CONSUMER APPROVAL OF GENETIC MODIFICATION OF FOOD PRODUCTS: A COMPARISON OF UNITED STATES AND SOUTH KOREAN PERSPECTIVES

A Thesis

by

MARY CAPERTON GILLETT

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2004

Major Subject: Agricultural Economics

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Approved as to style and content by:

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ABSTRACT

Consumer Approval of Genetic Modification of Food Products: A Comparison of United States and South Korean Perspectives. (May 2004)

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Genetic modification presents the potential to advance not only agricultural production but to increase quality of life as well. The potential this innovation presents will be irrelevant if the public is unwilling to accept and adopt it. The following study examines public perceptions of biotechnology, specifically, consumer approval of genetically modified food products.

This study was based on data collected from a national survey conducted in both the United States and South Korea. The United States survey was designed to be nationally representative and consisted of 1201 respondents. The South Korean survey was also designed to be nationally representative and consisted of 1054 respondents.

Analysis was conducted using two questions from the survey questionnaire as dependent variables: (1) approval of the use of genetic modification in the creation of plant-based food products, and (2) approval of the use of genetic modification in the creation of animal-based food products. This study utilized probit models for binary choice and ordered probit models to analyze the likelihood of consumer approval of the use of genetic modification for the creation of food products.

Findings indicated that consumers in the U.S. and South Korea who possessed an accurate knowledge of the applications and outcomes of GM technology were more likely to approve of its use for the creation of foods than those who had inaccurate or no knowledge of the technology. Additionally, the majority of consumers in the U.S. and South Korea believe that GM foods should be labeled as such. Those consumers who felt GM labeling to be necessary were less likely to approve of the GM of foods than those who did not feel GM labeling to be necessary. It was also found that consumers in both countries are less approving of the GM of animals than the GM of plants.

Consumer approval of the use of genetic modification in the creation of food products can be increased with proper education that provides accurate knowledge of the applications of GM. Labeling of GM products is likely to result in a decrease in demand, which may be offset by public educational campaigns.

ACKNOWLEDGMENTS

I feel that it is essential to acknowledge the contributions of those who made my time at Texas A&M University both enjoyable and successful.

First, words cannot express how much I appreciate the guidance and support of my advisory committee in the development and completion of my thesis. I am deeply indebted to Dr. Rudy Nayga, the chair of my committee, for his patience, encouragement, and unending support in the development of my ideas. I consider him an excellent professor and a good friend for whom I have great respect. This thesis and my academic growth would not have occurred without him.

I also wish to thank Dr. John Nichols, Dr. Oral Capps, and Dr. Michael McCarthy for their willingness to hear me out with issues relating both to my thesis research as well as my other interests and pursuits. They will all be forever remembered for their part in my development as a student and a person. I must also thank Dr. Doo Bong Han for his unquestioned willingness to help me with my research and writing. His enthusiasm was contagious and highly motivating and for that I am grateful.

My appreciation is extended to everyone at the Food Policy Institute at Rutgers University for their efforts in providing me with any research report I requested and their

role as a sounding board for my work. I would especially like to express my thanks to Dr. Ben Onyango for all the guidance he provided me. He was always happy to assist me and was influential in the development of my research.

Many thanks are due to the many other members of the faculty and staff at Texas A&M University who enriched my life as a master's student and made my time in the program truly rich. Thanks especially to the Texas A&M University Board of Regents, Dr. David Leatham, and Dr. Ed Rister for their financial support that made my degree possible.

I must express my most sincere gratitude to my father Glenn and my mother Susie for all their love and support throughout my educational years. I would not be where I am today had it not been for their wisdom and guidance throughout my life. To my mother, I owe special thanks for all of her help with the editing of my thesis.

Finally, I must thank my husband, Max for his extreme patience and unconditional love during both the research for and the writing of my thesis. He stood strong when I needed it and more importantly had a gentle nature throughout the process. Without him this would not have been possible.

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CHAPTER I

INTRODUCTION

Overview

Agriculture in the United States has always thrived on innovation. New technologies, with the potential to improve agricultural production in this country, are highly sought after and viewed to be of great importance to our way of life. Genetic modification is a prime example of a new technology, which may possess not only the ability to advance agricultural production but increase quality of life as well.

The genetic modification or organisms intended for consumption is a relatively recent development that came onto the scene a little over 20 years ago. Since its beginning genetic modification, GM, has encountered praise from some and harsh criticism from others. GM technology has been used to create crop varieties that have enhanced attributes such as, greater innate pest tolerance, better drought tolerance, more desirable physical appearance, and improved flavor. The research and development of GM crops has occurred worldwide despite heavy opposition in particular areas. The powerful governments of the world have adopted an array of positions on the issue, some denouncing the technology completely, others allowing it with restrictions, and yet others proclaiming that there exists no difference between GM and traditional crop varieties. With so many varied points of view across the global political structure it is

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This thesis follows the style of the *American Journal of Agricultural Economics*.

not surprising to discover that at least as many points of view exist among the consumers of the world. These views arise from the perceived risks and benefits of the genetic modification of products for human consumption.

Genetic modification as it is commonly thought of, is the process whereby a gene or genes foreign to one organism are introduced into the genetic makeup of that particular organism. The introduction of the foreign gene or genes thereby modifies the genetic code of that organism in essence changing its genetic code from the "original" genetic code of the organism to a new unique code. Genetic modification can also refer to the removal or alteration of a gene or genes present in an organism's "original" genetic makeup. The genetic modification of food products presents both potential benefits and risks. An October 2001 USDA report developed for the Asia Pacific Economic Cooperation outlined many of these potential benefits and risk. Several of the risks discussed in the report include:

- Potential resistance on target organisms to the modified trait(s)of the GM crop;
- Potential weediness caused by the spread of GM crops into fields other than those they were planted in;
- Horizontal gene transfer that may occur if genes from GM crops are spread to other crops or closely related weeds via cross-pollination;
- Potential effects on non-target organisms i.e. increased mortality of beneficial insects affected by a modification intended to harm pests;
- Potential adverse effects on biodiversity.

The same study also presents many potential benefits of biotechnology to the agricultural industry. Crops that have been genetically modified have the potential to: (1) produce higher yields than traditional varieties, (2) use less agronomic inputs, (3) be cultivated in drought, cold, heat and salinity, (4) be utilized in environmental remediation, (5) supply production livestock with feeds that reduce the amount of phosphorus excreted, and (6) provide a substitute for petroleum-based products. Biotechnology can also be used to enhance the micronutrient and protein content of traditional crops thus reducing the occurrence of diseases related to vitamin deficiencies (USDA, 2001).

Food safety is a major concern of the general public. Consumers expect the food supply be diverse, abundant and, most importantly, safe for consumption. Genetically modified crops present the potential to ensure a diverse and abundant supply of food products. Despite this potential, consumers have not readily embraced using genetic modification for the creation of food products because of the perceived risks of the technology. Therefore, the success of food biotechnology depends greatly on consumer confidence in the benefits and safety of genetically modified food products.

This study will examine consumer approval of genetically modified food products originating from plant and animal sources in both the United States and South Korea. The level of approval will be compared between types of GM products i.e. plant or animal in each country individually. Additionally, the level of approval will be compared between United States and South Korean consumers. The specific research objectives are presented in a later section.

Background of Genetic Modification

Genetic modification came into the spotlight in the early 1980's when Monsanto announced they had produced the first genetically modified plant. The government responded with the release of a coordinated framework for the regulation of biotechnology-derived products in 1986 (USDA, 2001). Following Monsanto's development of the first GM plant, the USDA's Agricultural Research Service developed the first transgenic livestock animals in 1986 (USDA, 2001). The first field trials of GM plants were conducted in 1987 and in 1991 the USDA's Animal and Plant Health Inspection Service published guidelines for field trials of GM crops (USDA, 2001). Then in 1992, the United States Food and Drug Administration (FDA) published a Statement of Policy concerning foods derived from new plant varieties in the Federal Register. The 1992 policy provides an overview of the FDA's responsibility for food safety, the statutory framework for new foods and food ingredients, as well as guidance to the industry to ensure the safety of new products.

The first product to be reviewed under the FDA's 1992 policy was the Calgene Flavr Savr tomato. Calgene's tomato was created through recombinant DNA techniques, which introduced a foreign gene into a tomato resulting in the creation of a new variety (Maryanski). The Flavr Savr tomato, softened less quickly than traditional varieties, thus allowing it to remain on the vine longer enhancing its flavor (Maryanski). In tests comparing the Flavr Savr tomato line and the control parental line, Calgene found no significant differences, other than those intended because of the modification, between the two lines (Maryanski). The research done by Calgene was submitted

according to the FDA's 1992 policy and in 1994 the Flavr Savr tomato was the first GM plant to be deregulated (USDA, 2001). In 1996, the first large scale plantings of GM crops occurred and included genetically modified varieties of corn, cotton, and soybeans (USDA, 2001).

By 2003 nearly two-thirds of all GM crops planted globally were located within the United States. U.S. farmers produce a range of GM crops including corn, soybeans, canola, cotton, papaya, and squash (Pew Initiative on Food and Biotechnology).

Worldwide GM acreage has increased dramatically in the past six years. In 1996, GM crops occupied 4.2 million acres across six countries; by 2002 the number of GM acres planted had increased to 145 million acres across sixteen countries (Pew Initiative on Food and Biotechnology). South Korea is not one of the sixteen countries currently producing GM crops. While there are no GM acres for commercial production in South Korea biotechnology research is being conducted. Stemming from the research done through the government, universities, and individual institutes 14 genetically modified crops have been developed in Korea since the late 1980's (Cho).

The production of and research on genetically modified food products has not progressed unimpeded. The creation of biotech crops that end up in the human food supply has drawn a great deal of criticism and negative media attention. At Monsanto's 2003 annual meeting a Greenpeace representative told shareholders "We believe the company's direction and pursuit of genetically modified agriculture is reckless" (Gillam). Greenpeace activists also argue that Monsanto products will contaminate the food supply with dangerous elements and cause resistance in pests and weeds that will

become out-of-control (Gillam). Groups like Greenpeace are not the only ones who are skeptical of the use of genetic modification. Even the Vatican is unsure of the use of biotechnology. In 2003 a two-day meeting was held in Vatican City to help the Roman Catholic Church develop a position on genetic modification. At the meeting, two Jesuit priests displayed their resistance to GM urging the Vatican to follow the precautionary principle and quoting Pope John Paul II as having said "the world is not yet in a position to assess the biological disturbance that could result from indiscriminate genetic manipulation and from the unscrupulous development of new forms of plant and animal life" (Winfield). In South Korea, U.S. trade officials were met by protests when visiting the Korean Food and Drug Administration to discuss trade issues. Members of Green Korea United, the Korean Federation for Environmental Movement and Women's Link were some of the groups involved in the rally (Ji-young). Protesters with signs reading, "USA Go Home With Your GMO" accused the U.S. of "flinging genetically modified products onto Korean tables for their own national interest" (Ji-young, 6/24/02). Instances of staunch opposition such as those in the U.S., Europe, and South Korea highlight a key issue in the GM debate, which is the level of consumer approval, or lack thereof, for the use of genetic modification.

Current Regulations

The statutory framework relative to genetic modification reflects public and political concerns as addressed by government. It is important to examine current regulations as they provide a basis for understanding the responses of both the U.S. and South Korean governments as to the issue of genetic modification. The following

section discusses the current general regulations as well as the labeling policies pertaining to genetic modification in both countries.

United States Regulation of Genetically Modified Organisms

In the United States, three federal bodies are responsible for the regulation of biotechnology. These bodies include, the United States Department of Agriculture (USDA), the U.S. Food and Drug Administration (FDA), and the Environmental Protection Agency (EPA). One or all of these agencies may be involved in the regulation of genetic modification depending on the intended use of the product (USDA, 2003).

The two branches of the USDA responsible for the regulation of genetically modified products are the Animal and Plant Health Inspection Service (APHIS) and the Food Safety and Inspection Service (FSIS). APHIS regulates the field testing of GM plants as well as approving and licensing animal vaccines that are potentially a product of GM. FSIS monitors and ensures the safety of meat and poultry intended for human consumption. The USDA's responsibility for the regulation of biotechnology is focused primarily on GM plants under the Federal Plant Pest Act. The Federal Plant Pest Act gives APHIS the authority to regulate genetically modified plant varieties. APHIS regulates GM plants through a permit and notification system. Those seeking to test GM plants are required to provide information as to the plant's new genes and gene products, origin, purpose of the test, manner in which the test will be conducted, as well as precautionary measures that will be employed to prevent the escape of the plant, plant pollen, or plant parts from the test site (USDA, 2003). A scientific reviewer from

APHIS then reviews the information submitted by the applicant and assesses potential environmental impacts, the impact on endangered or threatened species and non-target species (USDA, 2003). For those interested in the commercial production of GM plants a process more detailed than the request for permission to conduct a field test is required. The creators of GM plants seeking approval for commercial production must submit scientific information as to the plant's genetics, the origin and nature of genetic material used, indirect effects on other plants, and reports from field-testing (USDA, 2003). APHIS determines the status of the plant which can either be "regulated" or "non-regulated". If APHIS determines that the plant has not been shown to be a significant risk to other plants and is as safe as traditional varieties that plant is awarded "non-regulated" status (USDA, 2003). Once granted "non-regulated" status the plant is permitted to be commercially produced and requires no further review from APHIS when being moved or released in the U.S. (USDA, 2003).

The U.S. Environmental Protection Agency (EPA) regulates GM plants with the authority granted through the Federal Food, Drug, and Cosmetic Act (FFDCA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Toxic Substances Control Act (TSCA). The EPA under the direction of the FFDCA sets tolerance limits for pesticides on and in food and feed (USDA, 2003). Under the FFDCA the EPA also sets tolerance limits for herbicide residues used on genetically modified herbicide-tolerant crops (USDA, 2003). The BioPesticides and Pollution Prevention Division of the Office of Pesticide Programs (OPP) within the EPA regulates the testing, use, sale, and distribution of plants and microbes which produce pesticides under the authority of

FIFRA (USDA, 2003). The EPA under the authority of the TSCA also regulates microorganisms that contain or express new combinations of traits that are intended for commercial use (USDA, 2003). Permits for large scale testing of GM plants containing new pesticidal substances are issued by the EPA, which considers human safety, the environment, the effectiveness on the target pest, and the effects on "non-target" species during the permitting process (USDA, 2003).

The U.S. Food and Drug Administration under the authority of the FFDCA regulates food products for human consumption, holding them to the same standard as more traditional food products (USDA, 2003). The FDA considers GM ingredients intentionally added to food products as additives if they differ significantly from substances traditionally found in those food products (USDA, 2003). As many of the GM food crops currently being produced have been determined to not differ significantly from traditional food crops they do not require pre-market approval by the FDA (USDA, 2003).

United States Voluntary GM Labeling Policy

The FDA possesses regulatory authority over food labeling. Currently, the labeling of products containing GM ingredients, those ingredients which are derived from a GM plant or animal, is only required if the ingredients are significantly different from similar conventional ingredients (USDA, 2003). In 2001, the FDA released an industry guidance draft for comment pertaining to the voluntary labeling of GM containing foods. The draft outlines the FDA's role in the process of voluntarily labeling GM or GM-free products. It provides guidance on several points: (1) As to

statements about foods containing GM ingredients or having been produced via GM technology, (2) as to statements about foods that have not been created via GM technology and/or do not contain GM ingredients, and (3) as to the substantiation of label statements (FDA).

South Korean Regulation of Genetically Modified Organisms

GM products are slightly more regulated in South Korea than in the United States. The regulation of biotechnology is spread across several ministries, including the Ministry of Environment, the Ministry of Foreign Affairs and Trade, the Ministry of Health and Welfare, the Ministry of Science and Technology (OECD) and the Ministry of Agriculture and Forestry (NAQS). The Ministry of Foreign Affairs and Trade focuses on bio-safety issues. The Ministry of Health and Welfare is responsible for the creation and establishment of gene-recombinant research guidelines, while the Ministry of Science and Technology is responsible for Biotechnology Promotion Law and regulations stemming from it (OECD). Other agencies involved in the regulation of GM products include the National Institute of Health (NIH), the Korea Food and Drug Administration (KFDA), and the National Agricultural Products Quality Management Service (NAQS). Safety assessment of genetically modified organisms is the responsibility of the National Institute of Health whereas the responsibility for the safety assessment of foods rests with the Korea Food and Drug Administration (OECD). More specifically, the KFDA monitors and regulates processed foods created via GM technology and/or containing GM ingredients (KFDA). The control of raw agricultural products created via GM technology is the responsibility of the National Agricultural

Products Quality Management Service (NAQS). The NAQS responsibilities include safety inspection, quality certification and the regulation of GM product labeling (NAQS).

South Korean Mandatory GM Labeling Policy

South Korea has required the labeling of GM corn, soybeans, and bean sprouts since March 2001 (NAQS). GM potatoes were added to the list of products requiring labels in March 2002 (NAQS). In addition to the labeling requirement for these raw products, the labeling of processed products made from GM soybeans, corn, and bean sprouts has been required since July 2001. Labeling is required for any of the previously mentioned products if the contain more than 3% GM content (Phillips and McNeill). Punishment for failing to label or labeling inadequately can include in an administrative fine of up to 10 million won (~$10,000 US) (NAQS). The punishment for false labeling of GM products is even steeper, allowing for a term of imprisonment of up to 3 years or a fine up to 30 million won (~$30,000 US) (NAQS). The labeling of GM products is managed and regulated by the NAQS.

