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ABSTRACT

To be effective, groups that disseminate information need the trust of consumers. When multiple groups provide conflicting information on a new product or process like GM-foods, consumers place different levels of trust in the various sources. We present a model of the contributions of personal and social capital of a consumer, and test a multinominal logit model of relative trust in five different sources of information on genetic modification using a unique data set. Among our findings is that an increase in consumer's education lowers the probability of trusting information from government, private industry/organizations, consumer and environmental groups, or other sources relative to information from an independent third-party source. Older consumers have lower odds of trusting nobody relative to an independent, third-party source, and conservative religious affiliation reduces the odds of a consumer trusting private industry/organization and increases the odds of trusting nobody relative to an independent, third-party source.

Who Do Consumers Trust for Information:
The Case of Genetically Modified Foods?

During the 20th century, R&D has produced a steady stream of inventions and new

consumer goods, many of which have been adopted and proven to be the source of a rising

standard of living (Boskin et al.,1998). The introduction of new goods, however, creates a

disequilibrium (Hausman, 1996), and therefore a demand for more information to assist in

making decisions on adoption and use (Schultz, 1975).[1] The challenge for the consumer is to sort

through the various, often competing, sources of information. Consider, for example, the

controversial case of GM-products. Biotech industry firms, e.g., Monsanto, Syngenta, and the

industry's Council on Biotechnology Information have hailed the use of biotechnology to create

new products as a major revolution in product innovation (Hobans, 1997, 2001). They have

disseminated information claiming that GM-crops will be the next Green Revolution, lowering

food costs worldwide and leading to increased nutrition and energy in third world countries. The

Council has even created and distributed children's coloring books that promote the positive

aspects of GM-foods. In contrast, Greenpeace and Friends of the Earth, two major environmental

groups, claim that GM-food is "Frankenfood" (Gates 2001) and that GM-technology is a disaster

for the environment and of considerable risk to human health. They also argue on ethical grounds

that GM-products should be labeled so that consumers can choose between GM and other

products (Friends of the Earth, 2001; Greenpeace, 1997). These environmental groups have

produced volumes of negative GM-product information and distributed it through websites,

public protests, and press releases.

The federal government is also a supplier of information on genetic modification. In

1992, the Food and Drug Administration (FDA) issued a statement saying that genetically

modified foods did not have to be labeled if the new product has the same characteristics as its non- genetically modified counterpart (FDA, 1992). Since then, the US has not changed it position on genetically modified foods significantly (FDA, 2001). In contrast, the European Union, Australia, New Zealand, Japan, and Brazil have mandatory labeling policies for GM-foods. Furthermore, in 1998 the European Union enacted a moratorium on approvals of genetically modified foods, which has not been lifted. Other interest groups, e.g., independent, third-parties may also disseminate information on GM products.

Interested and disinterested parties disseminate information with the goal of affecting consumers' (and producers') decisions on GM-technology and products. However, for these groups to be influential, they must garner the "trust" of consumers. Recent evidence by Glaser et al. (2000) shows that individuals who are closer in social status or who have similar personal capital are more likely to trust one another. For example, individuals who were raised with a particular religious tradition place more trust in others that were raised within the same religious tradition, c*eteris paribus*. More generally, Becker (1996) argues that a consumer's social and personal capital is an important determinant of his/her tastes or preferences. Social capital is defined as the capital that the individual acquires through his/her surroundings, upbringing, and social network. Personal capital is defined as capital that the individual personally acquires, such as schooling, habits, or experience. Becker shows that when personal and social capital are incorporated into economic models, economic theory can explain many previously mysterious outcomes such as the effect of advertising on consumers' purchasing behavior and addictions.

Understanding the formation of trust in information sources is an important step in understanding consumers' preferences for information on new products. With the aid of a simple model, we formulate hypotheses about the role of measurable attributes of a consumer,

which are related to personal and social capital, in the formation of trust. For this study unique

data were collected from real adult consumers who participated in laboratory auctions of food

products that might be genetically modified. Information on personal and social capital,

household attributes, and prior beliefs about new technologies were collected from participants

in a pre-auction questionnaire. As part of the experiment, a new source of information was

introduced: independent, third-part or verifiable information (see Rousu et al 2002). In a post-

auction questionnaire, participants were asked to respond to a question dealing with trust in a

source for verifiable GM-information. This information was coded into a dependent variable for

a multinomial logit model with five outcomes and pre-auction information on a participant's

personal and social capital and beliefs provide the regressors for explaining trust. Relative trust

in shown to be related to a participants schooling, religion, age and prior beliefs about

genetically modified foods.

