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Trust and willingness to pay for nanotechnology food

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ABSTRACT

We analyze the role of trust in the evaluation of a new food technology, namely nanotechnology. A literature review in the social and economic sciences reveals that many different trust concepts are available. The economics literature suggests that trust can lead to lower efforts of self-protecting behavior. Translating this concept into the framework of willingness to pay (WTP) for food products allows for the derivation of hypotheses on the workings of trust. We show that WTP for new food characteristics increases with trust also when new information about the technology is revealed. The results are confirmed with online survey data for Canada and Germany and experimental data in Germany.

Introduction

The development of integrated, long supply chains and some food technologies has made modern food businesses more vulnerable to safety incidents and consumer trust in the food industry has been challenged by a series of scandals. Consumers have become skeptical of food innovations and industrialization. Even when responding to the growing demand for convenience and safety, the successful introduction of new food technologies has become a major challenge.

It has been shown that trust is a construct that helps people to accept risks in the face of moral hazard. Hence, trust contributes to economic progress (Arrow, 1974). However, despite this recognized importance of trust in the economics literature, most original contributions and those that operationalize trust as a measurement construct have come from the field of other social sciences, such as sociology (e.g., Luhmann, 1968/2000; Giddens, 1990). Here trust is a source of social capital that helps to reduce complexity and to facilitate interaction. Giddens (1990), for example, posits that trust in expert systems is a mechanism to reduce complexity: when a layperson's knowledge is inadequate, the person will retain his or her ontological security by trusting experts. In a context of food safety crises and the development of new food technologies, trust is considered to be a key concept (Berg, 2004; de Jonge et al., 2008; Frewer et al., 1996; Kjærnes et al., 2007; Renn and Rohrmann, 2000; Sassatelli and Scott, 2001).

The objectives of this paper are twofold. From extant literature, definitions of trust are reviewed with regard to food technologies and an attempt is made to relate trust to consumers' willingness to pay (WTP) for altered food characteristics. Secondly, the relationship between trust and WTP is assessed for a new food attribute that is introduced using nanotechnology. We analyze whether trust correlates with the acceptance of a functional food attribute (here: vitamin enrichment and protection) and if this evaluation changes when consumers learn that the attribute has been created by means of nanotechnology.

Food nanotechnology is regulated under existing legislation (European Commission, 2012; Government of Canada, 2013) and a case by case approach is applied through a pre-market approval system (European Commission, 2012). A review of approaches to the regulatory governance of nanotechnology up to 2009 can be found in Pelley and Saner (2009). However, the application of nanotechnology in the food domain is surrounded by high levels of scientific uncertainty with several studies pointing to possible negative long term effects (Wang et al., 2006; Oberdörster et al., 2005). The application of nanotechnology in the food industry is still limited and new and rather unknown to consumers. In this context of low knowledge, high complexity and high uncertainty nobody retains the authority of better knowledge (Luhmann, 1993) and the safety of the food market increasingly depends on the decisions of the responsible actors (Fischler, 1988). Consumer acceptance of such new, complex technologies is likely to depend on how much they trust these actors.

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For the analysis we use data from online surveys conducted in Canada and Germany. The German survey was accompanied by an economic laboratory experiment. In all three studies, we propose two types of orange juice to the respondents and measure WTP under two different information scenarios. While data from the online surveys have been analyzed in Matin et al. (2012) and Vandermoere et al. (2010), results on the WTP data of the surveys have not yet been published. Bieberstein et al. (2013) analyze the experimental data used in this paper, however, the WTP data has not been linked to the question of trust. To our knowledge, this presents one of the few studies that analyze the impact of trust on WTP. Nocella et al. (2010) analyze the impact of trust on consumers' WTP for higher animal welfare standards. However, they measure trust not as institutional trust, but by using Fishbein's attitude model. Oh and Hong (2012) provide a theoretical analysis of the role of trust on WTP, where trust presents a shift in the expected value of an uncertain outcome. Meyer and Liebe (2010) use a measure of generalized trust as an antecedent of WTP for environmental protection in Switzerland. Our analysis differs from previous analysis in that we use institutional trust as a determinant of WTP and that we not only analyze the mean impact, but also aspects of the distributional impact based on experimental data.

Our results show that information about the use of a new technology in the food domain leads to a welfare decrease for consumers. Furthermore, we can show that trust increases WTP and that it protects WTP from bad news.

The paper proceeds in four sections. First, a literature review covers the different definitions of trust and their amenability for a meaningful definition of trust in the context of WTP studies. The following section describes the surveys and the methods for measuring trust and WTP. Results are presented next and the paper concludes with implications for research and regulation.