Trade Issues

The level of approval for GM foods varies greatly across nations. The EU has been adamant in its disapproval of GM foods going so far as impose near to impossible tolerance levels for GM contamination of foods. The trade relationship between the U.S. and EU has been deeply strained because of this issue and the two superpowers have gone to battle within the World Trade Organization court system. Due to the EU's demonstrated staunch opposition and the U.S. government's approval of the genetic

modification of foods, most comparative studies to date have examined EU perceptions in contrast to U.S. perceptions of GM. It is therefore important to broaden the research base and begin comparing countries other than the EU. Increasingly, countries including South Korea, are playing a larger role in the U.S. export market. South Korea, like the EU, has set a GM contamination tolerance level. However, the tolerance level set forth by the South Korean government is more realistic than the level set by the EU. As South Korea is a more significant importer of U.S. agricultural products, it is important to determine the level of approval for GM food products among South Korean consumers.

The creation and subsequent large-scale production of GM crops in the United States has led to new, complex issues in the trade relationship between the U.S. and South Korea. South Korea has mandatory labeling for GM products while the U.S. has only a voluntary labeling policy. This creates a unique situation for U.S. merchants exporting to South Korea. Exporters must be able to identify GM products they ship to South Korea despite the fact that those same products are not required to be identified domestically. Thus, grain merchandisers are now forced to keep track of those countries to which they can and cannot ship GM products (Ekanem et al.). In addition to tracking the countries that will and won't accept GM product imports, the grain market is now faced with the challenge of being able to distinctly identify GM and non-GM grains.

Identity preservation requires precise and accurate records, as well as separate storage, transportation, and processing facilities. The issue of identity preservation was central in recent trade relations with South Korea. In 2000, Starlink bio-corn was found within the human food supply; since this discovery, South Korean purchases of U.S.

corn have significantly fallen (Ekanem et al.). The U.S. government is now contemplating approving GM wheat for commercial production and certain sectors within South Korea have not responded favorably. When negotiating the purchase of 208,800 tons of wheat with producers and government officials in Montana and North Dakota, representatives of the Korea Flour Mills Industrial Association (KOFMIA) warned that their trade relationship would be ruined if the U.S. began producing GM wheat (Cowan). This could put a substantial dent in the U.S. wheat export market as the U.S. currently supplies South Korea with close to half of its wheat import needs (Cowan). Determining the consumer approval of GM food products in South Korea is therefore vital to the production decisions of the U.S. agricultural industry.

Importance of the Study

Genetic modification of organisms is yet another technology which may prove vital in advancing agriculture. Such "biotechnology" may affect all of U.S. and South Korean society in a variety of ways. It has the potential to create new varieties of crops that not only produce more efficiently but also actually provide the American and South Korean consumers with better nutrition than previous crop varieties. Many GM crop varieties present the possibility of reduced costs of production due to a reduced requirement for chemical pesticides while causing less environmental damage than the former varieties as a result of their production with fewer chemicals. Genetic modification may also produce higher-yielding varieties that require less land for production, and can be grown across a greater range of environments while staying fresh longer, thereby improving storage and transportation.

The major issue facing the GM arena is not one of how to create such products; rather, will American and South Korean consumers approve of them once produced and will an adequate demand follow consumer approval? After all, producers are unlikely to embrace a production technology without some assurance that consumers will purchase the final products. The first step toward assessing U.S. and South Korean consumer willingness to purchase GM products is to determine their approval of the creation of such products. It is also important to determine whether the nature of the product being modified affects the level of consumer approval. If research indicates that consumers are more likely to approve of one application of GM than another, producers will likely concentrate on the application more favored by the general public. Additionally, if the factors influencing consumers' disapproval of a particular application of GM than producers will better know what groups and topics to target in marketing and educational campaigns so as to increase consumer approval. The trade relationship between the U.S. and South Korea will potentially be affected by each countries' particular level of approval of genetic modification and so it is important to identify any differences that may exist so as to better predict trade conflicts which may arise.

Objectives of the Study

The overall purpose of this study is to examine consumer perceptions of the genetic modification of plant-based foods and animal-based foods and determine if the level of approval varies between these two applications. Additionally, a comparison of U.S. and South Korean consumers' approval of GM foods will be made to determine if any differences exist in their likelihood of approval of GM foods.

The specific objectives of this study are the following:

a) To assess consumer likelihood of approval of genetically modified plant-based food products in the United States and in South Korea;
b) To assess consumer likelihood of approval of genetically modified animal-based food products in the United States and in South Korea;
c) To compare United States and South Korean consumer attitudes toward the use of genetic modification in the creation of plant- and animal-based food products.

Organization of the Thesis

Chapter I details the background of genetic modification, the current issues, regulations, and objectives of this study. Chapter II provides a review of the literature pertinent to the topic of this study. The survey methodology, sampling procedures, and questionnaire design are presented in Chapter III. In Chapter IV the empirical framework and estimation of the models is discussed. Chapter V contains the descriptive analysis and findings of the study. Discussion of the implications and conclusions drawn from this study are in Chapter VI.

CHAPTER II

REVIEW OF LITERATURE

The issue of genetic modification of organisms is both controversial and of great importance because of the potentially radical changes it may bring to agricultural production. Regardless of how beneficial and safe the technology proves to be scientifically, it is ultimately the perceptions of the public that will determine its success. Success for GM products will be in the form of consumer approval and willingness to purchase. Assessment of consumers' approval of genetic modification is the crucial first step to estimating a demand for GM products, which may in turn provide incentive for industry to supply such products. In keeping with the importance of measuring public perceptions and attitudes toward GMO's many studies examining the issue have been conducted.

International Overview

Hallman examined consumer concerns about biotechnology on an international scale. The study noted that in the U.S. over the past decade the percentage of consumers who are aware of biotechnology has not grown by much (Hallman). More important to note was that not being adequately informed as to the issue of biotechnology did not prevent consumers from having an opinion as to the issue (Hallman). This was made evident by the fact that in most surveys the total number of respondents who "approved" or "disapproved" of biotechnology generally exceeded those who reported having heard much about the subject (Hallman). Herein rests the underlying issue, which will most

greatly influence consumer approval and willingness to purchase GM products. As Hallman points out "Because the use of biotechnology involves many complex and often abstract ideas, many people are uncertain about the potential risks and benefits posed by this new technology."

Overview of Genetic Modification

Uzogara discusses the impact genetic modification has had on human foods in the 21st century. The study examines the potential risks and benefits of GM technology while suggesting ways of minimizing those risks and maximizing the benefits. Perceived risks of GM technology include: Potential alteration in the nutritional quality of foods, possible antibiotic resistance, concerns of enhanced or created toxicity as a by-product of modification, potential allergenicity, unintentional gene transfer from GM varieties to traditional or wild varieties, the possible creation of new viruses, limited access to GM seeds due to patenting, threats to biodiversity, social concerns, as well as the issue of the labeling of GM products (Uzogara). The potential benefits of GM technology include: Improved self-life of fruits and vegetables, enhanced nutritional quality and health benefits of food products, improved protein quality as a result of genetic modification, increased carbohydrate content via GM technology, improvement in quantity and quality of animal-based products, higher crop yields, production of edible vaccines and drugs, lesser environmental impact from crop production that requires a lesser amount of chemical inputs, an overall increase in agricultural productivity, and the ability of GM to remove industrial waste and improve toxic chemical recycling (Uzogara). Uzogara points out that avoidance of harmful effects of

GM technology will result from adequate regulation, as well as constant monitoring and research. Uzogara also asserts that there exists little difference between foods derived from GM and foods created via traditional means and that GM products are easier to control than are those resulting from traditional breeding. "Careful application of genetic engineering will make life better, improve human health and welfare, and save time and money" (Uzogara).

Factors Affecting Consumer Attitudes

In a study examining consumer acceptance and willingness to pay for genetically modified foods in the U.S. and the European Union, House et al. used a model synthesized from prior literature on consumer acceptance. Three antecedents: Trust, benefits, and social norms, were studied for their impact on consumer acceptance (House et al.). The model used in the House et al. research suggested that perceived benefit by the consumer would affect subsequent levels of acceptance. In addition to the implications relative to perceived benefit the model predicted that social norms would affect consumer acceptance (House et al.). This is of importance because, as House et al. pointed out, knowing the influence of social norms will provide "a global assessment of a consumer's belief regarding what behaviors, goals, and policies are important or unimportant, appropriate or inappropriate or right or wrong." The conclusions of this study are of great significance for understanding how to change the public's attitudes toward GM foods (House et al.).

Baker and Burnham conducted research to develop an understanding of factors that influence consumer preferences for GM food products, so as to aid both food

manufacturers in the development and marketing of GM products and policy makers in the creation of GM food product policy. A major finding of this study was that those consumers who reported they were most resistant to consuming GM products were also hesitant to purchase other new products; these consumers were slow to change in general and risk averse (Baker and Burnham). Baker and Burnham, in findings similar to the results of the House et al. study, found that consumer acceptance of GM food products could be increased via focus on products that present direct benefits to consumers. Benefits including increased shelf life, improved taste, and greater nutritional value were easily perceived by consumers (Baker and Burnham). Baker and Burnham stated "Such direct benefits make it easy for consumers to understand the benefits they are receiving in return for the perceived increased risk."

Onyango et al. found that consumer acceptance of genetically modified foods depends heavily on associated risk and benefit perceptions, level of knowledge and formal education, as well as trust that government will protect the interests of the public. This study utilized data from a telephone survey with 1201 respondents and a mail survey with 380 respondents. It focused specifically on consumers' willingness to consume meat products that were the result of GM technology with disclosure of the benefits and risks inherent to the product. Analysis of the survey data was conducted using the Lancaster model in combination with the random utility discrete choice model. Additionally, three separate logistic models, specific to each type of GM meat product, were used to describe and predict willingness to consume.

With the risks and benefits of consumption of GM food products made known, only half of participants in the study were willing to consume genetically modified foods (Onyango et al.). Additionally, consumers under 35 and those with greater than a high school diploma were more willing to consume GM food products (Onyango et al.). A greater general willingness to accept genetic modification of food was observed in those who possessed an average understanding of science relating to biotechnology (Onyango et al.). Confidence in experts also played a role in consumers' willingness to consume GM products, in fact, those with a greater amount of confidence were more willing to consume them (Onyango et al.). As would be expected, individuals' whose risk perception outweighed their benefit perception were less likely to accept GM foods (Onyango et al.). A low level of trust in information provided by government also led to a decreased likelihood of acceptance of GM food products (Onyango et al.). Social and political views were also found to be a factor in the willingness of consumers to accept GM foods, and males were found to be more willing than females to accept GM food products when presented with potential benefits of those foods (Onyango et al.).

Onyango et al. concluded that consumer confidence in experts to guard the better interests of society plays an important role in the decision to consume GM food products. Additionally, consumption of GM foods is strongly related to the perceived risks and benefits of those foods (Onyango et al.).

A recent study conducted by Moon and Balasubramanian looked at the mediating role of risk perceptions on the impact of trust, awareness, and outrage as factors influencing public attitudes toward agrobiotechnology. Data was collected via mail

surveys in the United States and internet surveys in the United Kingdom. The data was analyzed using Fishbein's multiattribute and mediation models as theoretical frameworks, while the empirical framework involved ordered probit and ordinary least squares regression modeling.

Results indicated that the greater part of the differences in attitudes toward agrobiotechnology were due to negative and positive perceptions of the attributes associated with the technology (Moon and Balasubramanian). Even more poignant is the fact that the favorable effects of positive characteristics of agrobiotechnology were outweighed by the adverse effects of the negative characteristics (Moon and Balasubramanian). Other major factors influencing consumers' negative attitude toward agrobiotechnology include a lack of trust in regulatory agencies and involuntary exposure to risk (Moon and Balasubramanian). Moon and Balasubramanian also inferred from a factor coined as "outrage" that consumers tend to overestimate risks when they are involuntary.

Comparison between the results of the U.S. models and the U.K. models revealed several differences between consumers in the two countries. Consumers in the U.S. were more positive toward agrobiotechnology than were consumers in the U.K. (Moon and Balasubramanian). U.S. consumers related agrobiotechnology with negative characteristics less fervently than U.K. consumers (Moon and Balasubramanian). Consumers in the U.S. were more trusting of regulatory agencies and would be less outraged if they did not have the choice between GM and non-GM products than consumers in the U.K. (Moon and Balasubramanian).

Moon and Balasubramanian concluded by asserting that “regulatory agencies should not overtly support agrobiotechnology as a part of industrial or economic policy” and “stringent regulatory oversight may be required to convince consumers that government has appropriate rules/regulations for GM foods.” In other words, is may appear inappropriate and consumers may be suspicious if governmental agencies were to actively promote and endorse GM products while also being responsible for GM product regulation.

Economic and Political Risks

Ekanem et al. examined economic risks and marketing issues related to the GM issue while considering potential policy issues related to trade. Analysis was conducted with data from the Food and Agricultural Organization (FAO), the United States Department of Agriculture’s Foreign Agricultural and Economic Research Services, as well as the United States Department of Commerce. Economic risks to producers and consumers include the lack of market demand for GM crops, the costs of segregated production and supply systems for GM and non-GM crops, as well as the transfer of federal dollars from disaster assistance to reducing the economic impact of contamination caused by GM crops (Ekanem et al.). These risks pose the threat of causing major disturbances in agricultural trade (Ekanem et al.). Additional economic risks with the potential to disrupt trade arise from the issue of GM labeling. With no universal standard for labeling, and a multitude of opinions as to how GM products should be labeled, trade dilemmas are likely to occur (Ekanem et al.). Agricultural trade

could be compromised if varying labeling regulations between nations result in non-tariff trade barriers (Ekanem et al.).

Ekanem et al. also points out that inherent to the GM issue are certain political risks. As certain countries, the United States in particular, forge ahead at a rapid pace in pursuit of the newest innovations in biotechnology, international governments are under pressure to keep up (Ekanem et al.). Keeping up requires taking political risks in the creation of legislation that will either hinder or accelerate developments in biotechnology and the public perception of such government action. The level of progress with biotechnology in a given country will influence public perceptions, and consumers in countries with greater experience in technology are more likely to be accepting (Ekanem et al.).

To keep international trade from being adversely affected by the issue of genetically modified products, science-based criteria would need to be employed in the institution of objective border measures (Ekanem et al.). The World Trade Organization (WTO) will play a large role in mediating disputes that arise from the trade of genetically modified organisms, with the ultimate goal of preventing governments from imposing extreme regulatory costs on importers without proportionate benefits to consumers (Ekanem et al.).

Animal vs. Plant Genetic Modification

Objections to biotechnology likely arise as a reaction to the specific applications of the technology as opposed to the technology in general (Frewer et al). The 1997 Frewer et al. study focused on determining what applications of biotechnology

consumers are most averse to. The study involved two different sample groups of 200 respondents each. Respondents in the first group were asked to indicate their objections to biotechnology in general via a survey instrument. The second group of respondents were also asked to indicate their objections to biotechnology but, unlike the first group, were given specific applications of the technology with obvious tangible benefits to consider when quantifying their objections. Frewer et al., used a combination of "objection mapping" to reveal overall patterns of objection to differing applications and analysis of variance to identify individual differences in the samples.

Analysis of the data from the respondents asked to express their objections to general applications of biotechnology revealed less objection to biotechnology involving plants and microorganisms (Frewer et al.). Those respondents who objected most to applications involving animals and humans included women as well as those who were most concerned with the environment (Frewer et al.). While Frewer et al. found that individual differences were reduced in the second group of respondents, who were asked to consider specific applications of biotechnology, objection was still greater for biotechnology involving animals and humans. Despite the general reduction in individual differences across the second sample set, those who reported high levels of consideration for the environment were noted to have objections to large-scale agricultural applications (Frewer et al.).

From the results, Frewer et al. inferred that when applications of biotechnology are presented in general terms they cause individuals to think of the issue in a single dimension; thus, they either accept or reject biotechnology. When individuals are

presented with more specified applications, particularly those that relay obvious tangible benefits, the perceived risks of GM technology in some instances are then viewed as necessary and therefore more acceptable (Frewer et al.). With this in mind, Frewer et al. asserted that "providing information about tangible benefits and risks of the technology is more informative to respondents, and this would seem to be the most effective route to the establishment of public discourse about the technology and its subsequent evolution."

The Hossain et al. study examined the issues of public perceptions of biotechnology and public acceptance of genetically modified foods. The study utilized survey data from 978 respondents and analysis was conducted using three different logistic models. Results indicated that a general optimism exists as to the potential of biotechnology particularly as it relates to the genetic modification of plants (Hossain et al.). However, there also exists a substantial rift within the public concerning the acceptability of the genetic modification of animals (Hossain et al.). More specifically, the study found that close to half of the respondents who approved of the genetic modification of plants disapproved of its use in animals. It was also noted that while certain sectors of the population were more apt to approve of plant genetic modification those same sectors were no more likely to approve of animal genetic modification (Hossain et al.).