The Model

Following Becker (1996), consider the strictly quasi-concave utility function shown in

equation (1):

$$U = U(X_{labeled}, X_{nonlabeled}; T_1, \ldots T_j) \tag{1}$$

Utility is based on the consumption of two choice variables: foods labeled as genetically

modified ($X_{labeled}$) and foods that have a plain label ($X_{nonlabeled}$). The utility of these two goods is

hypothesized to be affected by information from j sources. This information differs in quality for

each type (i.e., level of trust). Information quality or trust in the *jth* type is assumed to be a

function of the consumer's personal capital (PC) and social capital (SC):

$$T_j = f_j(SC, PC). \tag{2}$$

The market price for foods labeled as genetically modified is $p_{labeled}$ and the price of plain-labeled foods is $p_{nonlabeled}$. At time t, the consumer maximizes his/her utility, subject to his/her budget constraint M, and stock of personal and social capital:

$$MAX\ U\left(X_{labeled}, X_{nonlabeled}; T_1, ...T_J\right),\ \ T_j = f_j\left(SC, PC\right) \tag{3}$$

$$\text{s.t.}\ \ p_{labeled}X_{labeled} + p_{nonlabeled}X_{nonlabeled} \leq M\ . $$

The first-order conditions are as follows:

$$MU_{labeled}\left(X_{labeled}, X_{nonlabeled}; T_1, ...T_J\right) - Ip_{labeled} = 0. \tag{4}$$

$$MU_{plain-labeled}\left(X_{labeled}, X_{plain-labeled}; T_1, ...T_J\right) - Ip_{plain-labeled} = 0. \tag{5}$$

$$p_{labeled}X_{labeled} + p_{nonlabeled}X_{nonlabeled} - M = 0\ . \tag{6}$$

This can be rearranged to show the marginal rate of substitution between genetically modified-labeled and plain-labeled foods, as shown in equation (7):

$$\frac{MU_{labeled}\left(X_{labeled}, X_{nonlabeled}; T_1, ...T_J\right)}{MU_{nonlabeled}\left(X_{labeled}, X_{nonlabeled}; T_1, ...T_J\right)} = \frac{p_{labeled}}{p_{nonlabeled}}\ . \tag{7}$$

A consumer's marginal rate of substitution between genetically modified-labeled and plain-labeled food is a function of the relative prices of the goods and personal and social capital, which influences the trust for the j providers of information. By moving the ratio of prices to the left-hand side, we can differentiate with respect to personal capital or social capital. Consider the equation below, which examines the impact of a change in a consumer's personal capital for the two goods:

$$\frac{MU_{nonlabeled}(\bullet)\left(\sum_{j=1}^{J}\frac{\partial MU_{labeled}(\bullet)}{\partial f_j}\frac{\partial f_j}{\partial PC}\right) - MU_{labeled}(\bullet)\left(\sum_{j=1}^{J}\frac{\partial MU_{non-labeled}(\bullet)}{\partial f_j}\frac{\partial f_j}{\partial PC}\right)}{\left[MU_{nonlabeled}(\bullet)\right]^2} \tag{8}$$

A change in personal capital seems likely to have differential impacts across the j information

quality types and is not neutral on the marginal rate of substitution between genetically modified-

labeled and plain-labeled food. To simplify the analysis and without loss of generality, assume a

change in T_j, $j = 1,...J$, does not impact the marginal utility for plain-labeled (nongenetically

modified) foods. Then equation (8) becomes

$$\frac{MU_{nonlabeled}(\bullet)\left(\sum_{j=1}^{J}\frac{\partial MU_{labeled}(\bullet)}{\partial f_j}\frac{\partial f_j}{\partial PC}\right)}{[MU_{nonlabeled}(\bullet)]^2}. \tag{8a}$$

To further understand how social capital can change consumption behavior, consider the

following example. Suppose environmental groups provide negative information about

genetically modified food, and agribusiness companies provide positive information about

genetically modified food. Suppose an increase in a consumer's education increases his/her trust

in environmental groups while decreasing his/her trust in agribusiness companies, other things

equal. The response is summarized in equation (9):

$$\frac{MU_{nonlabeled}(\bullet)\left(\frac{\partial MU_{labeled}(\bullet)}{\partial f_{ENV}}\frac{\partial f_{ENV}}{\partial PC}+\frac{\partial MU_{labeled}(\bullet)}{\partial f_{AGRI}}\frac{\partial f_{AGRI}}{\partial PC}\right)}{[MU_{nonlabeled}(\bullet)]^2}. \tag{9}$$

