What the Adoption Literature can teach us about Social Media and Network Effects on Food Choices

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ABSTRACT

Decisions about food choices in terms of products, preparation, and venue are technology choices in the context of the household production function where consumers consider benefits from taste, health, convenience, and budget given different technologies and information. The literature on adoption in economics and marketing as well as the literature on information sources in food decision-making provides a context to assess the impact of new information and new media on food choices. This literature suggests that consumers use media for identifying information relevant to their decisions, but make final assessments based on total benefits and the probability of fit of a product in meeting their needs. Consumers rely on both formal and informal sources of information in making different choices, and electronic social networks improve the quality of and help more effectively target information from formal sources, but especially information from informal sources. Informational networks expand access of visual information to consumers when making food choices, and allow real-time interaction among consumers that enables them to be more informed about these decisions. Finally, food providers will recognize the role of electronic social networks and new media in food choices, and thus may use them to influence consumers' food selection.

Introduction

Humans are social creatures, and social scientists understand that interaction through social networks is a key element in influencing consumer behavior, including food consumption choices. The recent emergence of electronic social networks like Facebook, Twitter, and others has both reduced the cost of and modified interactions among individuals, affecting their choices as consumers. We argue that changes in food consumption patterns and experimentation with new food products are forms of adoption of new technologies at the consumer level. Consumers use social forums to inform one another about where and what they eat, exchange pictures of their meals and recipes, and use review websites like Yelp to rate their recent restaurant activity. Thus, there is a need to have a conceptual understanding of how social networks influence food consumption choices, and the literature on technology adoption provides a useful foundation to understand these patterns.

While much of the literature in agricultural economics considers adoption of technology by farmers, marketers have applied this literature in understanding consumer behavior. The large body of literature on technology adoption and diffusion can provide a conceptual and empirical foundation for emerging bodies of literature on how electronic social media is affecting food and natural resource consumption choices. This paper aims to identify some of the major lessons from the adoption and diffusion literature that are especially applicable to these choices.

The first section of the paper will provide an overview of the basic models of adoption and diffusion. This will be followed by a discussion of how these models address learning in the context of social networks. We will follow this with a discussion of the implications for food consumption choices.

Alternative Approaches to Modeling Adoption and Diffusion

The literature distinguishes between diffusion, which is measured by the aggregate share of individuals or share of land using a new technology, versus adoption by individuals. The early work was done by sociologists using aggregate data on diffusion, who noticed that diffusion rates behave as an S-shaped function over time and typically took the form $P_t = k * \left(1 - e^{-(a-bt)}\right)$ where *a* is a measure of initial diffusion, *b* is the indicator of the rate of diffusion, and *k* is the final rate of diffusion. Initial studies suggested that the parameters are larger in locations that were closer to commercial centers, and emphasized the geography of diffusion (Rogers 1974). Griliches (1957) adapted this model to introduce economic considerations and argued that the parameters of diffusion are determined by profitability of a new technology relative to the existing, traditional technology as well as factors such as average size of operation, etc. There is a large literature of conceptual and empirical work that is based on the work of Griliches. The models presented in this literature make up the imitation model, and it assumes that

individuals are to a large extent homogenous and that the technology is spread by imitation among agents.

The imitation model was criticized for its lack of explicit economic mechanisms and because it cannot be linked to general equilibrium models, and thus an alternative was introduced by David (1975) and later refined by Stoneman (1983) and Feder, Just, and Zilberman (1985). This new strain of literature assumes that agents have their own economic decision-making criteria (e.g. profit-maximizing or risk aversion), agents are heterogeneous in their characteristics (e.g. age, human capital, etc.), and that the technology evolves through processes of learning by doing or learning by using. If the distribution of heterogeneity is unimodal, then a small number of individuals adopt the technology in its early stages, a greater number of individuals adopt as it becomes more popular, and the marginal rate of adoption declines in the later stages of the technology's diffusion. The applications of the threshold model have increased with access to time series and individual panel data that allow economists to assess sources of heterogeneity and market segmentation, which may explain differences in adoption rates, as well as run simulations to estimate adoption rates in the future (Feder, Just, and Zilberman 1985).

A major challenge is the reconciliation of the mutual learning that can be taken from the imitation model with the individual decision-making that is key to the threshold model. One approach is to view adoption as a multi-stage process. Rogers divided the adoption decision-making process into five stages: awareness, interest, evaluation, trial, and final adoption. Kalish (1985) builds on this with a formal analysis dividing adoption into two stages: awareness and adoption. The stage of awareness is a time when one learns about a new technology, and in this case the logic of the imitation framework fits well—people are more likely to learn when they are apart of networks. But once someone is aware of a new technology, they will assess it following their own decision-making process. We will distinguish between obtaining information about technology and individual assessment, and incorporate findings from relevant literatures.