Individuals' approval of genetic modification in general and more specifically its use in plant and animals is a function of their socio-economic characteristics, social/political and religious beliefs, education level, as well as their knowledge of

science as it relates to biotechnology (Hossain et al.). Another factor responsible for influencing an individual's attitudes toward biotechnology and approval of its use in food production is the individual's level of trust and confidence in both private and public institutions (Hossain et al.).

Labeling of GM Products

Hine and Loureiro explored consumers' perceptions toward biotechnology and the labeling of products produced using biotechnology. The study analyzed data collected from 437 in-person surveys conducted in supermarkets across Colorado. The survey consisted of questions concerning consumer attitudes about issues relating to biotechnology and specifically their attitudes associated with the purchase of potatoes created using biotechnology. Well-informed consumers appeared to be less concerned with the mandatory labeling of GM food products relative to those who were less informed (Hine and Loureiro). Hine and Loureiro also noted that in the context of specific applications of biotechnology (i.e. the increase of nutritional content of potatoes, enhancement of flavor, or reduction of pesticide use in potato production) female consumers with children were less accepting of biotechnology.

Consumer welfare and consumption decisions are affected when GM products are perceived to be different from traditional products (Giannakas and Fulton). Giannakas and Fulton made this determination through the development of a model of differentiated consumers and examination of the consumption effects of genetic modification in varying scenarios. These scenarios included the presence of GM products in the market without labeling, with mandatory labeling and full compliance,

and with mandatory labeling with the occurrence of mislabeling. The greater the costs of segregation required in a mandatory labeling scheme, the more likely it is that the absence of labeling is a better policy; however, with the increased likelihood that a particular product has been genetically modified, the more likely it is that a mandatory labeling scheme will be preferred (Giannakas and Fulton). Mandatory labeling is less preferred by consumers as the potential for product mislabeling increases; additionally consumers are likely to favor a policy of no labeling as trust in the labeling system decreases (Giannakas and Fulton). The level of consumer aversion to genetically modified products is also a factor in the preference for either a mandatory labeling scheme or a lack of labeling. Consumers with a lesser aversion to GM products prefer no labeling (Giannakas and Fulton). Giannakas and Fulton conclude that consumption will be influenced by consumer concerns about biotechnology and the subsequent consumption patterns will influence public policy. Demand for GM products will arise from these consumer concerns and policy makers' actions (Giannakas and Fulton).

Is a mandatory labeling policy for GM food products beneficial if it is put in place to provide consumer choice but falls short of doing so? This is the main question examined in a Carter and Gruère article. Mandatory labeling increases costs to taxpayers because of the additional enforcement and testing it requires, while causing losses to consumers who prefer to purchase cheaper GM food products (Carter and Gruère). It also results in barriers to trade and may hinder adoption of GM food crops on a large-scale (Carter and Gruère).

Mandatory labeling of GM food products provides processors, not consumers, with the purchasing choice (Carter and Gruère). Processors make production decisions, namely which ingredients to use in their products based on data from market research. Due to the negative perceptions of the use of GM technology for the creation of food products that currently exist in many countries, processors are not likely to use GM ingredients in the products they market to those outlets (Carter and Gruère). A mandatory labeling policy also lends those products which are labeled as containing GM ingredients to protest from activist groups against the use of GM technology in food production (Carter and Gruère). With producers skeptical of producing GM food products because of uncertain, potentially low demand, and no significant profit incentive, the presence of GM products in retail outlets in countries with mandatory labeling policies is far from overwhelming (Carter and Gruère). This trend is likely to repeat itself if mandatory labeling is adopted in those nations that currently have no or voluntary labeling policies. Carter and Gruère therefore, contend that a voluntary labeling for GM foods provides consumer choice so long as "the maximum willingness to pay for non-GM products exceeds the corresponding price premium." In other words, voluntary labeling schemes create a niche for products that can be marketed as GM-free, thus giving the processor an economic incentive to create products for consumers demanding products free of GM ingredients. On the other hand, in recognition of the fact that a portion of the market will prefer to buy lower-priced GM containing products, processors will produce GM products as well.

Teisl et al. examined the issue of the how consumers prefer GM food products to be labeled. Data for the study was collected via mail surveys mailed across the U.S. and Maine (an oversample was collected in Maine to provide representative data from Maine for policymakers as some funding was provided by the Maine Agriculture and Forest Experiment Station). A total of 2,012 U.S. and 375 Maine residents returned surveys. Data was evaluated according to the type of data being tested. Analysis of variance and contingency tables were utilized in the quantitative examination of the data.

Respondents ranked concerns relating to potential risks encountered by consumers as most important, specifically the risks of a possible breakdown in food safety or possible negative environmental impacts (Teisl et al.). In essence consumers are concerned with the uncertainty of long-term impacts of foods created by way of GM technology (Teisl et al.). This is an important finding to note as the uncertainty may motivate consumer rejection of GM food technology (Teisl et al.). It is therefore possible that the lack of a labeling policy may keep consumers from having known contact with GM food products without adverse effects which could potentially reduce uncertainty of the use of the technology in the production of food (Teisl et al.).

Teisl et al.found that over three-fourths of respondents were in favor of GM food labeling and most surveyed preferred that the labeling be administered by a federal agency. Respondents also placed a high value on labels with warnings associated with genetic modification (Teisl et al.). Benefits that applied directly to consumers, particularly those relating to the improvement of food's health attributes, rated as most important among respondents (Teisl et al.).

In concluding remarks, Teisl et al. asserted that “a simple GM food label will be of limited usefulness to consumers because it would only allow consumers to differentiate GM food products from non-GM food products.” Additionally, Teisl et al. contend that both the benefits and costs should be recognized when and if a decision to mandate labeling is made.

Rousu et al. developed experimental auction markets to collect data reflective of consumers’ behavior towards GM products labeled non-GM in accordance with contamination/tolerance level and products labeled non-GM and certified GM-free. The experimental design included the two treatments each with three experimental units that consisted of 13-16 consumers from Iowa who were given a monetary incentive to participate.

The products considered in the rounds of bidding were all labeled as non-GM. Non-GM was then quantified on each of the products labels as either certified GM-free, or with the percentage content of GM material tolerated. The products that were labeled non-GM within the context of a specific tolerance level had either a 1% or 5% GM contamination level present.

Consumers value products that are GM-free, and if products are GM contaminated consumers’ willingness to pay is practically indifferent whether the contamination is at a 1% level or a 5% level (Rousu et al.). In other words, consumers exhibit reduced demand for products produced with GM tolerance levels relative to products produced GM-free (Rousu et al.). The magnitude of that reduction materialized as a 7 to 13 percent discount on GM-tolerant food products relative to GM-free food

products (Rousu et al.). With these results in mind, Rousu et al. remarked that due to the higher segregation costs of lower GM tolerance levels and the indifference in consumer demand between 1% and 5% contamination levels, policy mandating a higher tolerance level may be best for society.

Environmental Issues

Batie discusses the environmental impacts of GM plants and the inherent challenges to decision making at the regulatory level. There exists a great amount of uncertainty as to the potential environmental impacts of wide-spread adoption and production of GM plants (Batie). GM plants are manufactured for several different purposes including, herbicide tolerance, insect tolerance, virus tolerance, biopharmaceutical and industrial products (Batie). These characteristics raise concern not for their intended purposes but for the unintended side-effects they may cause in the environment. Batie contends that some of these potential risks include: The transfer of genes from GM plants to traditional varieties that may cause disease in the traditional crops or the emergence of stronger, harder to control viruses; the creation of “super weeds” that require the use of more toxic herbicides or more invasive tillage practices to eradicate; insect resistance to GM insect tolerant crops; adverse effects on non-target species; and ecosystem damage due to loss of biodiversity. These risks and the relatively small amount of current knowledge as to other potential risks of large-scale production of GM plants present major challenges for those governmental agencies responsible for regulating biotechnology (Batie).

Batie asserts that these challenges are compounded by the current system of regulation in place. The burden of assessing the safety of a product is placed on consumers and governmental agencies once a product is already far along the path to commercialization (Batie). The current regulatory approach involves minimizing Type I error, which in the case of approval for genetically modified plants reduces the chance of the market being deprived of the benefits inherent to these products (Batie).

Batie suggests that a more precautionary approach by government is more appropriate than the current system. This approach would concentrate more on controlling Type II errors and would require those who create GM plants to prove the safety of their product considering all risks and possibly delaying release until the risks are made more clear (Batie). Batie challenges agricultural economists to: (1) "estimate the true social costs of delaying GM plant commercialization," (2) "develop meaningful criteria for discriminatory risk assessments and risk management tools," and (3) "assist in the development of industry-led, proactive, safety-first efforts to manage new technologies as well as the development of appropriate institutional settings for such proactive efforts."

Summary

In summary, there have been a number of studies exploring genetic modification in general and a limited number on the consumer acceptance issues related to the technology. Previous research has examined consumers' socio-economic, demographic, and belief characteristics relative to their level of acceptance of genetic modification. Additionally, several studies have analyzed the relationship between consumer's risk and

benefit perceptions, attitudes on labeling, and trust in government and industry as potential factors in their decision to approve or disapprove of GM technology. Relatively few of the available studies pertaining to consumer issues and genetic modification include comparisons between countries. Those studies that do include country comparisons focus mainly on the differences and similarities between the U.S. and EU nations. This study attempts to examine the factors involved in consumer approval of various types of genetic modification. More specifically, comparisons between approval of genetic modification of plant-based foods and animal-based foods will be made. Unique to this study, U.S. consumers' level of approval for food genetic modification will be compared with South Korean consumers' level of approval. The analysis conducted in this study will be conducted using primary data collected in the United States and South Korea in 2003.

CHAPTER III

METHODOLOGY

Survey Methodology

The survey was conducted in the United States and in South Korea. The survey questionnaires used in the U.S. and South Korea had in many instances identical questions. Other questions were similar with modifications made in consideration of cultural differences.

United States Survey Methodology

The survey was created by the Food Policy Institute at Rutgers University in collaboration with investigators across the United States participating in a USDA grant project exploring the issue of consumer attitudes toward the use of food biotechnology. It was designed to address topics pertaining to public perceptions of agricultural biotechnology and public approval of genetically modified food products. The survey also addressed the socio-demographics of the survey sample with questions in the survey questionnaire as to respondents' sex, age, race, ethnicity, education level, political association, employment status, length of work week, marital status, household size, frequency of church attendance, and income. Respondents divulged information relating to their attitudes of the labeling on genetically modified foods, the various uses of genetic modification in the creation of food products, and their previous exposure to the issue of the genetic modification of foods via media and word-of-mouth. Additionally,

the survey revealed the respondents' basic understanding of food production, basic understanding of science and technology, as well as a series of knowledge questions specific to the applications of genetic modification.

South Korean Survey Methodology

The survey was conducted across South Korea to investigate general public knowledge, behavior, and understanding of biotechnology. The survey results are intended to provide background information for the creation and implementation of biotechnology policy. The survey revealed respondents' purchasing behavior of food and meals, perceptions of food and agricultural products, perceptions of eating habits, perceptions of and behavior related to biotechnology and genetically modified organisms. Additionally, the survey addressed the respondents' evaluation of non-government organizations and the perceptions and behavior of mass media response to the issue of genetic modification.

Survey Sample

United States Survey Sample

The survey was conducted nationally by telephone from February 27, 2003 until April 1, 2003 by a private-public polling firm employed by the Food Policy Institute at Rutgers University. U.S. Census Bureau population estimates were used to draw a geographically proportionate, nationally representative target population. From the target population a random, proportional probability sample of U.S. adults (18 years of

age or older) was drawn. A target sample of 1200 was chosen to allow for a sampling error rate of ± 3 percent with a statistical significance level of 95 percent.

Individuals within the target population were contacted at varying intervals during the week with a maximum of twelve callbacks allowed. Messages were left on the second, fifth, and ninth calls expressing the purpose of the call and a brief explanation of the study. Upon contact a random, balanced electronic selection led to the collection of representative numbers of males and females. In an effort to keep the survey concise and minimize respondent fatigue, a split ballot scheme was utilized for several of the survey questions. The average cooperation rate for both versions of the survey was 65 percent. In total, 1201 complete telephone surveys were collected using a computer-assisted telephone interview (CATI).

South Korean Survey Sample

The survey was conducted nationally in face-to-face interviews from April 10, 2003 until May 9, 2003 by Gallup Korea employed by Korea Biosafety Clearing House at Korea Research Institute of Bioscience and Biotechnology. A target sample was obtained through proportionate random sampling based on population by region. The survey group included adults from across South Korea ranging in age from 20 to 59 years. The sampling error was ± 3.1 percent with a statistical significance level of 95 percent.

Qualified persons were selected to conduct the face-to-face interviews from a pool of special interviewers registered by the Gallup Institute. Interviewers attended an orientation covering the survey method, contents, and exercise in an effort to minimize

non-sampling error. Control over the interviewers was exercised by distributing and collecting questionnaires each day. Respondents were given a pen (worth $2 US) for answering the questionnaire. The cooperation rate from initially selected interviewees was 40 percent. In total, 1054 complete face-to-face surveys were collected.

Questionnaire Design

United States Questionnaire

The questionnaire was designed to gather a range of information related to U.S. public perceptions of agricultural biotechnology. It consisted of 51 questions covering a range of topics including; demographics, socio-economics, social/political views, approval of various uses of genetic modification, basic understanding of agricultural production and science and technology, knowledge of the applications/outcomes of using genetic modification to produce food products, as well as exposure to media coverage and hearsay pertaining to the genetic modification of food products. As the survey questionnaire was administered following a split ballot, certain questions were only answered by half of the sample population. All of the questions used in this study, however, were asked of all 1201 respondents.

In keeping with the focus of this study, respondents were asked two separate questions related to their approval of the use of genetic modification for the creation of: (1) plant-based food products, and (2) animal-based food products.

In two separate questions, respondents were asked to rate their basic understanding of how food is grown and produced as well as rate their basic understanding of science and technology. Several knowledge-based questions pertaining

to the applications and outcome of genetic modification were also asked in the form of True/False questions.

As Hallman points out, consumers generally have an opinion about biotechnology whether or not they are adequately informed. With this trend in mind, a question pertaining to the amount the respondents had heard or read about biotechnology was included in the questionnaire.

Additionally, respondents were asked if they thought products containing GM ingredients should be labeled as such.

Respondents were asked "*Regardless of the political party you might favor, do you consider yourself to be a liberal, conservative, or somewhere in between?"* If the respondent answered "*somewhere in between,"* they were then asked whether they lean more toward the liberal side or the conservative side.

The final questions in the survey were socio-economic or demographic in nature and included the respondent's age, education level, ethnicity, race, and income.

South Korean Questionnaire

The questions in the South Korean survey questionnaire were provided by the Food Policy Institute at Rutgers University and translated into Korean. The majority of the questions were identical to the United States survey questionnaire with the exception of certain questions that were modified to better align with South Korean culture. Much the same as the U.S. survey questionnaire, the South Korean survey questionnaire was also split into two versions. While the two versions had several different questions they

had a core of questions in common. The questions considered in this study were drawn from the core group of questions and were asked of all 1054 respondents.

With the comparison to the results of the U.S. models in mind, the questions from the South Korean survey questionnaire that were included in this study were markedly similar or in many instances identical to the questions from the U.S. survey questionnaire analyzed in this study. South Korean respondents were asked if they approve the use of genetic modification to create: (1) plant-based food products, and (2) animal-based food products.

Questions as to the respondents' basic understanding of: (1) how food is grown and produced, and (2) science and technology were asked. Respondents were also asked how much they had previously read or heard about biotechnology. Several questions were also asked relative to the respondents' knowledge of the applications and outcomes of the genetic modification of foods. These questions were administered in a True or False format.

The issue of labeling was also addressed in the South Korean survey questionnaire. Respondents were asked if they thought that food products containing genetically modified ingredients should be labeled as such.

Additionally, South Korean respondents were asked whether they considered themselves to be liberal, conservative, or somewhere in between. Unlike the U.S. survey, the South Korean survey questionnaire did not ask those respondents who answered "*somewhere in between*" whether they leaned more toward the liberal side or the conservative side.

The survey questionnaire concluded with socio-economic and demographic questions that covered the respondents' age, education level, and income. Unlike the U.S. survey questionnaire, the South Korean survey questionnaire did not ask questions relating to the respondents' ethnicity or race.

CHAPTER IV

EMPIRICAL FRAMEWORK

Empirical Framework and Models

Researchers have generally found that consumers respond differently depending on the type of product created by means of genetic modification. A significantly more positive attitude was shown by consumers toward the genetic engineering of plants and microorganisms than the genetic engineering of animals or human genetic material (Frewer et al.). Hossain et al. found that close to half of the respondents in its study who approved of the use of biotechnology in plants did not support its use in animals. The dependent variables in this study were selected in keeping with previous studies which found that consumer acceptance of genetic modification varies depending on the type of product being modified.