Consider the sign of the derivative. First, assume that the marginal utility of genetically

modified foods is positive. Second, the change in marginal utility of foods labeled as genetically

modified is negative with respect to trust of environmental groups, because environmental

groups provide negative information on foods labeled as genetically modified. Third, the change

in the marginal utility of foods labeled as genetically modified is positive with respect to trust of

agribusiness firms because agribusiness firms provide positive information on foods labeled as

genetically modified. If an increase in personal capital causes a consumer to trust environmental

information more and agribusiness information less, then equation (9) has a negative sign and the consumer would purchase more plain-labeled food products relative to their genetically modified-labeled counterparts.

For this case, an increase in personal capital causes the consumer's marginal rate of substitution between genetically modified-labeled and plain-labeled foods to decrease, and the consumer will purchase more plain-labeled foods (see figure 1). The opposite result holds if a change in a consumer's personal capital causes him or her to trust environmental groups less and agribusiness firms more. A change in a consumer's social capital causes similar effects on the demand for foods labeled as genetically modified. This example illustrates that, when personal or social capital changes the trust in an interested party (by changing the perceived quality of the information), it can change the consumer's demand for genetically modified-labeled or plain-labeled food.

The Survey

The participants in our survey and project were adult consumers over 18 years of age from two major Midwestern metropolitan areas that were chosen by a random digit dialing method. Three-hundred-eighteen individuals participated in our project, which was a response rate of approximately 19 percent. Table 1 summarizes the demographic characteristics of the survey participants (or respondents). The demographics of our sample do not perfectly match the U.S. census demographic characteristics for these regions, but they are similar and provide a sufficient representation to examine who consumers trust for information on genetically modified foods (see the Appendix for the demographic characteristics of the areas). Although our participants are slightly skewed toward women, Katsaras et al. (2001) show that women make up a disproportional share of grocery shoppers—83 percent of shoppers versus 52 percent in the

U.S. Census of Population. We now briefly discuss some of the demographic characteristics of the participants, which are presented in Tables 2 and 3.

Education is a form of personal capital. An individual's education not only affects the opportunity cost of his/her time, but also his/her ability to acquire and process information and to make decisions (Schultz ,1975; Huffman, 1977). Six percent of the participants did not complete high school; just under 19 percent of the participants completed high school but did not attend college. Almost 35 percent of the participants attended college but did not obtain a 4-year degree. About 20 percent of the participants received a 4-year college degree, and 19 percent completed at least some graduate work.

An individual's age is a proxy for years of experience as a decision-maker and also an indicator of length of expected remaining length of life. Accumulated experience as a decision making is expected to affect trust in information sources in general. Also, as an individual ages they have fewer expected years over which to obtain benefits from acquired information.

Religious upbringing is a form of social capital. A person's religious upbringing could affect every decision a person makes and could play a big role in trust formation. Our survey asked individuals to indicate their religious upbringing. Fifteen percent of the participants were raised as Baptists, slightly more than 26 percent of participants were raised as Catholics, over 17 percent of the participants were raised as Lutherans, and almost 16 percent were raised as Methodists (see table 2). Almost 20 percent indicated they were raised with so other specific religious upbringing and almost 6 percent indicated that they were not raised with any religious upbringing.

Individuals participating in our project were asked to bid on vegetable oil, tortilla chips, and Russet potatoes. After these bidding experiments were completed, they were then asked to complete a post-auction questionnaire containing the question: "If a source were to give you verifiable information on genetically modified foods, who would you trust most?"[2] This was an open-ended question, and participants wrote their answer down on the questionnaire. We then coded the responses into six categories: government; university, scientists/researchers, or third-party groups; environmental/consumer group; private industry/organization; none; and other, including media.[3]

The first category, "government," contains responses from individuals who named a government (national, state, or local) or a governmental entity (e.g., the FDA). The second category is independent third-party sources. It contains responses from individuals who would most trust universities, scientists, or an independent third-party group that does not have financial ties to genetic modification. The third category is for participants who indicated they would most trust an "environmental or consumer group" to provide verifiable information on genetically modified foods. The fourth category is "private industry/organization," which contains the response for any individual who listed a private entity or business as the group they would trust most. Most of these responses were for agribusiness firms or grocery stores. The fifth category is "none" and it is for individuals who said they would not trust any source. The last category is classified as "other" and it contains responses by individuals that were unusable, and some other responses that were too sparse for their own category (e.g., one person said he or she most trusted God to provide verifiable information on genetically modified foods). This group also contained the respondents who said they most trusted the media (about 5 percent),

which was not included in a separate category because the media reports information from various sources.