We will start with the literature on the second stage, which discusses technology adoption choices. Simple models of firm adoption behavior assume profit-maximization or expected net present value optimization in making decisions about buying capital goods, especially in cases where the technology is not divisible (for example, a farmer's decision of whether or not to invest in a tractor). Analysis of this type can help one understand the role of firm size, productivity, location, features of the technology, quality of land, weather conditions, etc. However, many technologies are divisible. The literature on how to allocate land between traditional and modern technologies or labor between two different activities distinguishes between the discrete choice of whether or not to adopt a technology, and if so how intensively. In this context, risk consideration is important, and the extent to which a new crop or technology is being adopted depends on risk aversion as well as other variables like farm size, human capital, etc. These decisions may also vary over time.

As the literature suggests, the share of a modern technology that is more beneficial but also more risky increases as it generates more profits compared to the traditional technology and the less correlation it has to the traditional technology. The considerations of relative profitability, riskiness, and correlation are especially important

in the decision of intensity of adoption. The decision of whether or not to adopt a new technology is also associated with the initial (or possibly periodical, due to discounting) fixed cost of the technology. This fixed cost may include the cost of investment and installation of new capital as well as investment in time and effort associated with learning and obtaining information about a new technology.

Over time, it was suggested that adoption may increase because the riskiness associated with the performance of the new technology decreases over time while the expected benefits from utilizing the new technology may increase (Zilberman, Zhao, Heiman 2012). At the same time, learning by doing among manufacturers reduces the fixed cost of a technology and increased awareness and better information reduces the cost of adjustment for consumers. The literature also notes that in some cases adoption may decline over time due to poor performance of the technology, resistance against the technology (e.g. pesticides), or the emergence of an alternative technology.

Learning and Uncertainty

A key element in the dynamic of adoption is learning. Several studies assume learning about new technologies to be a Bayesian process, namely there is a prior distribution of estimated profitability and other parameters of the new technology. This prior frequently tends to be pessimistic. Experimenting with the new technology leads to updating of this perceived distribution, and revised estimates are used to facilitate further decision-making into the future. There has not been much discussion in the adoption literature on the source of information about a new technology, which is an area where social networks can play a major role. Some studies assume that farmers learn from their own experience using a technology, while other studies assume full information or that farmers learn about the technology from others. The literature that builds around the threshold model and emphasizes heterogeneity recognizes that potential adopters are different and decision makers are more likely to rely on information from people that are similar to them.

But in reality, how do similar people obtain information about one another? Recent studies have found that traditional social networks have a limited role in explaining adoption behavior. There is clear evidence that availability of electronic means, for example cell phones, enhances transfer of information and affects patterns of production (Jensen 2007), and thus suggests that advances in electronic media enhances adoption by improving quality and accessibility of information (Aker 2010).

While the economic literature on adoption emphasizes the role of risks about price and performance, some of the marketing literature emphasizes risks about fit and reliability. Risk fit suggests that despite the usefulness of a technology, it may not meet the needs of certain consumers. Much of the marketing literature is based on addressing this risk. For example, to reduce fit risk, sellers provide product demonstration to buyers, including test-driving cars, the ability to try on clothes at the store, and sampling food at a grocery store. Fit risk may also be addressed through money-back guarantees that allow people to correct their mistakes after the fact. Reliability or performance risk is especially

important for durable goods, and reflects concern about quality and performance in the long run. One way to address this is through warranties and brand recognition.

While early studies rely on expected utility as the main tool to assess adoption behavior, there is a growing reliance on prospect theory, and, in particular, the notion of loss aversion. This notion suggests that there is extra pay associated with losses relative to gains, which will make buyers less likely to buy products with low probability of fit, and thus product promotion strategies that increase the probability of fit are likely to increase willingness to pay for a product.

Another recent development in the adoption literature was influenced by the real option model developed by Dixit (1994). While traditional adoption models consider the decision of whether or not to adopt a technology at a given time, decision makers live in a dynamic environment and may also consider a third option, which is to delay the adoption decision. Individuals may delay adoption if they expect the price of the technology to decline over time and the gain from the use of the technology in the immediate future to be smaller than the gain associated with the delay. Individuals may also delay adoption of a technology because more information about its performance may be revealed over time. The need to resolve uncertainty about a technology may lead potential adopters to experiment with the technology. In the case of a divisible technology, an individual may adopt on a small-scale, and if the results are satisfactory, may increase the scale of adoption. In the case of non-divisible technologies, money-back guarantees allow for learning and can delay the final decision until the buyer has sufficient certainty about the technology.

