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[MARKETING]

The Power of Product Recommendation Networks

New research on the structure of product recommendation networks reveals how demand flows among products — and that has important implications for marketers.

BY GAL OESTREICHER-SINGER, ARUN SUNDARARAJAN, AND GERALD C. KANE

We all know that colds, the flu, and other diseases are contagious. They spread from one person to another, with different individuals displaying varying degrees of susceptibility. Similarly, ideas and information can be contagious. Online social networks like Facebook and Twitter amplify the spread of concepts and content — sometimes to such a degree that they're said to be "going viral." This phenomenon can play a role in marketing, as customers spread awareness of and interest in products through word-of-mouth interactions.

Such social interactions form the basis for network-based demand shifts for specific products. However, today's platforms can also enable demand to spread across different and potentially competing products. Online retail platforms like Amazon.com provide product recommendations, noting, for instance, on the landing page of Product A that people who bought Product A also bought Product B. Such recommendations define what we call a

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copurchase network of products connected by shared purchasing behaviors. As users click from one product to the next, attention flows from one product page to the next, causing the network to become a potential channel for redistributing demand across brands. Think of this phenomenon as the virtual aisle structure of the online storefront.

How might this contagion actually play out? Consider this real-life example: In September 2007, actress Jenny McCarthy appeared on "The Oprah Winfrey Show" and discussed *Louder than Words: A Mother's Journey in Healing Autism*, her book about dealing with her son's autism. After the show aired, demand for the book increased about 200-fold on Amazon.com. Further examination of Amazon's sales rank data, however, shows that the impact of McCarthy's appearance on "Oprah" was more far-reaching, altering demand not just for *Louder Than Words* but also for books that were recommended on Amazon's *Louder Than Words* landing page. For example, two books located one click away in Amazon's copurchase network at the time — *Life Laughs: The Naked Truth About Motherhood, Marriage, and Moving On* (also written by McCarthy) and *Ten Things Every Child With Autism Wishes You Knew* — experienced estimated sales increases of 16-fold and sixfold, respectively. Even books located several recommendation clicks (or "degrees of separation") away enjoyed sizable demand gains.

To discover whether such an effect is systematically induced by external recommendations of books on Amazon, two of the authors, along with fellow researchers Eyal Carmi of Google Inc. and Uriel Stettner of the Coller School of Management at Tel Aviv University, collected Amazon data on more than 700,000 books and the products that Amazon recommended alongside those books. We then tested whether recommendations on "The Oprah Winfrey Show" or in *The New York Times* Sunday book review section could also drive sales for other products that appeared alongside the recommended product. Specifically, we studied the impact of 2,000 different recommendations from *The New York Times* book review section and all of the recommendations made by Oprah's Book Club. We estimated increases in book sales by analyzing sales ranking data available on Amazon.com using formulas based on prior research about the relationship between changes in Amazon sales rankings and actual book sales. (Detailed findings from our research were published in the March 2017 issue of the journal *MIS Quarterly*. See "Related Research.")

RELATED RESEARCH

E. Carmi, G. Oestreicher-Singer, U. Stettner, and A. Sundararajan, "Is Oprah Contagious? The Depth of Diffusion of Demand Shocks in a Product Network," MIS Quarterly 41, no. 1 (March 2017): 207-221.

We uncovered a number of interesting ripple effects of these high-profile media placements. The network amplified their economic impact, spreading demand increases to other products on the platform while yielding valuable information about a company's products and competitors that can support strategic decision-making. And the structure of the network shaped the magnitude of these ripple effects. Our findings have important implications for how managers consider product strategy and promotion on digital platforms.

How Demand Flows in Recommendation Networks

Companies have for years studied what products customers buy together; that data helps retailers configure physical-world shelf space to optimize such linkages. Online retail platforms take the analysis to the next level. They can examine the lifetime purchase histories of users to better understand the economic connections between products over time. The result is a rich network of products that are linked by the past purchasing behavior of millions of customers.

Much as connections in social networks have been used to understand and influence how ideas flow among people, we wondered whether it might be possible to use the structure of product recommendation networks online to understand or influence how demand flows among products. The short answer is yes, and the implications for marketers are significant. It means that when marketers try to influence the demand of one product, say through advertising, the demand spillovers to other products in the recommendation network can dominate the ensuing economic impact. Our research revealed several important insights about how this demand spreads:

1. External recommendation can drive sales several degrees of separation away. Demand contagions can spread deep into a product network. The "Oprah Winfrey Show" and *New York Times* recommendations influenced demand for books that were, on average, three degrees of separation away from the recommended item. So demand shocks aren't just contagious; they fan out into a product network as well.