Excluding the "other" category, the most frequently reported source of trusted verifiable information was the second group, "university, scientists/researches, or third-party group," accounting for 30 percent of the responses (see table 4). The "government" was listed by 20 percent of the respondents. The "environmental/consumer group," "private industry/organization," and "none" each received less that 6 percent of the responses.

Econometric Model

Consider a random utility model in which the utility of the consumer is based on the choice he or she makes:[4]

$$U_{ij} = \boldsymbol{b}'x_{ij} + \boldsymbol{e}_{ij}. \tag{10}$$

Here the utility of consumer i is based on choice $j \in J$. If s/he chooses j, it must be the choice that yields the highest utility to the individual. With disturbance terms that are independently and identically distributed Weibull, the probability of consumer i choosing choice j is:

$$\text{Prob}(Y_i = j) = \frac{e^{\boldsymbol{b}_j'x_i}}{\sum_{k=1}^{J} e^{\boldsymbol{b}_k'x_{ii}}} \quad \text{for } j=0,1,\ldots,J. \tag{11}$$

Equation (11) is the multinomial logit model. However, to solve the model, one must first define $\boldsymbol{b}^*_j = \boldsymbol{b}_j + q$, for a vector q, and then normalize $\boldsymbol{b}_0 = 0.$[5] The probability of choice j is then

$$\text{Prob}(Y = j) = \frac{e^{\boldsymbol{b}_j'x_i}}{1 + \sum_{k=1}^{J} e^{\boldsymbol{b}_k'x_{ii}}} \quad \text{for } j=1,2,\ldots,J. \tag{12}$$

$$\text{Prob}(Y = 0) = \frac{1}{1 + \sum_{k=1}^{J} e^{\mathbf{b}_k ' x_{ii}}}. \tag{13}$$

Now, we can represent the probability that a consumer prefers one choice over another as the

log-odds ratios:

$$\ln\left(\frac{P_{ij}}{P_{i0}}\right) = \mathbf{b}_j ' x_i. \tag{14}$$

Equation (14) shows the probability that a consumer prefers (trust) choice j over choice 0, the

reference choice.[6] If $\mathbf{b}_j'$ is positive, then a marginal increase in x_i increases the odds that the

consumer prefers choice j over the reference choice. For this study, the reference choice is the

"independent third-party source." The regressors are the reported personal and social capital and

beliefs of the respondents.

Econometric Results

The fitted model allows us to examine the odds that a consumer trusts one of the five

sources of information more or less than he or she trusts an "independent third-party source" to

provide verifiable information on genetically modified foods. Four regressors are included in

this multinomial logit model: a consumer's education, age (which can be thought of as a proxy

for experience), and a dummy variable that equals one if the consumer perceives him- or herself

as being "at least somewhat informed regarding genetically modified foods." These three

variables are all types of personal capital. The fourth regressor is a consumer's religious

upbringing, represented by a dummy variable that equals one if the consumer was raised as a

Baptist, a Catholic, or a Lutheran (the three strictest religious upbringings in the survey).

Religious upbringing is a form of social capital.

The estimated coefficients for the multinomial logit model of consumers' trust in information sources on genetic modification are reported in table 5. The independent variables are listed on the far-left column, while the information sources are listed on the top row. Matching the regressor on the left-hand side with the information source (written relative to the third-party source) provides the coefficient for the log-odds ratio.

In our results, consumers who are well educated are more likely to trust an "independent third-party" source relative to other sources. Those who have more education are less likely to name "other," report they trust "nobody," report they trust the "government," or trust information from private sources than to "trust third-party" information. However, the respondent's education does not have a significant effect on the odds of a person trusting environmental groups relative to an independent third- party organization.

As a consumer becomes older, the odds in favor of trusting "nobody" fall relative to trusting third-party sources. However, the respondent's age does not have a statistically significant effect on his/her odds of trusting the government, environmental groups, or private industry/organizations relative to third-party sources.

Consumers, who reported being "informed about genetically modified foods" are more likely to trust the "government" than an independent third-party organization to provide verifiable information on genetically modified foods. Being informed, however, does not have a statistically significant effect on the odds of trusting other types of information sources relative to trusting an independent third-party source. When a consumer reported he/she was well informed about genetically modified foods the odds of trusting the government relative to a third-party group increases.

