical as a method to better understand the implications of the individual model's assumption, to what extent are the implications at the aggregate diffusion pattern level not directly the result of the assumptions? If this effect is indirect, what insight is gained about the process that goes beyond the assumption itself?

Goldenberg et al. (2009) point out that the results concerning the distribution of the threshold (effect 2) are not straightforward to understand. They explain that greater variance causes two effects described on pages 16–17. This complexity is also perhaps due to the lack of independence between the mean of the threshold and its variance: the range of the standard deviation is defined as a function of the mean h. It may be possible that the varying range, depending on the mean h, influences the results. This is further obscured by the use of a single variable (σ/h) in the regression estimated to analyze the results.

In summary, agent-based simulations have interesting potential, as illustrated in Goldenberg et al. (2009). They allow us to derive diffusion patterns from complex interdependent individual behaviors of innovation adoption. Future research may need to go beyond the simple structure assumed in typical current research. The experimental designs to analyze the various factors involved need to be carefully examined in order to draw unequivocal insights into the mechanisms that explain these effects.

3. Extended Bass Model to reflect word-of-mouth and network externalities

Goldenberg et al. (2009) model the network externalities threshold as affecting the market potential at time t in the Bass model. Word-of-mouth is reflected by the regular coefficient of internal influence q. While these mathematical representations enable us to distinguish between the two types of effects, it is not clear that they correspond to the constructs of network externalities and word-of-mouth. Indeed, if one were to assume a process without internal influence (no word-of-mouth effect), i.e., where $q=0$ in Eq. (2), the network externalities would still be reflected by the varying market potential according to Eq. (3). However, in such a case, the utility which varies according to the level of network externalities could arguably more appropriately affect the propensity to purchase, i.e., the factor p would be increased by the purchase propensity due to the network externalities which would apply to the remaining unsatisfied market $(N-x(t))$. Following Bass (1969), it is the likelihood of purchase at time T given that no purchase has yet been made, i.e., $f(T)/[1-F(T)]$, which represents these network externalities.

In conclusion, Goldenberg et al. (2009) contribute to the literature on diffusion of innovations in that they address key questions which have not received a complete answer to date. They propose a modeling approach which can be useful to develop further our understanding of the patterns of diffusion by providing explanations at the individual level of aggregate phenomena. The communication process of word-of-mouth communication involving social interactions is of a different nature than the evaluation of an innovation which may depend on the utility being derived from the number of users of a product. Distinguishing between these two notions and modeling better these critical processes are fruitful endeavors. This should open the road to the modeling of complex behavioral patterns, with important strategic implications at the aggregate level.

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