Sources of Information

As we have seen, the literature on the adoption choice has evolved to include dynamic considerations about learning. However, there are also studies investigating the sources of information that economic agents have when making decisions. In particular, Just et al. (2002) and Wolf, Just, and Zilberman (2001) studied the sources of information for decision-making in different sectors of agriculture. They distinguish between several types of actors that included final consumers and intermediaries, which included farmers, grain elevator owners, bankers, etc., and investigated the main sources of information for different types of decisions. They found that farmers obtain half their information from formal sources like commodity associations, media, and extension and commodity dealers, and half from informal sources, like peers. Farmers use different sources for different types of information and choices. For example, farmers rely most heavily on commercial consultants and the USDA for price forecasts and predictions of future global situations. The major sources of information for new agricultural innovations are, in order of importance: agricultural media, extension, informal sources, and extension. Information vendors, consultants, and the media are main sources of information for market conditions, while commodity associations and extension are the main sources of information about institutional problems (Wolf, Just, and Zilberman 2001). This study was conducted in the 1990s, and today the electronic media likely plays a much larger role in solving problems of information accessibility. Additionally, decision-makers

recognize that the value of information from different sources varies—generally USDA, extension, and in-house analysis tends to be much more reliable than informal information or information provided by brokers and vendors. Publicly provided information is generally appreciated for its accuracy and non-biased nature, but has been shown to be lacking in clarity, accessibility, and timeliness. The information provided by consultants is very timely and precise, while informal information is timely, accessible, and geographically specific, but is heavily biased (Just, Wolf, and Zilberman 2003). The major lesson is that decision-makers use different sources of information for different decision problems. They appreciate the accuracy, unbiased information, and geographic specificity of information.

These three studies as well as others cited by them document that farmers may be willing to pay consultants or even hire in-house expertise to have timely access to information that is tailored for their specific needs. They recognize some of the limitations of informal sources, but frequently rely on them when there are no better options of formal sources and appreciate their capacity to be relevant and meet their needs in many circumstances.

Adoption by Consumers

As mentioned earlier, most of the literature on adoption in agriculture considers choices by producers. A modeling framework that builds on the framework of the threshold model but uses the household production model for basic decision-making was introduced by Zilberman and Liu (2011). It assumes that consumers obtain utility from certain characteristics provided by durables as well as variable inputs and expenditures on other goods. For example, in the case of a car, consumers obtain utility from transport and convenience that is provided by both the car and the fuel. In food, consumers obtain utility from taste, health, and time-saving provided by consumption and preparation of food, which includes raw materials as well as cooking appliances. Consumers differ in their incomes as well as other characteristics (age, gender, etc.) and thus can be segmented into different groups that will make different product choices both in terms of adoption of durables as well as patterns of input use. This framework can be expanded to include dynamic considerations (for example, assessment of investment in cars or appliances) as well as various types of uncertainties and risk, and it suggests that there is a very transparent path from the knowledge obtained in the adoption literature that emphasizes firms to adoption choices by consumers.

There is a growing literature on adoption of technology by consumers that is being used to assess decisions regarding the purchase of durable goods, consumption of energy, adoption of conservation technologies, etc. (Davis 2010, Borenstein 2013). This new literature compliments older literature that identifies differences in income and price variation as a major determinant of differences in adoption within and between countries (Parker 1992). Different empirical strategies to assess adoption as well as resulting variable input demand are presented by Fleiter, Worrell, and Eichhammer (2011) who survey evidence of barriers for the adoption of energy efficient technologies. The large literature on adoption of innovations by both firms and individuals as well as related

studies on sources of information identify some of the main challenges and constraints that the introduction of electronic social media can address.