Analysis was conducted using two separate questions from the survey as dependent variables: (1) Approval of the use of genetic modification in the creation of plant-based food products, and (2) approval of the use of genetic modification in the creation of animal-based food products. In accordance with previous studies, it was assumed that approval of genetic modification is related to consumers': (1) Knowledge of genetic modification (Onyango et al), (2) previous exposure to the issue of genetic modification (Hallman), (3) thoughts on the labeling of products containing genetically

modified ingredients (Giannakas and Fulton), (4) values and beliefs (Baker and Burnham), (5) socio-economics, and (6) demographics.

The list and definitions of the variables used in the models are shown in Tables 1-4.

Table 1. Variable Definitions and Their Descriptive Statistics: U.S. Plant Approval

United States Plant Approval Models (Binary and Ordered Probit) **Descriptive Statistics of Explanatory Variables Used in Analysis**				
	Description of Variable	**Mean**	**Std. Dev.**	**Range**
Dependent Variable				
Binary Model	1=respondent strongly or somewhat approves of plant GM; 0=otherwise	0.58	0.49	0-1
Ordered Model	0= respondent strongly disapproves of plant GM;1=respondent somewhat disapproves of plant GM;2=respondent somewhat approves of plant GM; 3= respondent strongly approves of plant GM	0.56**	0.50	0-3
Independent Variables				
FEMALE	1=respondent is female;0=otherwise	0.56	0.50	0-1
GUNDPROD	1=respondent rated their basic understanding of food production as good, very good, or excellent;0=otherwise	0.79	0.41	0-1
HEARDSOM	1=respondent has heard/read some or a great deal about genetic modification;0=otherwise	0.65	0.48	0-1
LABEL	1=respondent thought foods containing GM ingredients should be labeled as such;0=otherwise	0.94	0.25	0-1
PUNDSCI	1=respondent rated their basic understanding of science and technology as poor or fair;0=otherwise	0.58	0.49	0-1
GENEMOD	1=respondent answered false (correct ans.) Q: By eating GM fruit a person's genes could also become modified;0=otherwise	0.75	0.43	0-1
TOMFISH	1=respondent answered false (correct ans.) Q: Tomatoes genetically modified with genes from a catfish would probably taste fishy;0=otherwise	0.69	0.46	0-1
AGE	continuous variable; range 18-93 years in age	45.51	16.27	18-93
AGESQ	continuous variable; age variable squared	2335.1	1624.4	324-8649
ASBSGRAD	1=respondent had some college education, an Associate degree, 4 yr. College degree, or post-graduate education;0=otherwise	0.65	0.48	0-1
CONSERV	1=respondent classified them-self as conservative;0=otherwise	0.6	0.49	0-1
NONHISP	1=respondent classified them-self as not of Hispanic origin;0=otherwise	0.95	0.22	0-1
AFAMER	1=respondent classified them-self as black/African-American;0=otherwise	0.11	0.31	0-1

Table 1. Continued

United States Plant Approval Models (Binary and Ordered Probit) Descriptive Statistics of Explanatory Variables Used in Analysis				
		Mean	**Std. Dev.**	**Range**
Independent Variables				
OTHERACE	1=respondent classified them-self as Asian or Pacific Islander, Native American, or "other";0=otherwise	0.05	0.21	0-1
INCOME1	1=total household income (2002) was under $25,000;0=otherwise	0.16	0.37	0-1
INCOME2	1=total household income (2002) was $25,000-$34,999;0=otherwise	0.16	0.37	0-1
INCOME3	1=total household income (2002) was $35,000-$49,999;0=otherwise	0.13	0.34	0-1
INCOME4	1=total household income (2002) was $50,000-$74,999;0=otherwise	0.26	0.44	0-1
INCOME5	1=total household income (2002) was $75,000-$99,999;0=otherwise	0.14	0.35	0-1
	*Base for race variable: respondent classified them-self as white *Base for income variable: total household income (2002) was $100,000-$124,999 or $125,000 or more ** Mean for ordered probit model is misleading because values range from 0-3; The frequencies from the ordered probit are as follows: 0=0.20; 1=0.21; 2=0.44; 3=0.15			

Table 2. Variable Definitions and Their Descriptive Statistics: South Korean Plant Approval

South Korean Plant Approval Models (Binary and Ordered Probit) Descriptive Statistics of Explanatory Variables Used in Analysis				
	Description of Variable	**Mean**	**Std. Dev.**	**Range**
Dependent Variable				
Binary Model	1=respondent strongly or somewhat approves of plant GM; 0=otherwise	0.35	0.48	0-1
Ordered Model	0= respondent strongly disapproves of plant GM;1=respondent somewhat disapproves of plant GM;2=respondent somewhat approves of plant GM; 3= respondent strongly approves of plant GM	0.49**	0.50	0-3
Independent Variables				
FEMALE	1=respondent is female;0=otherwise	0.49	0.50	0-1
GUNDPROD	1=respondent rated their basic understanding of food production as good, very good, or excellent;0=otherwise	0.86	0.35	0-1
HEARDSOM	1=respondent has heard/read some or a great deal about genetic modification;0=otherwise	0.83	0.37	0-1
LABEL	1=respondent thought foods containing GM ingredients should be labeled as such;0=otherwise	0.96	0.18	0-1

Table 2. Continued

South Korean Plant Approval Models (Binary and Ordered Probit) Descriptive Statistics of Explanatory Variables Used in Analysis				
Independent Variables		**Mean**	**Std. Dev.**	**Range**
PUNDSCI	1=respondent rated their basic understanding of science and technology as poor or fair;0=otherwise	0.49	0.50	0-1
GENEMOD	1=respondent answered false (correct ans.) Q: By eating GM fruit a person's genes could also become modified;0=otherwise	0.41	0.49	0-1
TOMFISH	1=respondent answered false (correct ans.) Q: Tomatoes genetically modified with genes from a catfish would probably taste fishy;0=otherwise	0.43	0.50	0-1
AGE1	1=respondent was between 20 and 29 years of age;0=otherwise	0.22	0.42	0-1
AGE2	1=respondent was between 30 and 39 years of age;0=otherwise	0.34	0.47	0-1
AGE3	1=respondent was between 40 and 49 years of age;0=otherwise	0.29	0.46	0-1
ASBSGRAD	1=respondent was attending college or was a college graduate or above;0=otherwise	0.42	0.49	0-1
CONSERV	1=respondent classified them-self as conservative;0=otherwise	0.32	0.47	0-1
INBETWN	1=respondent classified them-self as somewhere in between liberal and conservative	0.44	0.50	0-1
INC1	1=total household income (2002) was below 20 million Won;0=otherwise	0.21	0.41	0-1
INC2	1=total household income (2002) was 20-30 million Won;0=otherwise	0.28	0.45	0-1
INC3	1=total household income (2002) was 30-40 million Won;0=otherwise	0.28	0.45	0-1
	*Base for age variable: age range 50 to 59 years old *Base for income variable: Over 40 million Won **Mean for ordered probit model is misleading because values range from 0-3; The frequencies from the ordered probit are as follows: 0=0.28; 1=0.38; 2=0.30; 3=0.42			

Table 3. Variable Definitions and Their Descriptive Statistics: U.S. Animal Approval

United States Animal Approval Models (Binary and Ordered Probit) Descriptive Statistics of Explanatory Variables Used in Analysis				
	Description of Variable	**Mean**	**Std. Dev.**	**Range**
Dependent Variable				
Binary Model	1=respondent strongly or somewhat approves of animal GM; 0=otherwise	0.27	0.45	0-1
Ordered Model	0=respondent strongly disapproves of animal GM;1=respondent somewhat disapproves of animal GM;2=respondent somewhat approves of animal GM; 3=respondent strongly approves of animal GM	0.57**	0.49	0-3
Independent Variables				
FEMALE	1=respondent is female;0=otherwise	0.57	0.49	0-1
GUNDPROD	1=respondent rated their basic understanding of food production as good, very good, or excellent;0=otherwise	0.79	0.41	0-1
HEARDSOM	1=respondent has heard/read some or a great deal about genetic modification;0=otherwise	0.64	0.48	0-1
LABEL	1=respondent thought foods containing GM ingredients should be labeled as such;0=otherwise	0.94	0.24	0-1
PUNDSCI	1=respondent rated their basic understanding of science and technology as poor or fair;0=otherwise	0.59	0.49	0-1
GMBIGGER	1=respondent answered false (correct answer) Q: Genetically modified animals are always bigger than ordinary animals;0=otherwise	0.65	0.48	0-1
TRANSGEN	1=respondent answered false (correct answer) Q: It is not possible to transfer animal genes to plants;0=otherwise	0.47	0.50	0-1
AGE	continuous variable; range 18-93 years in age	45.78	16.33	18-93
AGESQ	continuous variable; age variable squared	2362.3	1632.2	324-8649
ASBSGRAD	1=respondent had some college education, an Associate degree, 4 yr. College degree, or post-graduate education;0=otherwise	0.64	0.48	0-1
CONSERV	1=respondent classified them-self as conservative;0=otherwise	0.60	0.49	0-1
NONHISP	1=respondent classified them-self as not of Hispanic origin;0=otherwise	0.95	0.22	0-1
AFAMER	1=respondent classified them-self as black/African-American;0=otherwise	0.10	0.31	0-1
OTHERACE	1=respondent classified them-self as Asian or Pacific Islander, Native American, or "other";0=otherwise	0.05	0.22	0-1
INCOME1	1=total household income (2002) was under $25,000;0=otherwise	0.16	0.37	0-1
INCOME2	1=total household income (2002) was $25,000-$34,999;0=otherwise	0.17	0.37	0-1
INCOME3	1=total household income (2002) was $35,000-$49,999;0=otherwise	0.13	0.34	0-1
INCOME4	1=total household income (2002) was $50,000-$74,999;0=otherwise	0.26	0.44	0-1
INCOME5	1=total household income (2002) was $75,000-$99,999;0=otherwise	0.14	0.34	0-1
	*Base for race variable: respondent classified them-self as white *Base for income variable: total household income (2002) was $100,000-$124,999 or $125,000 or more ** Mean for ordered probit model is misleading because values range from 0-3; The frequencies from the ordered probit are as follows: 0=0.48; 1=0.24; 2=0.22; 3=0.06			

Table 4. Variable Definitions and Their Descriptive Statistics: South Korean Animal Approval

South Korean Animal Approval Models (Binary and Ordered Probit) Descriptive Statistics of Explanatory Variables Used in Analysis				
	Description of Variable	**Mean**	**Std. Dev.**	**Range**
Dependent Variable				
Binary Model	1=respondent strongly or somewhat approves of animal GM; 0=otherwise	0.22	0.41	0-1
Ordered Model	0=respondent strongly disapproves of animal GM;1=respondent somewhat disapproves of animal GM;2=respondent somewhat approves of animal GM; 3=respondent strongly approves of animal GM	0.49**	0.50	0-3
Independent Variables				
FEMALE	1=respondent is female;0=otherwise	0.49	0.50	0-1
GUNDPROD	1=respondent rated their basic understanding of food production as good, very good, or excellent;0=otherwise	0.86	0.35	0-1
HEARDSOM	1=respondent has heard/read some or a great deal about genetic modification;0=otherwise	0.83	0.37	0-1
LABEL	1=respondent thought foods containing GM ingredients should be labeled as such;0=otherwise	0.96	0.18	0-1
PUNDSCI	1=respondent rated their basic understanding of science and technology as poor or fair;0=otherwise	0.49	0.50	0-1
GMBIGGER	1=respondent answered false (correct answer) Q: Genetically modified animals are always bigger than ordinary animals;0=otherwise	0.24	0.43	0-1
TRANSGEN	1=respondent answered false (correct answer) Q: It is not possible to transfer animal genes to plants;0=otherwise	0.31	0.46	0-1
AGE1	1=respondent was between 20 and 29 years of age;0=otherwise	0.22	0.42	0-1
AGE2	1=respondent was between 30 and 39 years of age;0=otherwise	0.33	0.47	0-1
AGE3	1=respondent was between 40 and 49 years of age;0=otherwise	0.30	0.46	0-1
ASBSGRAD	1=respondent was attending college or was a college graduate or above;0=otherwise	0.42	0.49	0-1
CONSERV	1=respondent classified them-self as conservative;0=otherwise	0.32	0.47	0-1
INBETWN	1=respondent classified them-self as somewhere in between liberal and conservative	0.44	0.50	0-1
INC1	1=total household income (2002) was below 20 million Won;0=otherwise	0.21	0.41	0-1
INC2	1=total household income (2002) was 20-30 million Won;0=otherwise	0.28	0.45	0-1
INC3	1=total household income (2002) was 30-40 million Won;0=otherwise	0.28	0.45	0-1
	*Base for age variable: age range 50 to 59 years old *Base for income variable: Over 40 million Won ** Mean for ordered probit model is misleading because values range from 0-3; The frequencies from the ordered probit are as follows: 0=0.38; 1=0.40; 2=0.19; 3=0.03			

Two variables reflecting consumers' basic understanding of (1) food production and, (2) science and technology were included (*gundprod* and *pundsci*). Another two variables reflecting consumers' actual knowledge of the applications and outcomes of genetic modification were also included (plant models: *genemod* and *tomfish*; animal models: *gmbigger* and *transgen*). The four variables were included as a means of relating the consumers' actual knowledge to their approval of the genetic modification of food products. Consumers from different countries have differing levels of knowledge, as well as different attitudes towards GM food (House et al.). Onyango et al., found that consumers were generally more willing to accept food biotechnology if they possessed an average understanding of scientific knowledge relative to biotechnology.

The variable *heardsom* was included to represent the consumers' level of exposure via media or word-of-mouth to the issue of genetic modification. Most surveys have found that the number of respondents who approve or disapprove of biotechnology exceeds the number who had heard much about the subject (Hallman).

Giannakas and Fulton found that consumers with a lesser aversion to GM products prefer non-labeled products while those who had a higher aversion were likely to consume a substitute. The variable *label* was included to represent the consumers' attitude toward the labeling of food products containing genetically modified ingredients.

As a representation of consumers' social beliefs the variable *conserv* was included in the models. Consumers are best differentiated based on *what they believe*

rather than *who they are;* thus, understanding that consumers are motivated by deeply held values provides insight into their actions (Baker and Burnham).

The socio-economic and demographic variables included in the United States models are gender, age, education level, ethnicity, race, and income (*female, age, agesq, asbsgrad, nonhisp, afamer, otherace, income1, income2, income3, income4, and income5*). The socio-economic and demographic variables included in the South Korean models are gender, age, education level, and income (*female, age1, age2, age3, asbsgrad, inc1, inc2, and inc3*). Onyango et al., Hine and Loureiro, and Hossain et al., among others, included demographic variables in their models.

Estimation of the Models

The respondents were asked two separate questions pertaining to their approval of the use of (1) the genetic modification of plant-based food product, and (2) the genetic modification of animal-based food products. Each question had four possible answers which included: Strongly approve, somewhat approve, somewhat disapprove, and strongly disapprove. In the initial United States and South Korean models, the observations in which respondents reported that they somewhat or strongly approved were combined into a sub-category generalized as “approve”. The observations in which respondents reported that they somewhat or strongly disapproved were combined into a sub-category generalized as “disapprove.” A dummy variable was then created for the dependent variable, either approval of plant genetic modification or approval of animal genetic modification, to represent a dichotomous choice. Dummy variables were also created for most of the explanatory variables in the models. Dummy values of “1” were

awarded based on the highest proportion of responses to any one answer for questions which allowed for dichotomous choice or a logical combination of answers for questions with more than two possible answers. On the premise that approval of genetic modification is a dichotomous choice, a probit model for binary choice was selected to examine the data. The number of the possible responses to the questions selected as dependent variables poses a problem when modeled solely by way of probit models for binary choice. The probit models for binary choice do not take into account the ordered nature of the responses to questions selected as dependent variables in the plant- and animal- genetic modification models. Hence, the United States and South Korean data were also examined utilizing Ordered probit models.

Ability of the Models to Predict Correctly

It is important to note the ability of the models to make accurate predications. Measures such as the McFadden R^2 and the percentage of right predications give insight into the model's goodness of fit.

The U.S. plant approval model had a McFadden R^2 of 0.091 and a percentage of right predications of 64.68%. The U.S. animal approval model had a McFadden R^2 of 0.087 and a percentage of right predications of 73.97%.

The South Korean plant approval model had a McFadden R^2 of 0.502 and a percentage of right predications of 68.44%. The South Korean animal approval model had a McFadden R^2 of 0.031 and a percentage of right predications of 78.34%.

The Probit Model for Binary Choice

The "approval of plant genetic modification" probit model for binary choice may be defined as:

(1) $y_i^* = \beta' x_i + \varepsilon_i$,

where y_i^* is unobserved. The observed dichotomous variable y_i is related to y_i^* as follows:

$$y_i = 0 \text{ if } y_i^* \leq 1$$

$$y_i = 1 \text{ if } y_i^* > 1$$

When $y_i = 1$, the consumer reports that they either somewhat or strongly approve of the use of genetic modification for the creation of plant-based food products; $y_i = 0$ if otherwise.