The role of trust

Literature review

Trust is a construct that has been developed in the social sciences. In this section we attempt to grasp the significance of trust in the social sciences and its meaning for the economics of consumers dealing with new food technologies.

According to Earle (2000) many trust researchers accept some version of the definition offered by Rousseau et al. (1998): "Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (p. 395). This type of interpersonal trust has been defined in a trustor–trustee relationship and more specifically as a state of expectation from a trustor (Gambetta, 1988; Bradach and Eccles, 1989). An alternative approach to trust is less centered on the individual and includes groups as trusting or trusted actors. Rotter (1967, p. 651), for example, defines interpersonal trust "as expectancy held by an individual or a group that the word, promise, verbal or written statement of another individual or group can be relied upon." (see also Nooteboom, 1996). Another definition of basic trust goes back to Erikson (1953) who describes it as central to a healthy personality. Trust in terms of personality has been assessed using attitudinal survey questions such as the one in general social surveys that asks the following: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (Glaeser et al., 2000, p. 812).

Research on technology acceptance has focused on the impact of social trust on technological risk perception and on the acceptance of a technology. Hereby, the definition of social trust relates to interpersonal relationships and to relationships between individuals and institutions (Kasperson et al., 1992). While interpersonal trust and institutional trust are often differentiated (Hudson, 2006), the latter is supposed to be important in complex societies such as ours (Luhmann, 1968/2000) and important for understanding the acceptance of modern technologies. Institutional trust has also been found to play an important role in explaining perceived risk (Earle and Cvetcovich, 1995; Siegrist et al., 2000; Slovic, 1999) and the acceptance of new food technologies (Costa-Font et al., 2008; Visschers et al., 2007).

Trust and willingness to pay (WTP)

Calculative trust plays a central role in decisions under uncertainty and is based on the expected behavior of others. While trust is mostly measured by attitudinal questions in the social sciences, economists tend to use choice-based metrics (McEvily et al., 2012). One example of measuring trust is the investment game (Berg et al., 1995). Here two groups of players interact on an investment. A player in group A can share an amount x of his show-up fee, say € 10, with a player in group B. By this investment the amount grows to αx, where $\alpha > 1$, and players in group B can decide the share to be returned (β). For a player in group A the pay-off is $10 - x + \alpha\ \beta x$, and for the player in group B it is $(1 - \beta)\alpha x$. The full information equilibrium of this game is to invest nothing. However, precluding side arrangements, individuals still invest and this is based on trust. Indeed, it is this feature of trust in overcoming the transaction costs of self-protection that makes trust ubiquitous in economic relationships (Arrow, 1974). Trust means that an individual is willing to forego self-protecting behavior that would come at a cost. Hence McEvily et al. (2012) turn to a definition of distrust that is expressed in terms of the (transaction) cost that someone is willing to bear in order to be less vulnerable to the action of another party. Taking a positive perspective, trust avoids costs that arise from measures of self-protection.

Translating this idea into a utility maximizing framework, our model starts on a money gamble. Suppose the payoff of an individual is $x - L$ with probability p and x with probability $1 - p$. The expected utility of the outcome is hence:

$$E[U] = pu(x - L) + (1 - p)u(x) \tag{1}$$

where u is the instantaneous utility function and L is the loss in the gamble. Now suppose the individual can invest an amount e in prevention or self-protection (Ehrlich and Becker, 1972). By this amount the individual is capable of decreasing the probability of a loss, so that

$$max_e E[U] = p(e)u(x - L - e) + (1 - p(e))u(x - e) \tag{2}$$

where p decreases in e. It has been shown that the optimal amount of prevention effort is not monotonic in risk aversion (Dionne and Eeckhoudt, 1985) and prudence (Eeckhoudt and Gollier, 2005). In contrast to a mean-preserving contraction of the payoff distribution in the sense of Rothschild and Stiglitz (1970) prevention causes a cost that shifts the probability distribution function downward by e.

Translating the expected utility maximizing framework to the definition of trust by Rousseau et al. (1998) and using the concept of distrust according to McEvily et al. (2012) leads to the conclusion that self-protecting effort e is lower with higher interpersonal trust. Hence trust alters the perceived risk by changing the probabilities of negative outcomes.

We now turn to the role that trust in food production may have when measuring WTP. The utility of a good that is consumed in x units depends on consumption and functional product quality denoted by q. Utility also depends on income, w, such that $u(x, q, w)$. For simplicity, we consider the case where the product is either not consumed ($x = 0$) or consumed in a single unit ($x = 1$). From this setup we can define the WTP for a quality q_1 and q_2 by the following set of equations.