There is a large literature on food choices and its relation to nutritional content, much of which builds formally on the family production function model (LaFrance 2001). There is an even larger empirical and multidisciplinary literature on factors affecting food choices (Asp 1999). This study emphasizes the transition from consumption at home and consumption in institutions like restaurants and company cafeterias and the growing importance of the decision of whether to cook at home or eat out. Just, Heiman, and Zilberman (2007) developed a household model to assess adoption of food of different characteristics, and identified that it is affected by needs, preference, and power of specific members of the family as well as by family income and evern more so by religious beliefs and social norms. Grunert (2005) argues for the importance of perception of quality and the factors that affect this perception in analyzing food choices. Quantitative assessments of the importance of labeling information and perceptions in attitudes, willingness to pay, and selection of various food products and categories are presented by Kiesel, Mccluskey, and Villas-Boas (2011). Kim and Geistfeld (2003) study the factors that affect the decision to eat an evening meal at a restaurant versus at home, and find that some of the factors that are crucial in technology adoption are also important in this decision. They also find that demographic factors, for example having young children, affect this decision as well. This literature on food selection explicitly and implicitly builds on main elements of the adoption and household production function literatures. This literature also provides an important perspective to assess how electronic social media will affect food choices.

Implications for the Impact of Electronic Social Media on Food Choices

As the adoption literature suggests, social networks as well as learning from others has played an important role in food choice in the past. The Internet and new media have led to provision of social networking services that enhance the exchange of information among members of the network. These networks enable real-time exchange of visual information as well interaction among users (Ellison 2007). This can be extremely helpful in assessing food choices, as it allows users to inform one another about what they eat, recipes, and help in preparation of food while cooking. These electronic networks also provide information about nutritional properties and the social implications of consuming different types of food. Furthermore, they provide continuously updated service on both location and performance of food services, and there is evidence that services like Yelp have a significant impact on consumer choices (Anderson and Magruder 2012).

Electronic social media can have substantial impacts on major food-related choices by consumers. These decisions are interdependent and sequential. A simple decision sequence a family may go through is whether to eat at home or at a restaurant. If they decide to eat at home, then they must decide what to eat and how to prepare it, which depends on decisions about food purchases as well as food preparation, which depends on previous appliance purchases. Similarly, if an individual or family chooses to

eat out, they must decide on a restaurant followed by what to order at the restaurant they choose. Of course, there may be intermediary choices when making choices about restaurants (for example, the type of cuisine, cost, location, etc.). These decisions are affected by socioeconomic, demographic, and geographic factors, among others.

Individual choices as well as sequences of decisions can be formalized by models of adoption within the household production function framework, and an aggregate outcome can provide a framework to assess measures of diffusion. For example, one can use diffusion models to assess the probability of selection of different types of restaurants or certain types of food. Because of the importance of informational considerations in these choices, electronic social networks can affect each of them. Consider the case of the family who has decided to cook at home. Electronic social media can impact the types of food families choose to eat and how they cook them. Families have a traditional inventory of meals they know how and are equipped to cook, and are frequently exposed to information about new types of meals (which can be analogous to new technologies).

As the literature on information sources suggests, main sources for information on production technologies are the media and informal sources, which is true in the case of food information. The development of electronic social media networks increases the effectiveness of informal interaction because the cost of exchanging informal information has fallen dramatically and it is not only provided through text, but also images as well. Of course, it would be ideal if the Internet could also provide a sense of smell or touch, but even a picture of food is superior to any textual description when making food-related decisions. Furthermore, as was mentioned earlier, informal sources are the major sources of information about production processes, and electronic social networks as well as cell phones allow real-time interaction with friends and colleagues guiding preparation.

When it comes to decisions about what and where to eat, the adoption literature suggests that one of the factors affecting this choice is fit risk. Fit risk is likely to be reduced if the suggestion about a new food or restaurant comes from someone with similar characteristics, including taste, geographic location, etc. Electronic social networks may allow better assessment of the relevance of others choices to ones own. When an individual is familiar with people in their network, they may place different weights on the opinions and information provided by different members of the network. Consumers may be more willing to trust information provided by sources like Yelp and other consumer-generated reviews that they believe to be more similar in preference than newspaper critics, who many feel to be part of the "elite." The extent to which electronic social networks allow the reduction of fit risk is an interesting area of future research.

The adoption literature emphasizes that decisions about adoption are multi-dimensional, and consider both the impact on obvious economic indicators like income, but also take into account health effects, convenience, etc. For example, one of the reasons farmers tended to adopt GM crop varieties is because of non-pecuniary externalities, including improved health and time-saving (Barrows, Sexton, and Zilberman 2014). Electronic social media may affect information about many dimensions that affect food choice decisions. Mccluskey and Swinnen (2011) provide a conceptual framework as well as evidence that the media affects food choice through its impact on food risk perception, and as electronic social media evolves, it will affect provision about

information on food risk and, as a result, food choices. Private companies, NGOs, and government extension organizations that are aware of this development are likely to modify their existing media strategies to adapt to the evolving media, which may affect food choice both directly as well as through the political process. Understanding these issues is another important topic of future research.

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