The "approval of animal genetic modification" probit model for binary choice may be defined as:

$$y_i^* = \beta' x_i + \varepsilon_i,$$

where y_i^* is unobserved. The observed dichotomous variable y_i is related to y_i^* as follows:

$$y_i = 0 \text{ if } y_i^* \leq 1$$

$$y_i = 1 \text{ if } y_i^* > 1$$

When $y_i = 1$, the consumer reports that they either somewhat or strongly approve of the use of genetic modification for the creation of animal-based food products; $y_i = 0$ if otherwise.

The vector of covariates is x_i and the parameter vector is β, thus the function $\beta' x_i$ is the vector of explanatory variables. The random error is ε_i with a $\sim N(0,1)$ distribution. The probit model implies that the probability of the consumer's approval decision is normally distributed. Generally, the estimation of a binary choice model is based on the method of maximum likelihood. The model, therefore has a success probability function $\beta' x$ and independent observations which lead to the likelihood function. For a detailed discussion of the probit model for binary choice, see W.H. Greene.

Ordered Probit Model

Greene points out that some multinomial-choice variables are inherently ordered and examples that have appeared in the literature include the data from opinion surveys.

The model is built around a latent regression as is the binary probit model. The latent regression is specified as:

(2) $y_i^* = \beta' x_i + \varepsilon_i, \varepsilon_i \sim N(0,1),$

$y_i = 0 \text{ if } y_i^* \leq 0,$

$= 1 \text{ if } 0 < y_i^* \leq \mu_1,$

$= 2 \text{ if } \mu_1 < y_i^* \leq \mu_2,$

…

$= J \text{ if } \mu_{J-1} \leq y_i^*.$

The y^* is unobserved, and y is the observed form of y^*. The μ's are unknown parameters that are estimated with β. The vector of explanatory variables is x. In this study, $J = 4$, with y values for the plant ordered probit model of:

Y = 3 if the respondent reported that they strongly approve of the genetic modification of plant-based food products;

Y = 2 if the respondent reported that they somewhat approve of the genetic modification of plant-based food products;

Y = 1 if the respondent reported that they somewhat disapprove of the genetic modification of plant-based food products; and

Y = 0 if the respondent reported that they strongly disapprove of the genetic modification of plant-based food products.

For the animal ordered probit model, $J = 4$, with y values of:

Y = 3 if the respondent reported that they strongly approve of the genetic modification of animal-based food products;

Y = 2 if the respondent reported that they somewhat approve of the genetic modification of animal-based food products;

Y = 1 if the respondent reported that they somewhat disapprove of the genetic modification of animal-based food products; and

Y = 0 if the respondent reported that they strongly disapprove of the genetic modification of animal-based food products.

The plant model question was phrased as “In general, do you approve or disapprove of using genetic modification to create plant-based food products?” The animal model question was phrased as “in general, do you approve or disapprove of using genetic modification to create animal-based food products?”

With the normal distribution the probabilities of observing y, given x are as follows:

$$\text{Prob}(y = 0) = \Phi(-\beta'x),$$

$$\text{Prob}(y = 1) = \Phi(\mu_1 - \beta'x) - \Phi(-\beta'x),$$

$$\text{Prob}(y = 2) = \Phi(\mu_2 - \beta'x) - \Phi(\mu_1 - \beta'x), \text{ and}$$

$$\text{Prob}(y = 3) = 1 - \Phi(\mu_2 - \beta'x).$$

The following condition must exist for all the probabilities to be positive:

$$0 < \mu_1 < \mu_2 < \mu_3.$$

From these probabilities, the likelihood function can be written as:

$$(3) \qquad L = \Pi_{y=0}\Pr(y = 0)\ \Pi_{y=1}\Pr(y = 1)\ \ldots\Pi_{y=3}\Pr(y = 3)$$

Making the appropriate substitutions, L can be written as:

$$L = \Pi_{y=0}\ \Phi(-\beta'x)\ \Pi_{y=1}[\Phi(\mu_1 - \beta'x) - \Phi(-\beta'x)]\ \ldots\Pi_{y=3}[1 - \Phi(\mu_2 - \beta'x)]$$

In log form, the log-likelihood function becomes:

$$\text{Ln}L = \Sigma_{y=0}\log[\Phi(-\beta'x)] + \Sigma_{y=1}\log[\Phi(\mu_1 - \beta'x) - \Phi(-\beta'x)] + \ldots$$

$$+\Sigma_{y=3}\log[1 - \Phi(\mu_2 - \beta'x)]$$

The coefficient estimates are not equal to the marginal effects of the explanatory variables x on the probabilities. The marginal effects of the explanatory variables are calculated in the following manner:

$$(4) \qquad \partial\text{Prob}[\text{cell j}]/\ \partial x_i = [f(\mu_{j-1} - \beta'x_i) - f(\mu_I - \beta'x_i)] \times \beta$$

where $f(.)$ is the standard normal density. The marginal effects for the dummy variables are calculated as the difference between two resulting probabilities when the dummy

variable equals its two values 0 and 1. For a further explanation of the ordered probit model and likelihood function see Nayga et al.

CHAPTER V

SURVEY RESULTS

Descriptive Analysis

United States Respondents' Characteristics

Within the sample of 1201 subjects, 502 respondents were male while 699 were female. Most were 35-44 years old (21.9%) or 45-54 years old (20.7%). The racial composition of the U.S. is approximately 77 % white compared with over 78% white respondents in the sample. Education was broken into five categories. The categories included, "no formal schooling", "1st through 7th grade", "8th grade", "some high school (9th but didn't finish 12th) were combined into the category: "below high school" (n=94). The other four categories were: "high school grad/GED" (n=354), "some college" (n=322), "college grad" (n=261), and "post grad" (n=165). About 62% of the survey sample had received at least some college education which is slightly higher than the almost 52% reported to the U.S. Census. Almost half (49.1%) of the respondents had incomes above $50,000, which is close to agreement with U.S. Census figures. The sample was slightly more educated than the profile of the U.S. created by U.S. data. Table 5 displays the demographic characteristics of the United States sample used in this study, as well as a comparison of the demographic profile of the United States as reported by the 2000 U.S. Census.

Table 5: Comparison of U.S. Survey Sample and U.S. Census Demographics

Characteristics	United States Survey Sample	United States 2000 Census
GENDER		
Male	41.8%	49.1%
Female	58.2%	50.9%
AGE		
18-24 years	8.6%	9.6%
25-34 years	16.2%	14.2%
35-44 years	21.9%	16.0%
45-54 years	20.7%	13.4%
55-64 years	13.2%	8.6%
65 years and over	18.1%	12.4%
RACE		
White	80.9%	75.1%
Black	10.4%	12.3%
Other	6.0%	12.5%
ETHNICITY		
Non-Hispanic	92.9%	12.5%
Hispanic	5.4%	87.5%
EDUCATION		
Below H.S.	7.8%	20.3%
H.S. grad/ GED	29.5%	28.6%
Some college	26.8%	28.8%
College grad or more	35.4%	22.3%
INCOME		
Under $25,000	16.07%	28.70%
$25,000-$34,999	13.74%	12.80%
$35,000-$49,999	12.07%	16.60%
$50,000-$74,999	21.90%	19.40%
$75,000-$99,999	11.32%	10.20%
$100,000-$124,999	5.83%	5.20%
$125,000 or more	5.75%	7.10%

***Survey sample percentages may not sum to 100% due to rounding and missing data*

South Korean Respondents' Characteristics

From a sample of 1054 respondents, 49.4% were male and 50.6% were female. The gender proportions of the survey sample were consistent with the male to female ratio found in the 2000 South Korean Census. The majority of survey respondents were 30 to 39 years of age (33%), followed by those who were 40 to 49 years old (28.2%), 20 to 29 years old (24.5%), and 50 to 59 years old (14.3%). The age proportions of the survey sample are not consistent with 2000 South Korean Census figures. The reason for the discrepancy lies with the sampling procedure used to administer the survey instrument. Only those between the ages of 20 and 59 were asked to participate in the survey thus skewing the age proportions of the sample relative to Census figures. A majority of the survey respondents had a high school degree (47.1%). About 12% of respondents had a middle school degree, while 11.2% of respondents were attending college. Only 29.7% of respondents had a college degree or more. As with the age proportions, the education level proportions of the survey sample are not consistent with 2000 Census data. The survey sample appears to be more educated than the general population of South Korea represented by Census data. Finally, the majority of respondents reported a household income of 30 to 40 million Won (28.2%). The remainders of the income proportions of the sample were relatively similar to one another. The remaining proportions were as follows: 27.6% of respondents reported household incomes of 20 to 30 million Won, 22.3% reported household incomes over 40 million Won, and 21.6% reported household incomes below 20 million Won. In comparison with 2000 Census figures representative of the population of South Korea,

the survey sample displays higher income proportions. The differences in age, education level, and household income proportions between the survey sample and Census figures must be considered when generalizing the findings of this study. Table 6 presents the comparison of the survey sample demographics and 2000 South Korean Census data.

Table 6: Comparison of South Korean Survey Sample and South Korean Census Demographics

Characteristics	South Korean Survey Sample	South Korea 2000 Census
GENDER		
Male	49.40%	50.34%
Female	50.60%	49.66%
AGE		
Up to 19 years	N/A	29.00%
20 to 29 years	24.50%	17.30%
30 to 39 years	33.00%	18.00%
40 to 49 years	28.20%	15.10%
50 to 59 years	14.30%	9.40%
60 years or above	N/A	11.20%
EDUCATION		
Middle school grad and under	12.00%	36.30%
High school grad	47.10%	39.40%
Attending college	11.20%	N/A
College grad or above	29.70%	24.30%
INCOME		
Below 20 million Won	21.60%	37.00%
20-30 million Won	27.60%	25.50%
30-40 million Won	28.20%	19.20%
Over 40 million Won	22.30%	18.40%

***Survey sample percentages may not sum to 100% due to rounding and missing data*

Understanding of Production

Respondents' were asked a question as to their basic knowledge of how food is grown and produced. Knowledge was classified into one of five categories ranging from poor to excellent. The question was identical in the U.S. and South Korean questionnaires.

United States Respondents

Table 7 displays the information on United States consumer understanding of production. The results indicate that the greatest number of respondents rated their understanding of production in both the plant and animal models as good (35.57%, and 35.77% respectively), followed by ratings of very good, fair, excellent, and poor.

South Korean Respondents

In contrast with the majority of U.S. consumers' reporting a good understanding of food production, in both South Korean models a majority of consumers reported having a very good understanding of how food is produced (33.33%, and 33.37% respectively). In the U.S. models 78.86%, and 79.08% of consumers reported having a good or better understanding of how food is produced whereas in the South Korean models 85.60%, and 85.63% of consumers reported having a good or better understanding. Even more noteworthy is that in the plant model, 13.78% more South Korean consumers reported having an excellent understanding of food production than did U.S. consumers, and in the animal model the proportion was 14.43%. Thus, it can be said that South Korean consumers reports having a better understanding of food

production than do U.S. consumers. Table 7 displays the information on South Korean consumers' understanding of food production.

Table 7: Comparison of U.S. and S. Korean Consumers' Understanding of Production

	GM Plant Model		GM Animal Model	
Understanding of Production	**U.S.**	**S. Korea**	**U.S.**	**S. Korea**
Poor	2.28%*	1.99%*	2.31%**	1.99%**
Fair	18.86%	12.40%	18.61%	12.38%
Good	35.57%	22.92%	35.77%	22.87%
Very Good	27.72%	33.33%	28.35%	33.37%
Excellent	15.57%	29.35%	14.96%	29.39%

***Values not statistically different from one another*
***Values not statistically different from one another*

Understanding of Science

In both the United States and South Korean surveys, respondents' were asked to rate their basic understanding of science and technology. The possible ratings ranged from poor to excellent.

United States Respondents

The results in the GM plant approval model were similar to those found in the GM animal approval model. While the majority of respondents rated their basic understanding of food production as good, when asked as their basic understanding of

science and technology the majority of respondents rated their understanding as being only fair (41.90%, and 41.48% respectively). The remaining respondents ranked their understanding of science and technology as follows; good, poor, very good, and excellent. In both models, almost 60% of respondents rated themselves as having a poor or fair understanding of science and technology. This is an interesting result in the context of its affect on the level of approval of genetic modification. Hallman et al., found that American consumers admit to having little knowledge on the subject of genetic modification and yet they continue to have an opinion as to the acceptability of the technology. Thus, it seems as though U.S. consumers develop their opinions of GM foods using their perceptions rather than their extensive knowledge of the technology (Hallman et al., 2003). Table 8 presents the information on consumer understanding of science and technology.

South Korean Respondents

Interestingly enough, while South Korean consumers' appear to have a better understanding of food production than do U.S. consumers the same is not entirely true when it comes to an understanding of science and technology. While in the majority of consumers in both the U.S. and South Korea reported having a fair understanding of science and technology, a greater proportion of U.S. consumers reported having an excellent understanding (greater by 3.37%, and 3.10% respectively). In both models, however, a lower proportion of South Korean consumers reported having a poor understanding of science and technology than did U.S. consumers (lower by 6.71%, and 7.58% respectively). Additionally, close to 60% of U.S. consumers in both models

reported having either a poor of fair understanding, whereas only about 49% of South Korean consumers reported the same. Thus, it can be said that South Korean consumers possess a relatively better understanding of science and technology. Table 8 presents information as to South Korean consumers' understanding of science and technology.

Table 8: Comparison of U.S. and S. Korean Consumers' Understanding of Science and Technology

	GM Plant Model		GM Animal Model	
Understanding of Science	**U.S.**	**S. Korea**	**U.S.**	**S. Korea**
Poor	16.46%	9.75%	17.52%	9.94%
Fair	41.90%*	38.87%**	41.48%*	38.78%**
Good	25.44%	31.78%	25.30%	31.71%
Very Good	12.28%	19.05%	12.04%	19.01%
Excellent	3.92%	0.55%	3.65%	0.55%

**Values not statistically different from one another*
***Values not statistically different from one another*

Previous Exposure to the Issue of Genetic Modification

To measure consumers' level of previous exposure to the issue of genetic modification, respondents' were asked how much they had heard or read about GM methods. The question was asked of both the U.S. and South Korean survey participants.

United States Respondents

While the majority of U.S. consumers reported having heard some about genetic modification in both the plant and animal models (53.16%, and 52.55% respectively), over a third of consumers reported having heard nothing at all or not much about the technology. Of those surveyed, less than 12% in either the plant or animal model reported having heard a great deal about genetic modification. This is surprising considering the prevalence of GM products in the retail food market and the level of coverage on the issue of GM in the media it is surprising that not even a fourth of consumers feel they have heard more than some about the topic. Table 9 displays the information on U.S. consumers' level of previous exposure to the issue of genetic modification.

South Korean Respondents

The majority of South Korean consumers, in both models, reported having heard some about genetic modification. This similar to the U.S., however the proportion of South Korean consumers having heard some is greater than was reported by U.S. consumers (greater by 12.22%, and 13.20% respectively). A greater proportion of South Korean consumers also reported that they had heard a great deal about GM technology (greater by 5.82%, and 5.88% respectively). In fact, in the plant model about 18% more South Korean than U.S. consumers reported having heard some or a great deal about GM. The proportional difference was even greater in the animal model. Just over 19% more South Koreans had heard some or a great deal about genetic modification than U.S. consumers. It can, therefore be said that South Korean consumers recall having been

exposed to a greater level of information on the subject of genetic modification than U.S. consumers. One explanation for the discrepancy between U.S. and South Korean consumers exposure to the issue of genetic modification is that South Korea has a mandatory labeling policy in place for certain GM products, thus South Korean consumers have a greater level of exposure in part due to the fact that the Korean government has brought the issue to public light be requiring labeling. Table 9 shows the information on South Korean consumer's level of previous exposure to the issue of genetic modification.

Table 9: Comparison of U.S. and S. Korean Consumers' Previous Exposure to GM Issue

	GM Plant Model		GM Animal Model	
Previous Exposure to GM Issue	**U.S.**	**S. Korea**	**U.S.**	**S.Korea**
Nothing at all	8.99%	5.20%	9.00%	5.19%
Not much	25.95%	11.30%	26.64%	11.38%
Some	53.16%	65.78%	52.55%	65.75%
A great deal	11.90%	17.72%	11.80%	17.68%

Attitudes toward the Labeling of Genetically Modified Foods

The labeling of foods containing genetically modified ingredients is an issue that is as controversial as the issue of the use of genetic modification in the creation of food ingredients. Labeling is a hot point because it is considered an issue of consumer choice.

If food products are labeled as containing GM ingredients and consumers do not wish to purchase GM products then they have the information necessary to make that choice. Both U.S. and South Korean respondents were asked a question as to their position on the labeling of GM food products.

United States Respondents

In the United States the labeling of foods containing genetically modified ingredients is voluntary. GM ingredients are only required to be labeled if they have significantly changed from the traditional ingredients. An overwhelming proportion of the U.S. survey respondents reported that they feel that food products containing GM ingredients should be labeled as such. In the plant model 93.54% of consumers reported that they felt that GM foods should be labeled, while 94.04% of consumers in the animal model also felt that GM foods should be labeled. Table 10 presents the information as to U.S. consumer attitudes on the labeling of foods containing genetically modified ingredients.