If a consumer had a strict religious upbringing, he or she is more likely to trust "nobody" relative to an independent third-party source. He or she is also less likely to trust a private organization relative to an independent third-party source. The person's religious upbringing, however, did not have a significant effect on the odds of any of the other choices relative to third-party information.[7]

Discussion

Huffman and Tegene (2002) hypothesize that an independent third-party source of information on genetically modified foods would improve welfare, and Rousu et al. (2002) show that verifiable information on genetically modified foods could have an annual value to U.S. consumers of over $2 billion dollars. The source would have to be independent of the interested parties—the environmental groups and agribusiness firms. The entity that creates this information may want to be at least partially independent of the government, because some individuals and groups are not in favor of current governmental, e.g., FDA, policies on voluntary food labeled.

Of the individuals in the survey, over 50 percent said they would most trust information on genetically modified foods if an independent third-party group or a government entity provided the information. If we exclude the "other" category, over 78 percent of participants said they would most trust information on genetically modified foods if an independent third-party group or a government entity provided it to them. Thus, a quasi-governmental entity or a group funded by the government but not answering to the government may be the best possible source to provide information on foods labeled as genetically modified. A key point is that this quasi-governmental entity should not include people from interested parties in the GM-food debate. Less than 10 percent of consumers said they would most trust information from the

interested parties (environmental groups and agribusiness firms), and this information is already available through websites.

Conclusion and Implications

Although many organizations disseminate information on a wide range of topics, these organizations must gain the trust of consumers before they can expect to affect their decisions. In the case of GM-food, organizations with competing interests are disseminating vastly different bits of information about its relative costs and benefits. Environmental groups, agribusiness companies, and the U.S. government all have different interpretations of the role genetically modified foods should play in society.

And while the body of literature on the economics of trust is growing rapidly, few studies have examined the contribution of an individual's personal and social capital to his/her trust. This paper provides new econometric evidence that personal and social capital of consumers affects significantly their trust in five different sources of GM-food information relative to an independent, third party source. We find an individual's schooling, age, religion, and self-reporting status as being informed about genetically modified foods contribute significantly to explaining the odds of particular outcomes. Considering the ongoing, contentious debates over genetically modified foods and other products, our analysis makes a significant contribution by linking personal and social capital of consumers to their trust in information on genetically modified foods. Additional work exploring the important information quality issues on other new products and processes and how they relate to our findings herein seems most worthwhile.

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Table 1. Characteristics of the Auction Participants (N = 318)

Variable	Definition	Mean	St. Dev
Gender	1 if female	0.62	0.49
Age	The participant's age	50.10	17.5
Married	1 if the individual is married	0.67	0.47
Household	Number of people in participant's household	2.73	1.47
Income	The household's income level (in thousands)	54.70	34.10
White	1 if participant is white	0.93	0.26
Read_L*	1 if never reads labels before a new food purchase	0.02	0.14
	1 if rarely reads labels before a new food purchase	0.90	0.29
	1 if sometimes reads labels before a new food purchase	0.32	0.47
	1 if often reads labels before a new food purchase	0.36	0.48
	1 if always reads labels before a new food purchase	0.21	0.40
Informed*	1 if an individual considered him/herself at least somewhat informed regarding genetically modified foods	0.48	0.44

*Pre-auction information.

Table 2. Religious Upbringing of Individuals in the Survey (N = 318)

Religious Upbringing	Percent
Baptist	15.0
Catholic	26.1
Lutheran	17.6
Methodist	15.7
Other	19.7
None	5.9

Table 3.   Education of Individuals in the Survey (N = 318)

Highest Level of Schooling Completed	Percent
Did not complete high school	6.0
Completed high school	18.6
Attended some college	22.6
Two-year college degree	12.3
Four-year college degree	21.4
Some graduate school work	19.2

Table 4. Who Individuals Trust for Information on Genetically Modified Food

Information Sources Individuals Trust	Number	Percentage
All	318	100
Government	62	19.5
University, scientists/researchers, or third-party group	94	29.6
Environmental/consumer group	12	3.8
Private industry/organization	16	5
None	19	6
Other, media, or no answer	115	36.1

Table 5.   Multinomial Logit Results: Who Do You Trust for Genetically Modified Food Information? (N = 318)

| Variable	(Other/ Third Party)	(None/ Third Party)	(Government/ Third Party)	(Env. Group/ Third Party)	(Private/ Third Party)
Intercept	5.494**	3.614*	1.146	–1.576	2.337
	(1.134)	(1.810)	(1.288)	(2.461)	(2.078)
Education	–0.375**	–0.248*	–0.140*	0.042	–0.321*
	(0.069)	(0.116)	(0.076)	(0.146)	(0.130)
Age	0.003	–0.035*	0.010	–0.026	0.004
	(0.009)	(0.016)	(0.010)	(0.020)	(0.016)
Informed	0.153	0.034	0.345*	0.455	–0.064
	(0.149)	(0.261)	(0.170)	(0.328)	(0.279)
Religious	–0.062	0.570*	–0.041	0.053	–0.857*
	(0.151)	(0.274)	(0.170)	(0.315)	(0.396)

The reference group is independent, third-party information.

