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Network externalities—Not cool? A comment on "The chilling effects of network externalities"

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In "The Chilling Effects of Network Externalities" (Goldenberg, Libai, & Muller, 2010), the authors seek to disentangle the effects of word-of-mouth vs. network externalities in driving product diffusion. This is a very appealing article in many respects. The topic is well-chosen, in that understanding the influence of network externalities in the diffusion process is important. In addition the authors employ an appropriate methodology, agent-based modeling, in the form of cellular automata. Agent-based models, although still not widely used in the marketing literature, make it possible to explore how complex aggregate-level phenomena can emerge from a large number of individual actors (agents) following fairly simple decision rules.

At the same time, the construction of the model leads one to question the substantive conclusions of the article. Let me first explain why the construction of their model makes the substantive implications a foregone conclusion. Then I will demonstrate an alternative model formulation that would result in opposite conclusions, still using an agent-based approach. Finally I will propose an approach that could be used to select the best model and validate the agent-based model, to provide the basis for more authoritative substantive results.

1. The current model

In the network externalities case, each consumer (agent) who has not yet adopted has the following decision rule:

> ***Current Adoption Rule (Network Externalities)****: Adopt if 1) word-of-mouth is received, AND 2) the network externality threshold level is exceeded.*

It is not clear from the paper, but communication with the authors confirms that the following is the decision rule in the no network externalities case:

> ***Current Adoption Rule (No Network Externalities)****: Adopt if 1) word-of-mouth is received.*

It is quite obvious from examining the above two rules that for any individual consumer (agent) and any non-zero threshold level, adoption will be faster in the no network externality case, because only one condition must be met, rather than two. In other words, the "chilling effects" of network externalities are "baked into" the model by construction. The substantive result is tautological.

2. An alternative model

Let me now show how an alternative model construction can result in opposite conclusions. Following the conventional wisdom about network effects (Doganoglu & Grzybowski, 2007; Shapiro & Varian, 1999), let me formulate a model in which the consumer chooses to adopt whenever the utility of adoption exceeds a utility threshold. Let the utility of adoption have two parts—a word-of-mouth part and a network externalities part. That is:

$$\begin{aligned}\text{Utility} = {} & \text{Utility from word-of-mouth} \\ & + \text{Utility from network externalities}\end{aligned} \tag{1}$$

Then the adoption rules are:

> ***Alternative Adoption Rule (Network Externalities)****: Adopt if Utility from word-of-mouth + Utility from network externalities ≥ Utility threshold.*
>
> ***Alternative Adoption Rule (No Network Externalities)****: Adopt if Utility from word-of-mouth ≥ Utility threshold.*

It is easy to see that under this model formulation adoption will always be faster under the network externalities case. Again the result is "baked into" the model construction, and the substantive result is tautological.

3. Which is right?

The demonstration above is not an indictment of agent-based modeling. Note that it is not the agent-based modeling approach that is producing the substantive ambiguity, but rather the modeling assumptions that underlie the agent-based model. Also theory alone cannot resolve the issue. As the authors note, there is theory to support their proposed model, and also theory to support my alternative model (which represents the current conventional wisdom).

In any simulation-based approach, such as agent-based modeling, validating the model's inputs is an essential part of the process (Rand & Rust, 2009). In this particular case, the model construction itself needs to be validated. Because individual consumers are simulated, the appropriate validation is at the individual consumer level. The appropriate validation test would then be to observe individual consumers with respect to their received word-of-mouth, network externalities, and decision whether to adopt. Then the two competing models could be fit to the individual-level data to see which model

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provided the better fit. It may also be possible that some consumers use one model and other consumers use the other. The validation could be performed in the field (for high external validity, but perhaps less internal validity) or in the laboratory (for high internal validity, but perhaps less external validity).

4. Conclusion

The authors have performed an important service by exploring an important problem using appropriate methodology. The effects of network externalities on diffusion can be explored effectively using this approach. At the same time, the substantive results from their current study appear to be an artifact of the chosen adoption decision rule. Alternative models, using the same agent-based approach, could produce diametrically opposite results. Validation of the individual decision modeling framework, using observation of actual consumers, would be necessary to fully validate the model and provide confidence in the substantive results.

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