South Korean Respondents

Unlike the United States, South Korea does having a mandatory GM labeling policy in place. The government of South Korea requires that commodities including soybeans, bean sprouts, corn, and potatoes that have been created via GM technology be labeled. Additionally, the Korean labeling policy requires that certain processed products made from GM corn, soybeans, or bean sprouts that consist of more than 3% GM content be labeled as genetically modified.

In both the plant and animal models, a vast majority of South Korean consumers thought that products containing genetically modified ingredients should labeled as such (96.46%, and 96.68% respectively). This is similar to the attitudes found in the U.S. where 93.54% of consumers in the plant model and 94.04% of consumers in the animal model thought that GM products should be labeled as such. The reason for the similarity may lie in the fact that both the U.S. and South Korea are democratic nations where consumers are accustomed to freedom of choice in most things they do. Thus, consumers in both countries believe they should be able to make informed choices as to the food products that they purchase. Table 10 presents information as to South Korean consumers' attitudes toward the labeling of food products either derived from or containing genetically modified ingredients.

Table 10: Comparison of U.S. and S. Korean Consumers' Attitudes on GM Food Labeling

	GM Plant Model		GM Animal Model	
Attitude Toward GM Labeling	**U.S.**	**S. Korea**	**U.S.**	**S.Korea**
Think GM products should be labeled	93.54%	96.46%	94.04%	96.46%
Do not think GM products should be labeled	6.46%	3.54%	5.96%	3.54%

Approval of the Use of GM for the Creation of Plant-Based Foods

The acceptance of GM foods has been shown to be related to the type of product it was used to create. About half of consumers approve of using GM technology to create plant-based foods, while only a fourth approve of its use in the creation of animal-based foods (Hallman et al., 2003). U.S. and South Korean consumers were asked if they approve of the use of genetic modification in the creation of plant-based food products.

United States Respondents

The majority of consumers somewhat approve of the creation of plant-based foods using genetic modification (43.92%). While almost 59% of consumers either strongly or somewhat approved. Similar proportions of consumers either somewhat disapproved (21.39%), or strongly disapproved (20.13%) of using GM technology to create plant-based food products. Table 11 shows U.S. consumers' level of approval for the creation of GM plant-based food products.

South Korean Respondents

Unlike U.S. consumers, the majority of South Korean consumers somewhat disapprove of the use of genetic modification in the creation of plant-based food products. Close to half of U.S. consumers either strongly or somewhat approved of using GM technology to create plant-based foods, whereas only about a third of South Koreans either strongly or somewhat approved. Only 4.21% of South Korean consumers strongly approved of GM plant-based foods while 14.56% of U.S. consumers strongly approved. Additionally, a greater proportion of South Korean consumers either

somewhat or strongly disapproved of using GM technology in the making of plant-based food products (greater by 23.93%). From these results, it seems as though South Korean consumers are less approving of using genetic modification to create plant-based foods than are U.S. consumers. Table 11 displays information as to South Korean consumer's level of approval of plant-based food products created with GM technology.

Table 11: Comparison of U.S. and South Korean Consumers' Approval of GM Plant-Based Food Products

	U.S. Approval of Plant GM	S. Korean Approval of Plant GM
Strongly Approve	14.56%	4.21%
Somewhat Approve	43.92%	30.43%
Somewhat Disapprove	21.39%	37.65%
Strongly Approve	20.13%	27.80%

Approval of the Use of GM for the Creation of Animal-Based Foods

In previous studies i.e. Frewer et al.,Hallman et al., and Hallman, point out that differences in the consumer approval exist relative to the type of product being created using GM technology. More specifically, this difference in approval is found between the genetic modification of plants and the genetic modification of animals. In general, consumers are less accepting of animal-based foods created using genetic modification than plant-based foods created in the same manner. Participants in both the U.S. and

South Korean surveys were asked if they approve of the use of genetic modification for the creation of animal-based food products.

United States Respondents

The results show that the majority of U.S. consumers strongly disapprove of using GM technology to create animal-based food products (48.18%). Nearly two-thirds of U.S. consumers either somewhat disapprove (24.33%) or strongly disapprove (48.18%) of GM animal-based foods. These results are in stark contrast with the results of the plant model in which 58% of consumers actually approved of GM if it was used to create plant-based food products. These findings are consistent with the findings of the previously mentioned studies that all found that consumers are less accepting of the use of GM technology to create animal-based food products. Table 12 displays U.S. consumers' level of approval of the creation of animal-based food products using GM technology.

South Korean Respondents

The majority of South Korean consumers somewhat disapprove of the use of GM technology in the creation of animal-based food products (40%). The proportion of those who somewhat disapprove is only slightly higher than those who strongly disapprove (38.34%). These findings vary from those of the U.S. animal approval model in which a majority of consumers strongly disapproved of the use of GM technology for the creation of animal based foods (48.18%). However, the overall proportion of South Korean consumers who either somewhat or strongly disapprove of GM animal-based

food products was about 6% higher than the proportion found in the U.S. animal approval model.

Similar to the findings of the U.S. models, South Korean consumers are more approving of the use of GM technology in the creation of plant-based food products than they are of its use in the creation of animal-based food products. In the South Korean plant approval model, about a third of consumers either strongly or somewhat approved of the creation of plant-based foods using GM technology whereas in the animal approval model slightly less than a fourth of consumers either strongly or somewhat approved (34.64% vs. 21.66%).

Given these results, it can be said that South Korean consumers are similar to U.S. consumers in that they disapprove more of the use of GM technology in the creation of animal-based foods than the use of GM technology in the creation of plant-based foods. However, when considering the proportion of consumers in both models that disapproved in some form, South Korean consumers are slightly more disapproving of using genetic modification to create animal-based food products than are U.S. consumers. This is despite the fact that a higher proportion of U.S. consumers strongly disapprove. Table 12 presents information as to South Korean consumers' level of approval for the creation of animal-based foods using GM technology.

Table 12: Comparison of U.S. and S. Korean Consumers' Approval of GM Animal-Based Food Products

	U.S. Approval of Animal GM	S. Korean Approval of Animal GM
Strongly Approve	5.84%	2.76%
Somewhat Approve	21.65%*	18.90%*
Somewhat Disapprove	24.33%	40.00%
Strongly Approve	48.18%	38.34%

**Values not statistically different from one another*

Binary Probit Model Results

As shown above, both U.S. and South Korean consumers are more approving of the use of genetic modification for the creation of plant-based food products than its use in the creation of animal-based food products. More specifically, it was found that South Korean consumers are less approving than are U.S. consumers of the use of genetic modification for the creation of plant-based foods. Additionally, South Korean consumers were found to have a better understanding of food production, a better understanding of science and technology and a greater level of previous exposure to the issue of genetic modification. U.S. and South Korean consumers were found to have similar attitudes toward the labeling of GM products. In both cases, consumers overwhelmingly thought (over 90% in both models in both countries) that products derived from or containing genetically modified ingredients should be labeled as such.

Analysis as to both U.S. and South Korean consumers' likelihood to approve of the use of genetic modification in the creation of different types of food products was

conducted using binary probit modeling. This type of modeling reduces both the dependent and independent variables down to a dichotomous choice. Dummy variables were used in the models and the description of the creation of those variables is explained in tables 1 through 4 in Chapter IV. Use of the binary probit models reduced consumers' level of approval from a four choice range of strongly approve to strongly disapprove down to the dichotomous choice of either approve or otherwise (i.e. disapprove). Four binary probit models were estimated to explain and predict U.S. and South Korean consumers' likelihood of approval of the use of genetic modification for the creation of plant- and animal-based foods.

Likelihood of Approval of the Use of GM for Plant-Based Foods

United States Results

Seven of the explanatory variables in the United States plant genetic modification model were found to be significant. The significant variables found included, *female, label, genemod, tomfish, asbsgrad, afamer,* and *income1*.

Results indicated that female consumers were 9.4% less likely than males to approve of the use of genetic modification for the creation of plant-based foods. This is consistent with the findings of Onyango et al. in which males were more willing to consume GM products than females.

Those consumers who thought that food products containing GM ingredients should be labeled as such were 48.7% less likely to approve of using GM technology to create plant-based food products than those who didn't believe labeling of GM products to be necessary. This finding is understandable as it is reasonable to assume that

individuals who intend to avoid products containing GM ingredients would prefer labeling so that GM products are easily identified and avoided in retail outlets.

Respondents were asked a series of questions to determine their actual knowledge of the outcomes of genetic modification. The questions were phrased in a true or false format. Two such questions were included in the U.S. plant approval model.

The first question asked was: *True or False? By eating a genetically modified fruit, a person's genes could also become modified*. This statement is false. Those respondents who answered this question correctly were 11.2% more likely to approve of plant-based GM than those who answered incorrectly or didn't know the answer. The second knowledge-based question was also in a True or False format and was asked as follows: *True or False? Tomatoes genetically modified with genes from catfish would probably taste fishy*. This statement, as with the statement in the first question, is also false. Those respondents who answered this question correctly were 9% more likely to approve of using GM technology to create plant-based foods than those who answered incorrectly or didn't know the answer. The results of the influence of these actual knowledge-based explanatory variables indicate that those consumers who possess a working knowledge of GM technology are more likely to approve of its use in the creation of plant-based foods. This is important because it can therefore be assumed that, given a correct understanding of GM plant technology, consumers will be more apt to accept it. An additional significant factor in the approval decision was the level of formal education attained by an individual. The findings reveal that those consumers

with some amount of college or more were 1% more likely to approve of using GM to create plant-based food products than were consumers with a high school diploma or below.

Race also appeared to play a role in the decision to approve of plant GM. Consumers who classified themselves as Black or African-American were 10.7% less likely to approve of using plant GM for the creation of food than were those who classified themselves as white.

Finally, income was shown to be a factor in the GM approval decision. Respondents who reported a household income of $25,000 or less were 16.6% less likely to approve of the creation of food products using GM than those who reported incomes of $100,000 or more. This is an interesting result considering that consumers with an income of $25,000 or less are more price sensitive relative to those with incomes of $100,000 or more. This result appears to refute the assumption that those who are more price sensitive would be less inclined to approve of a product based on its production attributes and more on its price, until we consider a reason for this finding. The reason may lie in the education level of the consumers with a household income of $25,000 or less, because those with lower incomes generally have a lesser education level. As was shown above, those with a greater education level (i.e. some college or above) are more likely to approve of the use of GM in the creation of plant-based food products than those with the lowest education level. Table 13 gives the results for the U.S. plant approval binary probit model.

South Korean Results

In relation to the U.S. plant approval binary probit model, the South Korean model had fewer significant explanatory variables. The variables that were found to be significant included: *genemod, age1,* and *conserv*.

Similar to the results in the U.S. plant approval model, the marginal effect of the variable *genemod* had a positive sign. South Korean consumers were asked the same actual knowledge question as the U.S. consumers. The question was in True or False format and was asked as follows: *True or False? By eating a genetically modified fruit, a person's genes could also become modified*. The answer is false. Those consumers who answered the question with the correct response were 14% more likely to approve of the use of GM for the creation of plant-based foods than those who answered incorrectly or didn't know the answer.

In the South Korean plant approval model, age was found to be a significant variable. Consumers who were 20 to 29 years old were 12.3% more likely to approve of plant-based foods created using GM technology than were those consumers ages 50 to 59. This finding could be a result of younger generations' overall greater acceptance and understanding of technology relative to that of older generations.

The last of the significant variables in this model pertained to consumers' social belief/orientation. Those who classified themselves as "conservative" were found to be 7.6% less likely to approve of the use of GM for the creation of plant-based foods than those who classified themselves as "liberal". As the question was posed to survey participants it asked for their orientation regardless of favored political party. With this

in mind this particular result is not unexpected as individuals who display more conservative (potentially more risk-averse) behaviors tend to be more cautious of the new and unknown. Table 13 presents the results of the South Korean plant approval binary probit model.

Table 13: Comparison of U.S. and S. Korean Binary Probit Results: Plant GM Approval Model

	U.S. Results (N=790)	South Korean Results (N=903)
Variable	**Marginal Effect**	**Marginal Effect**
FEMALE	-0.094**	-0.055
GUNDPROD	-0.166	-0.035
HEARDSOM	0.535	0.025
LABEL	-0.487***	-0.043
PUNDSCI	0.064	-0.031
GENEMOD	0.112**	0.14***
TOMFISH	0.09**	0.002
AGE	-0.003	N/A
AGESQ	0.00003	N/A
AGE1	N/A	0.123**
AGE2	N/A	-0.048
AGE3	N/A	-0.063
ASBSGRAD	0.01**	-0.044
CONSERV	0.002	-0.076*
INBETWN	N/A	-0.007
NONHISP	0.113	N/A
AFAMER	-0.107*	N/A
OTHERACE	-0.05	N/A
INCOME1	-0.166**	N/A
INCOME2	-0.104	N/A
INCOME3	-0.055	N/A
INCOME4	-0.086	N/A
INCOME5	-0.034	N/A
INC1	N/A	0.036
INC2	N/A	-0.024

Table 13. Continued

	U.S. Results (N=790)	South Korean Results (N=903)
Variable	**Marginal Effect**	**Marginal Effect**
INC3	N/A	0.022

denotes a significant variable with a p-value of 0.10, ** denotes a significant variable with a p-value of 0.05, and * denotes a significant variable with a p-value of 0.01(Variable Definitions are located in Tables 1-4)*

Likelihood of Approval of the Use of GM for Animal-Based Foods

United States Results

Of the twenty explanatory variables included the U.S. animal approval binary probit model, a fourth (25%) were found to be significant. The significant variables included: *female, gundprod, heardsom, label* and *gmbigger*.

As with females in the plant approval model, females in the animal approval model were also less likely to approve than males. In fact, females were found to be 15.4% less likely than males to approve of the use of GM technology for the creation of animal-based foods, whereas they were only 9.4% less likely in the plant approval model. This difference is not surprising considering previous studies; (Frewer et al, and Hossain et al) also found that consumers are more approving of plant related genetic modification than animal related genetic modification.

Consumers' self-rated understanding of how food is grown and produced was also found to be a significant explanatory variable. Consumers who rated their understanding of food production as good or better were found to be 7.4% less likely to approve of the use of GM to create animal-based foods than those consumers who rated

their understanding as poor or fair. This finding was somewhat unexpected as it is reasonable to assume that a greater understanding would result in a greater likelihood of approval. This result may be due to the nature of the binary model. Further explanation may be provided by the results of the ordered probit model, which will result in a greater disaggregation of the data.

The level of previous exposure was found to be significant in the animal approval model. Those who reported having heard some or a great deal about GM technology were found to be 8% more likely to approve of using GM technology to create animal-based food products than those who reported having heard not much or nothing at all about GM. It is reasonable to assume that those who had heard some or more about the technology would be aware of its potential benefits and therefore approve of its use for the creation of animal-based foods. It is also likely that the exposure these consumers encountered was positive as they are more willing to approve than those who had heard very little or nothing about GM technology.

As was the case in the plant approval model, those consumers who thought food products containing GM ingredients should be labeled as such were less likely to approve of the use of GM in animal-based food products. Consumers who favored labeling of GM products were 30% less likely to approve of the creation of animal-based foods using GM technology than those who did not feel labeling to be necessary. This finding in and of itself was not surprising but the fact that the percent likelihood in the plant approval model was greater than the percent likelihood in the animal approval model is notable. As mentioned above, previous studies (Frewer et al. and Onyango et

al.) found that consumers were less accepting of the use of GM technology for animal-related purposes. In consideration of these previous findings it is curious that, while consumers in both models who thought labeling to be necessary were less likely to approve of using GM than were those who didn't believe labeling to be necessary, the proportion was greater in the plant approval model (48.7% less likely to approve in the plant model vs. 30% less likely in the animal approval model).

Actual knowledge of the outcome of GM technology was found to be significant in the animal approval model. Consumers were asked a knowledge question in True or False format. The question asked was: *True or False? Genetically modified animals are always bigger than ordinary animals*. The answer is false. Those who responded correctly to this question were found to be 10.8% more likely to approve of using GM to create animal-based foods than those who responded incorrectly or didn't know the answer. This finding was consistent with the findings of similar actual knowledge questions asked of respondents in the plant approval model. Table 14 displays the results of the U.S. animal approval binary probit model.

South Korean Results

In contrast with the U.S. animal approval model in which five explanatory variables were found to be significant only three variables of significance were found in the South Korean animal approval model. The three significant explanatory variables included: *female, gmbigger,* and *age3*.

Female consumers were found to be 6.1% less likely to approve of using GM technology to create animal-based food products than male consumers. This finding is

consistent with both the U.S. plant approval and U.S. animal approval models although the proportion was lower than both of the U.S. models.

Similarly to the U.S. animal approval model, actual knowledge of a specific outcome of GM technology was found to be of significance. South Korean respondents were asked: *True or False? Genetically modified animals are always bigger than ordinary animals*. The answer is false. Consumers who answered this question correctly were found to be 7.4% more likely to approve of the use of GM in the creation of animal-based foods than those who responded incorrectly or didn't know the answer.

The age of the respondent was also found to be of significance in this model. Consumers 40 to 49 years old were found to be less likely to approve of using GM technology to create animal-based foods than consumers 50 to 59 years old. Table 14 presents the results of the South Korean animal approval binary probit model.