2. Contagious demand can increase sales by many multiples. The business impact of the demand increase was also highly significant. Specifically, Oprah's Book Club recommendations typically increased the estimated demand of the featured books 150-fold. More importantly, this demand shock then spread through the network. Estimated sales of books one degree of separation from the recommended book (in other words, titles

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directly recommended on the book's page) increased by more than 25-fold on average; books two degrees of separation away enjoyed an average increase of more than threefold in estimated demand; and books three degrees of separation away saw on average an estimated doubling of demand. Although the contagious effect of a typical *New York Times* book review recommendation was substantially less for books one and two degrees of separation away, its impact three and four degrees of separation away was comparable.

3. Demand echoes through dense networks. We found that, somewhat counterintuitively, tightly clustered networks (that is, areas where books tend to recommend each other) channeled demand contagions more effectively, albeit among a smaller set of products. This may be due to an "echo chamber" effect, which occurs in information networks when the same content recirculates through a cluster of nodes, amplifying its perceived importance. A similar effect can amplify how effectively the attention redistributed across related products converts into demand, particularly if these products are frequently bought together.

4. The network benefited more from the recommendation than the product itself did. Perhaps most importantly, we found that the aggregated economic effect of the recommendation was often far greater for the network than it was for the product publicized. In some cases, the products in the recommendation network that were not the focus of the initial publicity accounted for nearly 90% of the overall estimated revenue bump that would come from increased demand. In other words, the "Oprah effect" should be calculated broadly, not narrowly, and for the network, not just the individual product. Overlooking how demand shocks spread in product recommendation networks can cause marketers to miss the majority of promotion gains on digital platforms.

Managing for Recommendation Networks

Understanding that demand spreads through product networks has two important implications for managers. First, companies should reconsider how they spend their advertising dollars, developing advertising strategies that maximize marketing impact across a network rather than thinking in terms of a specific item. Second, the product recommendation network can provide marketers with valuable information about their products that can help managers make other types of strategic decisions.

Advertise to the network, not to an individual product. According to the old aphorism, half of your advertising dollar is wasted but you don't know which half. Our research provides guidance in determining which part is wasted — it's more likely the part that didn't take the recommendation network into consideration! Viewing the links in recommendation networks as pipes through which demand flows has important implications for how marketers should approach advertising.

Analyzing the structure of the recommendation network can help you allocate and assess the impact of marketing expenditures, media opportunities, or product placements better. Spending advertising money strategically on the products that

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are well positioned within the recommendation network to maximize demand spillovers drives sales for the entire network, not just the product you directly advertise. This approach will optimize the impact of your advertising dollars across your product portfolio.

You should also realize that network benefits could be a double-edged sword. Even though your primary goal is to promote your own products, recognize that demand may flow to your competitors' products as well. Since a majority of the impact may be felt in the network, it is entirely possible that your marketing dollars will drive sales of your competitor's products more than your own. Choose which regions of the network you target with care, and make sure the return on investment calculations for marketing and advertising campaigns include potential negative effects from the degree to which you help competitors.

Understand the network structure to improve decision-making. The recommendation network can help you gauge product demand patterns. Understanding the structure of this network can help improve product demand forecasting, a notoriously difficult task. It can be particularly helpful for assessing demand for products like books, music, and movies that do not have easily measurable characteristics to assess. In these situations, the product network can be a useful prism, providing considerable value by capturing latent preference and demand characteristics extracted from shared purchasing patterns. You don't need to know why customers like particular groups of products — you simply need to know that the demand for one product is also related to the demand of another product and that you can measure it.

The recommendation network can also help guide you in product development. Knowing which products your customers "also buy" can help you plan new products or upgrades of existing ones. Discovering that your customers copurchase certain types of products that you don't make may provide ideas for new product development. Likewise, if you discover that your customers are purchasing a competitor's product to complement a product you sell, there may be opportunities to improve your offering.

Lastly, data from the product recommendation network can also be used to help companies develop strategic partnerships. Rather than compete directly with other products, there may be opportunities to cross-promote with complementary products and synchronize development efforts.

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Recommendation Networks Beyond Amazon

As digital platforms increasingly mediate our commerce activities, the data generated by these interactions will generate analogous demand contagion effects for products on these platforms. Thus, managers have a constantly expanding universe of product recommendation networks. However, leveraging the networks for strategic advantage requires managers to know which network mechanisms drive which types of effects.

Recommendation networks only power demand contagion when connections between products are made visible to the customer. The customer must know what products are also purchased or viewed by other customers for the recommendation network to enable demand to spread across the network.

Similarly, recommendation networks provide predictive information about products only when the network is created based on customer preferences or choices. That is, the recommendations for products must be derived from the analysis of purchase or viewing patterns of customers. If a company simply creates a set of recommendations based on the products it thinks go together (in other words, not based on data generated by customer choice patterns), the network is unlikely to provide good variables for demand forecasting.

As digital platforms connect products and services in new ways, managers should adopt a network view of the business world. Every product portfolio is a network, the structure of which has important implications for product development, marketing, and promotion.

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