** Statistically significant at the 1% level

*   Statistically significant at the 5% level

*   Statistically significant at the 10% level

Figure 1. Graphical Depiction of a Change in Marginal Rate of Substitution (MRS) When a Change in Social Capital Causes the Individual to Place More Trust in a Source of Information That Views Genetically Modified Foods Negatively

$X_{nonlabeled}$

b

MRS^{SC_2}

a

MRS^{SC_1}

$X_{labeled}$
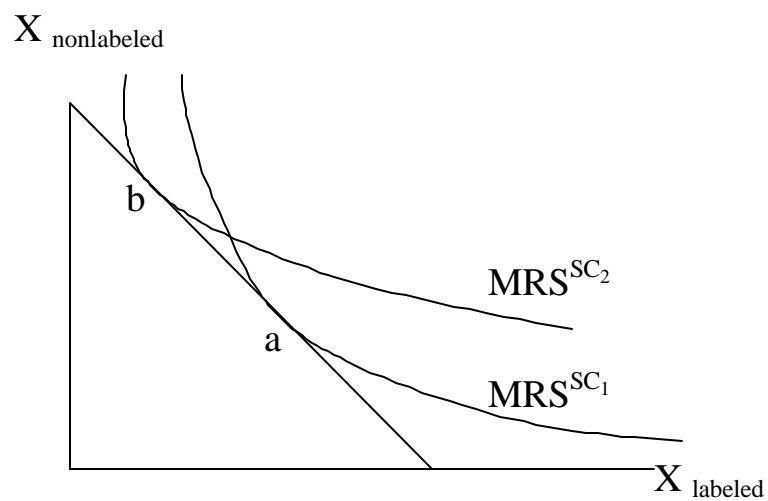
Appendix Demographic Characteristics of Polk County, IA (including Des Moines area) and Ramsey County, MN (including St. Paul area)

Variable	Definition	Polk	Ramsey	Average
Gender	1 if female	0.52	0.52	0.52
Age	Median age	45.7	45.7	45.7
Married	1 if the individual is married*	59.5	51.4	55.5
Education	Years of schooling**	13.52	13.76	13.64
Income	The median household's income level (in thousands)	46.1	45.7	45.9
White	1 if participant is white	0.9	0.8	0.85

All variables are for individuals of all ages, except for married, which is for individuals 18 or older; education, which is for individuals 25 or older; and age, which is for individuals 20 or older.

*The estimate of the number of married people who are 18 or older was obtained by taking the number of people married over 15 and assuming that the number of people who were married at ages 15, 16, and 17 was zero. This gives the percentage of people who are married who are 18 or older.

**The years of schooling was estimated by placing a value of 8 for those who have not completed 9th grade, 10.5 for those who have not completed high school, 12 for those who have completed high school but have had no college, 13.5 for those with some college but no degree, 14 for those with an associate's degree, 16 for those with a bachelor's degree, and 18 for those with a graduate or professional degree.

Footnotes

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[1] The appearance of new goods (or new attributes) has the same effect that the appearance of a new means of production has on a firm; it changes the household's production technology (Bianchi, 2002; Becker, 1976, p.137).

[2] For the format or results of the experiment, we refer the reader to Huffman et al. (2001) or Rousu et al. (2002).

[3] If an individual listed more than one category, we chose the first item they listed.

[4] This section follows Greene (2003, p. 720-722) closely.

[5] This arises because the probabilities sum to one, so only J parameter vectors are needed to determine the $J + 1$ probabilities.

[6] From the point of view of estimation, it is a major advantage that the odds ratio does not depend on the other choices, which follows from the independence of disturbances in the original model. However, from a behavioral viewpoint, this fact is not so attractive.

[7] Multinomial logit models examining the impact of other characteristics, such as gender, income, and marital status were also run. These coefficients were not statistically different from zero at any conventional level of significance.