Table 14: Comparison of U.S. and S. Korean Binary Probit Results: Animal GM Approval Model

	U.S. Results (N=822)	South Korean Results (N=905)
Variable	**Marginal Effect**	**Marginal Effect**
FEMALE	-0.154***	-0.061**
GUNDPROD	-0.074*	-0.060
HEARDSOM	0.080**	-0.038
LABEL	-0.300***	0.036
PUNDSCI	-0.016	-0.028
GMBIGGER	0.108***	0.074**
TRANSGEN	0.003	0.018
AGE	-0.002	N/A
AGESQ	0.00004	N/A
AGE1	N/A	0.017

Table 14. Continued

	U.S. Results (N=822)	South Korean Results (N=905)
Variable	**Marginal Effect**	**Marginal Effect**
AGE2	N/A	-0.069
AGE3	N/A	-0.080*
ASBSGRAD	-0.035	-0.037
CONSERV	0.028	-0.014
INBETWN	N/A	0.034
NONHISP	-0.013	N/A
AFAMER	0.006	N/A
OTHERACE	0.111	N/A
INCOME1	-0.033	N/A
INCOME2	-0.004	N/A
INCOME3	0.018	N/A
INCOME4	0.018	N/A
INCOME5	-0.006	N/A
INC1	N/A	-0.020
INC2	N/A	-0.042
INC3	N/A	-0.003

denotes a significant variable with a p-value of 0.10, ** denotes a significant variable with a p-value of 0.05, and * denotes a significant variable with a p-value of 0.01(Variable Definitions are located in Tables 1-4)*

Ordered Probit Model Results

Four ordered probit models pertaining to consumer approval of the use of genetic modification for the creation of different food types were estimated. Two models were estimated using the United States data; the other two were estimated using the South Korean data. U.S. consumers' likelihood of approval of the use of genetic modification for the creation of plant-based foods was estimated in one of the U.S. models. The other model estimated U.S. consumers' likelihood of approval of the creation of animal-based foods using GM technology. One of the South Korean models estimated South Korean consumers' likelihood of approval of the use of GM technology to create plant-based

food products, while the other model estimated consumers' likelihood of approval of the creation of animal-based foods using GM. The ordered probit models allowed for greater disaggregation of the data than the binary probit models. As a result of the further disaggregation, a greater number of variables in the ordered probit models were found to be significant.

Likelihood of Approval of the Use of GM of Plant-Based Foods

United States Results

In the U.S. plant approval ordered probit model, thirteen of nineteen explanatory variables were found to be significant. The significant variables included: *female, heardsom, label, genemod, tomfish, asbsgrad, nonhisp, afamer, otherace, income1, income2, income3,* and *income4*.

Females in the binary probit model were found to be less likely than males to approve of the use of GM for the creation of plant-based foods. The findings of the ordered probit model were consistent. Females were found to be 3.15% more likely to strongly disapprove and 1.56% more likely to somewhat disapprove of using GM technology to create plant-based foods than males. This is an important finding because it is reasonable to assume that given proper conditions (i.e. proof of benefits of GM) some of the females who only somewhat disapprove may be convinced to approve of the GM of plant-based foods.

Consumers' level of previous exposure to the issue of genetic modification was found to be of significance in this model. It was not significant in the plant approval binary model. Those who reported having heard some or a great deal about GM were

found to be 5.04% less likely to strongly disapprove and 2.31% less likely to somewhat disapprove of the use of GM technology for the creation of plant-based foods than those who reported having heard little to nothing about the issue. These findings suggest that a greater level of exposure to the issue of GM leads to a greater willingness to approve of the use of the technology for the creation of plant-based food products.

As with the plant approval binary model, consumers' attitudes toward GM labeling were found to be significant. Consumers who believed that GM food products should be labeled as such were found to be 17.99% more likely to strongly disapprove and 17.26% more likely to somewhat disapprove of the use of GM for the creation of plant-based foods than those who didn't believe GM labeling to be necessary. These findings are consistent with those of the binary model; however, the sum of the percentages from the ordered model is less than the percentage of those who were less likely to approve in the binary model.

Actual knowledge of the outcomes of GM technology was found to be as significant in this model as it was in the plant approval binary model. The two questions asked of respondents were the same as those asked in the binary model. The first question was: *True or False? By eating a genetically modified fruit, a person's genes could also become modified.* The second question was: *True or False? Tomatoes genetically modified with genes from a catfish would probably taste fishy.* Both statements are false. Those who responded correctly to the first question were found to be 8.59% less likely to strongly disapprove, 3.51% less likely to somewhat disapprove and 5.7% more likely to strongly approve of the use of GM in the creation of plant-

based food products than those who responded incorrectly or that they didn't know the answer. The proportions were not quite as high for the second question but were still consistent with the findings of the first question in this model. Those who responded correctly to the second question were found to be 3.33% less likely to strongly disapprove and 1.55% less likely to somewhat disapprove of using GM to create plant-based foods than those who responded incorrectly or that they didn't know the answer. These findings are important because they indicate that those with correct knowledge of GM are more likely than those who have an incorrect knowledge of GM to approve of its use for the creation of plant-based foods. It is therefore reasonable to assume that with proper education providing an accurate understanding of genetic modification, a greater proportion of consumers will approve of GM for creating plant-based food products. Additionally, an individual's level of education was found to be as significant in this model as it was in the binary model. Those who had some college or more were found to be 4.56% less likely to strongly disapprove and 2.11% less likely to somewhat disapprove of GM of plant-based foods than those who had a high school diploma or less. This is consistent with the findings of the binary model in which those with some college or more were more likely to approve of the use of GM for the creation of plant-based food products than those with a lesser education level. It appears that a greater level of general knowledge (i.e. level of education) increases approval as does a greater level of accurate knowledge.

Unlike the plant approval binary model, ethnicity was found to be significant in this model. Those who classified themselves as non-Hispanic were found to be 4.82%

less likely to strongly disapprove and 1.98% less likely to somewhat disapprove of the creation of plant-based foods using GM than those who classified themselves as Hispanic. Consistent with the binary model race was found to be significant in this model. Those who classified themselves as Black or African-American were found to be 9.92% more likely to strongly disapprove, 3.23% more likely to somewhat disapprove, and 7.57% less likely to somewhat approve of using GM for the creation of plant-based foods than those who classified themselves as white. These findings are in keeping with the findings of the binary model in which those who classified themselves as Black or African-American were less likely to approve than those who classified themselves as whites. Additionally, those who classified themselves as Asian or Pacific Islander, Native American , or another race were found to be 9.3% more likely to strongly disapprove, 3.53% more likely to somewhat disapprove, and 7.13% less likely to somewhat approve of the use of GM in the creation of plant-based foods than those who classified themselves as white. These findings may be as a result of cultural differences between minority races and Caucasians.

As with the plant approval binary model, household income was found to be of significance. In the binary model only one income level was found to be significant; however, in this model four income levels were found to be significant. Consumers who reported a household income of $25,000 or less were found to be 9.39% more likely to strongly disapprove, 3.53% more likely to somewhat disapprove, and 7.1% less likely to somewhat approve of the use of GM for the creation of plant-based food products than those who reported a household income of $100,000 or more. Those who

reported a household income of $25,000 to $34,999 were found to be 8.34% more likely to strongly disapprove, 3.24% more likely to somewhat disapprove, and 6.28% less likely to somewhat approve of using GM to create plant-based foods than those who reported a household income of $100,000 or more. Respondents who reported a household income of $35,000 to $49,999 were found to be 2.26% more likely to strongly disapprove and 1.03% more likely to somewhat disapprove of creating plant-based foods using GM than those who reported a household income of $100,000 or greater. Finally, those who reported a household income of $50,000 to $74,999 were found to be 2.63% more likely to strongly disapprove and 1.22% more likely to somewhat disapprove of using GM to create plant-based foods than those who reported a household income of $100,000 or more. These findings are consistent with the findings of the plant approval binary model. These results show that individuals with lower household income levels are more likely to disapprove of the use of genetic modification for the creation of plant-based food products. Table 15 displays the results of the U.S. plant approval ordered probit model as well as a comparison with the South Korean plant approval ordered probit model results.

South Korean Results

Nine explanatory variables were found to be significant in the South Korean plant approval model. This is an increase of six variables from those found to be significant in the binary model. The significant variables include: *female, heardsom, label, pundsci, genemod, age1, asbsgrad,inc1* and *inc2*.

Unlike the binary model, gender was found to be significant in this model. Females were found to be 4.14% more likely to strongly disapprove of the use of GM for the creation of plant-based food products. This is consistent with the previous U.S. models.

As with the U.S. plant approval ordered model previous exposure was found to be of significance; however, the likelihood of approval because of previous exposure was minimal. South Korean consumers who reported having heard some or a great deal about GM were found to be .02% less likely to somewhat disapprove of using GM to create plant-based foods.

Actual knowledge of genetic modification was found to be of significance in this model as it was in the U.S. plant approval ordered model. Consumers were asked: *True or False? By eating genetically modified fruit, a person's genes could also become modified.* This statement is false. Those who responded to this question correctly were found to be 12.2% less likely to strongly disapprove, 1.8% less likely to somewhat disapprove and 3.2% more likely to strongly approve of the use of GM in creating plant-based food products than those who responded incorrectly or that they didn't know the answer. These findings are consistent with the U.S. plant approval ordered model.

While age was not found to be significant in any of the U.S. models to this point, it was found to be significant in both the South Korean plant approval binary model and the South Korean plant approval ordered model. South Korean consumers ages 20 to 29 were found to be 12.64% less likely to strongly disapprove, 3.12% less

likely to somewhat disapprove and 4% more likely to strongly approve of using genetic modification to create plant-based foods than consumers ages 50 to 59. This may be a result of those consumers ages 20 to 29 having been brought up with a greater amount of new technology (i.e. personal computers, improved communication networks, etc.).

Education level was found to be significant in this model however the results were contradictory to the results for education level found in the U.S. models. South Korean consumers with some college (attending college) or more were found to be 2.9% more likely to strongly disapprove of the use of GM technology in creating plant-based foods than those with a high school diploma or less.

The final variable of significance in this model was found to be household income level. This variable was not significant in the South Korean plant approval binary model. Consumers with a household income below 20 million Won were found to be 2.6% less likely to strongly disapprove and .04% less likely to somewhat disapprove of the genetic modification of plant-based food products than those with a household income over 40 million Won. This result is expected as those with lower incomes are more price sensitive and would therefore be more concerned with the price of the product than how it was produced. Those who reported a household income of 20 to 30 million Won were found to be 2.7% more likely to strongly disapprove of using GM to create plant-based food products than those who reported a household income over 40 million Won. This is consistent with the U.S. plant approval binary model in which a lower income individual was less likely to approve of GM in the creation of plant-based foods than a high-income individual. Table 15 presents the

results of the South Korean plant approval ordered probit as well as a comparison with the U.S. plant approval ordered probit model results.

Table 15: Comparison of U.S. and S. Korean Ordered Probit Results: Plant GM Approval

	U.S. Results Marginal Effects				South Korean Results Marginal Effects			
Variable	**y=0**	**y=1**	**y=2**	**y=3**	**y=0**	**y=1**	**y=2**	**y=3**
CONSTANT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FEMALE	0.0315***	0.0156***	-0.0222	-0.025	0.0414***	0.0045	-0.0361	-0.0098
	(0.0098)	(0.0057)	(0.0412)	(0.0992)	(0.0120)	(0.0032)	(0.0652)	(0.0270)
GUNDPROD	0.0158	0.0080	-0.0110	-0.0128	0.0187	0.0025	-0.0166	-0.0047
	(0.0107)	(0.0058)	(0.0554)	(0.0917)	(0.0127)	(0.0026)	(0.0701)	(0.0241)
HEARDSOM	-0.0504***	-0.0231***	0.0364	0.0371	-0.0219	-0.0019***	0.0189	0.0049
	(0.0153)	(0.0057)	(0.1243)	(0.0523)	(0.0146)	(0.0003)	(0.0787)	(0.0159)
LABEL	0.1799***	0.1726***	0.0367	-0.3892	0.0318***	0.0052	-0.0286	-0.0084
	(0.0086)	(0.0065)	(0.2730)	(0.2461)	(0.0119)	(0.0035)	(0.0664)	(0.0276)
PUNDSCI	-0.0185	-0.0089	0.0132	0.0143	0.0233*	0.0025	-0.0203	-0.0055
	(0.0132)	(0.0059)	(0.0926)	(0.0706)	(0.0127)	(0.0025)	(0.0693)	(0.0240)
GENEMOD	-0.0859***	-0.0351***	0.0638	0.0572*	-0.1222***	-0.0184***	0.1085	0.0321***
	(0.0177)	(0.0049)	(0.1562)	(0.0325)	(0.0181)	(0.0030)	(0.1016)	(0.0032)
TOMFISH	-0.0333**	-0.0155***	0.0241	0.0247	-0.0035	-0.0004	0.0031	0.0008
	(0.0143)	(0.0057)	(0.1084)	(0.0614)	(0.0138)	(0.0014)	(0.0751)	(0.0196)
AGE	0.0048	0.0023	-0.0034	-0.0037	N/A	N/A	N/A	N/A
	(-0.0034)	(-0.0017)	(-0.0061)	(-0.0026)				
AGESQ	-0.0001	0	0	0	N/A	N/A	N/A	N/A
	0	0	0	0				
AGE1	N/A	N/A	N/A	N/A	-0.1264***	-0.0312***	0.1173	0.0402***
					(-0.0182)	(-0.0018)	(-0.1082)	(-0.0038)
AGE2	N/A	N/A	N/A	N/A	-0.0035	-0.0004	0.003	0.0008
					(-0.0138)	(-0.0014)	(-0.0751)	(-0.0196)
AGE3	N/A	N/A	N/A	N/A	0.017	0.0017	-0.0148	-0.0039
					(-0.0131)	(-0.0021)	(-0.0707)	(-0.0225)

Table 15. Continued

	U.S. Results Marginal Effects				South Korean Results Marginal Effects			
Variable	**y=0**	**y=1**	**y=2**	**y=3**	**y=0**	**y=1**	**y=2**	**y=3**
ASBSGRAD	-0.0456***	-0.0211***	0.0329	0.0338	0.0292**	0.003	-0.0254	-0.0068
	(-0.015)	(-0.0057)	(-0.1197)	(-0.055)	(-0.0126)	(-0.0026)	(-0.068)	(-0.0247)
CONSERV	0.0134	0.0066	-0.0095	-0.0106	0.0576***	0.0043	-0.0492	-0.0127
	(-0.011)	(-0.0058)	(-0.0598)	(-0.089)	(-0.0118)	(-0.0035)	(-0.0623)	(-0.0282)
INBETWN	N/A	N/A	N/A	N/A	0.0161	0.0017	-0.0141	-0.0038
					(-0.0130)	(-0.0021)	(-0.0709)	(-0.0227)
NONHISP	-0.0482***	-0.0198***	0.036	0.032	N/A	N/A	N/A	N/A
	(-0.0156)	(-0.0051)	(-0.1251)	(-0.0504)				
AFAMER	0.0992***	0.0353***	-0.0757***	-0.0589	N/A	N/A	N/A	N/A
	(-0.0079)	(-0.0054)	(-0.0087)	(-0.1151)				
OTHERACE	0.0930***	0.0323***	-0.0713***	-0.054	N/A	N/A	N/A	N/A
	(-0.0085)	(-0.0053)	(-0.0158)	(-0.1107)				
INCOME1	0.0939***	0.0353***	-0.0710***	-0.0582	N/A	N/A	N/A	N/A
	(-0.0079)	(-0.0054)	(-0.0083)	(-0.1156)				
INCOME2	0.0834***	0.0324***	-0.0628***	-0.0531	N/A	N/A	N/A	N/A
	(-0.0083)	(-0.0053)	(-0.0141)	(-0.1124)				
INCOME3	0.0226**	0.0103*	-0.0164	-0.0165	N/A	N/A	N/A	N/A
	(-0.0109)	(-0.0056)	(-0.0565)	(-0.0902)				
INCOME4	0.0263***	0.0122**	-0.019	-0.0195	N/A	N/A	N/A	N/A
	(-0.0106)	(-0.0056)	(-0.0518)	(-0.0929)				
INCOME5	-0.0026	-0.0013	0.0019	0.0021	N/A	N/A	N/A	N/A
	(-0.0121)	(-0.0059)	(-0.076)	(-0.0801)				
INC1	N/A	N/A	N/A	N/A	-0.0262*	-0.0036***	0.0232	0.0066
					(-0.0145)	(-0.0008)	(-0.0803)	(-0.0165)
INC2	N/A	N/A	N/A	N/A	0.027**	0.0024	-0.0233	-0.0061
					(-0.0128)	(-0.0024)	(-0.0686)	(-0.0238)
INC3	N/A	N/A	N/A	N/A	-0.0032	-0.0004	0.0028	0.0008
					(-0.0137)	(-0.0014)	(-0.0751)	(-0.0197)

denotes a significant variable with a p-value of 0.10, ** denotes a significant variable with a p-value of 0.05, and * denotes a significant variable with a p-value of 0.01(Variable Definitions are located in Tables 1-4)*
**Standard errors of the marginal effects are in parentheses*

Likelihood of Approval of the Use of GM of Plant-Based Foods

United States Results

The results of the U.S. animal approval ordered probit model are somewhat mixed and, in certain instances, inconsistent with previous findings. Twelve explanatory variables were found to be of significance. The significant variables included: *female, gundprod, heardsom, label, pundsci, gmbigger, conserv, nonhisp, afamer, otherace, income1,* and *income5*.

Similar to the results of the majority of the models, both binary and ordered gender was significant in the U.S. animal approval ordered model. Females were found to be 15.75% more likely to strongly disapprove and 9.17% less likely to somewhat approve of the use of GM technology for the creation of animal-based foods than males. Additionally, females were found to be 2.54% less likely to somewhat disapprove of using GM in the production of animal-based food products than males. While this result may appear contradictory upon first glance, it is easily explained. Females are less likely to somewhat disapprove because they are more polarized than males and therefore more likely to strongly disapprove. These findings are consistent with those of the previous models.

An individual's understanding of how food is grown and produced was found to be of significance in this model. Consumers who rated their understanding of food production as good or better were found to be 6.62% more likely to strongly disapprove and 1% less likely to somewhat disapprove than those who rated their understanding as poor or fair. These results, as with the gender results in this model, appear to contradict

each other. However, as with the gender results, the assumed discrepancy may be a result of the polarization of respondents who are more likely to strongly disapprove than merely somewhat disapprove. It is interesting to note, however, that those with a self-rated good or better understanding of food production are more likely to disapprove of GM for the creation of animal-based foods than those with a self-rated poor or fair understanding.

Previous level of exposure to the issue of genetic modification was found to be of significance in this model. Consumers who reported having heard some or a great deal about GM were found to be 6.44% less likely to strongly disapprove of using GM to create animal-based foods than those who reported having heard little or nothing of the issue. However those who reported having heard some or a great deal about GM were also found to be 1.24% more likely to somewhat disapprove of the use of genetic modification for the creation of animal-based foods than those who have heard little or nothing of GM. It may be that those who have heard some or a great deal about GM are less likely to be drastically swayed toward strong disapproval than moderate disapproval when compared with those who have heard little or nothing about GM.

Consumer attitudes toward the labeling of GM products were significant in this model, as they were in several of the previous models. Those who thought that products containing GM ingredients should be labeled as such were found to be 29.69% more likely to strongly disapprove and 1.6% more likely to somewhat disapprove of using GM technology in the production of animal-based food products than those who didn’t think products containing GM ingredients needed to be labeled as such.

Consumers who thought GM products should be labeled as such were also found to be 17.16% less likely to somewhat approve of the GM of animal-based foods than those who didn't believe GM labeling to be necessary. This is consistent with the findings of the previous models in which attitudes toward GM labeling were found to be of significance.

Understanding of science and technology was found to be of significance in this model. Consumers who rated their basic understanding of science and technology as poor or fair were found to be 3.84% more likely to strongly disapprove of the GM of animal-based food products that those who rated their understanding as good or better. Additionally, those who rated their understanding of science and technology as poor or fair were found to be .07% less likely to somewhat disapprove of GM used to create animal-based foods than those who rated their understanding as good or better. These findings may be the result, as with several other variables, of polarization. Those respondents who have a poor to fair understanding may be so averse to the unknown (i.e. GM technology used to create animal-based foods) that they are more likely to be strongly disapproving than merely somewhat disapproving.

Actual knowledge of the outcomes of genetic modification has been significant in most of the models to this point and is also significant in this model. Respondents were asked: *True or False? Genetically modified animals are always bigger than ordinary animals*. This is a false statement. Those who responded to this question correctly were 8.38% less likely to strongly disapprove of using GM to produce animal-based foods than those who answered incorrectly or that they didn't know. Consumers

who answered correctly were also found to be 1.65% more likely to somewhat disapprove of the use of GM technology for the creation of animal-based food products than those who answered incorrectly or that they didn't know. This result may have occurred because those who possess an inaccurate knowledge are most likely to strongly disapprove because of a fear of what they clearly do not know. In other words, those with an inaccurate knowledge view the decision to approve as "all or nothing" and due to the fact that they do not know about GM they choose to strongly disapprove as opposed to merely somewhat disapproving. It ma also be that the consumers' lack of knowledge leads them to assume the worst case scenario relative to the production of animal-based foods using GM.

One of the more interesting and perhaps perplexing significant results of this model pertained to consumer beliefs. Consumers who considered themselves to be conservative were found to be 3.55% less likely to strongly disapprove of the creation of animal-based foods via GM technology than those who considered themselves liberal.

Ethnicity and race were both of significance in this model. Consumers who classified themselves as non-Hispanic were found to be 5% more likely to strongly disapprove and .07% less likely to somewhat disapprove of the use of GM for the creation of animal-based foods than consumers who classified themselves as Hispanic. Those who classified themselves as Black or African-American were found to be 6.69% more likely to strongly disapprove and 1.45% less likely to somewhat disapprove than those who classified themselves as white. As with other split results within this model

this difference among those who classified themselves as Black or African-American may be due to polarization. Consumers who classified themselves as Asian or Pacific Islander, Native American, or of another race were found to be 4.29% less likely to strongly disapprove and .07% more likely to somewhat disapprove than those who classified themselves as white. These findings are not consistent with the plant approval model and that may be due to the different use of GM being considered in this model.

Consumers' level of household income was of significance in this model as it was in several previous models. U.S. consumers who reported a household income under $25,000 were 3.26% more likely to strongly disapprove and .06% less likely to somewhat disapprove of the creation of animal-based foods via GM technology than those with reported household incomes of $100,000 or more. Those who reported a household income of $50,000 to $74,999 were found to be .04% less likely to somewhat disapprove than those with reported household incomes of $100,000 or more. Additionally, those who reported household incomes of $75,000 to $99,999 were found to be 3.35% less likely to strongly disapprove than those who reported household incomes of $100,000 or greater. These findings are not consistent with the plant approval model and may be due to the nature of the application of GM in this model (i.e. animal modification). Table 16 presents the results of the United States animal approval ordered probit model as well as a comparison with the results of the South Korean animal approval ordered model.

South Korean Results

The South Korean animal approval ordered probit model was as mixed as its counterpart U.S. model. Thirteen of the explanatory variables were found to be of significance. The significant variables include: *female, gundprod, heardsom, label, gmbigger, age1, age2, age3, asbsgrad, conserv, inc1, inc2,* and *inc3*.

Gender was found to be of significance in this model as it was in the U.S. animal approval ordered model. Females were found to 8.66% more likely to strongly disapprove and 2.1% less likely to somewhat disapprove of using GM to create animal-based foods than males. This result is consistent with the U.S. animal approval ordered model.

Consumer understanding of how food is grown and produced was a significant variable in this model. Those who rated their understanding as poor or fair were found to be 5.88% more likely to strongly disapprove and 1.14% less likely to somewhat disapprove of the creation of animal-based foods using GM technology than those who rated their understanding as good or better. This is consistent with results of the U.S. ordered model and may be due to polarization as were those results.

Level of exposure to the issue of genetic modification was found to be a significant factor in the South Korean animal approval ordered model. Those who reported having heard some or a great deal about GM were found to be 2.87% more likely to strongly disapprove and .06% less likely to somewhat disapprove of using GM technology to create animal-based foods than those who reported having heard little or

nothing about GM. This may be attributable to the different application of GM technology being considered in this model.

As with the majority of the models, consumer attitudes toward the labeling of GM products were of significance in this model. South Korean consumers who thought that GM food products should be labeled as such were found to be 3.58% more likely to strongly disapprove and .07% less likely to somewhat disapprove of the GM of animal-based food products than those who didn't believe GM labeling to be necessary. These results are consistent with the U.S. animal approval ordered model.

Two actual knowledge variables were included in this model; one of the variables was significant. South Korean consumers were asked: *True or False? Genetically modified animals are always bigger than ordinary animals*. The statement is false. Those who responded correctly were found to be 4.82% less likely to strongly disapprove and 1.03% more likely to somewhat disapprove than those who answered incorrectly or that they didn't know. This may be a result of those who answered incorrectly or that they didn't know being more averse to the concept of using GM to create animal-based foods while those who possess an accurate knowledge of GM are hesitant but not as disapproving. Education level was also significant in this model. Those with some college or more were found to be 4.53% more likely to strongly disapprove and 1.13% less likely to somewhat disapprove of GM technology used in the creation of animal-based foods than those with a high school diploma or less.

The age of the consumer was found to be significant at several levels in this model. Consumers ages 20 to 29 were found to be 8.2% less likely to strongly

disapprove, 1.55% more likely to somewhat disapprove, and 1.46% more likely to strongly approve of using GM to create animal-based foods than consumers ages 50 to 59. Those in the 30 to 39 year age range were found to be 4.39% more likely to strongly disapprove and 1.13% less likely to somewhat disapprove of the creation of animal-based foods using GM technology than those ages 50 to 59. Additionally, those in the 40 to 49 year age range were found to be 2.68% more likely to strongly disapprove and .07% less likely to somewhat disapprove of GM technology used in the production of animal-based foods than those ages 50 to 59. Overall, it appears that those in the youngest age range (20 to 29 years old) are less likely to disapprove of the use of GM technology in the creation of animal-based food products than those in the older age ranges.

As with the U.S. animal approval ordered model, consumer beliefs were significant in this model. South Korean consumers who classified themselves as conservative were found to be 5.28% more likely to strongly disapprove and 1.38% less likely to somewhat disapprove of the use of GM for the creation of animal-based foods than those who classified themselves as liberal.

Finally, household income was significant in this model at several levels. Consumers who reported a household income below 20 million Won were found to be 3.01% more likely to strongly disapprove and .08% less likely to somewhat disapprove of using GM to create animal-based food products than those with reported incomes of over 40 million Won. Those who reported a household income of 20 to 30 million Won were found to be 7.48% more likely to strongly disapprove and 2.07% less likely to

somewhat disapprove than those who reported a household income of over 40 million Won. Additionally, consumers who reported household incomes of 30 to 40 million Won were found to be 2.71% more likely to strongly disapprove and .07% less likely to somewhat disapprove than consumers who reported household incomes over 40 million Won. These findings may be a result of those with incomes over 40 million most likely to somewhat disapprove in comparison to those with the lower incomes who appear most likely to strongly disapprove. Table 16 presents the results of the South Korean animal approval ordered probit model as well as comparison with the results of the U.S. animal approval ordered model.

Table 16: Comparison of U.S. and S. Korean Ordered Probit Results: Animal GM Approval

	U.S. Results Marginal Effects				South Korean Results Marginal Effects			
Variable	**y=0**	**y=1**	**y=2**	**y=3**	**y=0**	**y=1**	**y=2**	**y=3**
CONSTANT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FEMALE	0.1575***	-0.0254***	-0.0917**	-0.0404	0.0866***	-0.0210***	-0.0523	-0.0134
	(-0.0155)	(-0.0027)	(-0.0397)	(-0.0814)	(-0.0137)	(0.0000)	(-0.0492)	(-0.0256)
GUNDPROD	0.0662***	-0.0100***	-0.0388	-0.0173	0.0588***	-0.0114***	-0.0372	-0.0103
	(-0.0162)	(-0.0003)	(-0.0712)	(-0.0588)	(-0.0137)	(-0.0003)	(-0.0531)	(-0.0247)
HEARDSOM	-0.0644***	0.0124**	0.0371	0.0148	0.0287**	-0.0063***	-0.0177	-0.0047
	(-0.0169)	(-0.0054)	(-0.1107)	(-0.0218)	(-0.0146)	(-0.0021)	(-0.0569)	(-0.0195)
LABEL	0.2969***	0.0160**	-0.1716*	-0.1414	0.0358***	-0.0073***	-0.0224	-0.0061
	(-0.0067)	(-0.0081)	(-0.0901)	(-0.1769)	(-0.0143)	(-0.0015)	(-0.0563)	(-0.0211)
PUNDSCI	0.0384**	-0.0067***	-0.0224	-0.0094	0.0105	-0.0025	-0.0063	-0.0016
	(-0.0166)	(-0.0016)	(-0.0811)	(-0.0484)	(-0.0151)	(-0.0033)	(-0.0586)	(-0.0164)
GMBIGGER	0.0838***	0.0165***	0.0482	0.0191	-0.0482***	0.0103**	0.0299	0.008
	(-0.0168)	(-0.0061)	(-0.1154)	(-0.0171)	(-0.0161)	(-0.0053)	(-0.0668)	(-0.0104)
TRANSGEN	-0.0178	0.0032	0.0104	0.0043	0.0058	-0.0014	-0.0035	-0.0009
	(-0.0168)	(-0.0036)	(-0.0983)	(-0.034)	(-0.0152)	(-0.0035)	(-0.059)	(-0.0158)
AGE	0.0067	-0.0012	-0.0039	-0.0016	N/A	N/A	N/A	N/A
	(-0.0054)	(-0.001)	(-0.0037)	(-0.0016)				
AGESQ	-0.0001	0	0	0	N/A	N/A	N/A	N/A
	(0)	(0)	0	0				
AGE1	N/A	N/A	N/A	N/A	-0.0820***	0.0155**	0.052	0.0146**
					(-0.0167)	(-0.0064)	(-0.0725)	(-0.0069)
AGE2	N/A	N/A	N/A	N/A	0.0439***	-0.0113***	-0.0261	-0.0065
					(-0.0146)	(-0.0021)	(-0.0543)	(-0.0197)
AGE3	N/A	N/A	N/A	N/A	0.0268*	-0.0068***	-0.016	-0.004
					(-0.0149)	(-0.0028)	(-0.0563)	(-0.0178)
ASBSGRAD	0.0098	-0.0017	-0.0057	-0.0024	0.0453***	-0.0113***	-0.0272	-0.0068
	(-0.0167)	(-0.0026)	(-0.09)	(-0.0409)	(-0.0145)	(-0.0019)	(-0.0543)	(-0.0202)
CONSERV	-0.0355**	0.0066	0.0206	0.0084	0.0528***	-0.0138***	-0.0313	-0.0077
	(-0.0169)	(-0.0043)	(-0.1032)	(-0.0292)	(-0.0145)	(-0.0018)	(-0.0532)	(-0.0205)
INBETWN	N/A	N/A	N/A	N/A	-0.0076	0.0018	0.0046	0.0012
					(-0.0154)	(-0.004)	(-0.0607)	(-0.0143)
NONHISP	0.0500***	-0.0073***	-0.0294	-0.0132	N/A	N/A	N/A	N/A
	(-0.0163)	(-0.0008)	(-0.0766)	(-0.0552)				

Table 16. Continued

	U.S. Results Marginal Effects				South Korean Results Marginal Effects			
Variable	**y=0**	**y=1**	**y=2**	**y=3**	**y=0**	**y=1**	**y=2**	**y=3**
AFAMER	0.0669***	-0.0145***	-0.0381	-0.0143	N/A	N/A	N/A	N/A
	(-0.0168)	(-0.0013)	(-0.0731)	(-0.0494)				
OTHERACE	0.0429***	0.0065*	0.0252	0.0112	N/A	N/A	N/A	N/A
	(-0.017)	(-0.004)	(-0.1076)	(-0.0306)				
INCOME1	0.0326**	-0.0064***	-0.0188	-0.0075	N/A	N/A	N/A	N/A
	(-0.0167)	(-0.0022)	(-0.0829)	(-0.0443)				
INCOME2	-0.0103	0.0018	0.006	0.0025	N/A	N/A	N/A	N/A
	(-0.0168)	(-0.0033)	(-0.0963)	(-0.0363)				
INCOME3	-0.0169	0.0029	0.0098	0.0042	N/A	N/A	N/A	N/A
	(-0.0168)	(-0.0034)	(-0.0984)	(-0.0351)				
INCOME4	0.0219	-0.0041*	-0.0127	-0.0051	N/A	N/A	N/A	N/A
	(-0.0167)	(-0.0024)	(-0.0861)	(-0.0427)				
INCOME5	-0.0335**	0.0054	0.0196	0.0085	N/A	N/A	N/A	N/A
	(-0.0169)	(-0.0038)	(-0.104)	(-0.0319)				
INC1	N/A	N/A	N/A	N/A	0.0301**	-0.0078***	-0.0178	-0.0044
					(-0.0149)	(-0.0027)	(-0.0558)	(-0.0179)
INC2	N/A	N/A	N/A	N/A	0.0748***	-0.0207***	-0.0436	-0.0105
					(-0.0143)	(-0.0011)	(-0.0505)	(-0.0223)
INC3	N/A	N/A	N/A	N/A	0.0271*	-0.0069***	-0.0161	-0.004
					(-0.0149)	(-0.0028)	(-0.0563)	(-0.0178)

denotes a significant variable with a p-value of 0.10, ** denotes a significant variable with a p-value of 0.05, and * denotes a significant variable with a p-value of 0.01(Variable Definitions are located in Tables 1-4)*
**Standard errors of the marginal effects are in parentheses*

CHAPTER VI

CONCLUSIONS

Summary Remarks

Innovation has long been a driving factor in agriculture. Technologies including tractors, irrigation, selective breeding, and improved storage facilities have all impacted the industry greatly through improved efficiency and increased levels of production. Genetic modification possesses the potential to be the next revolution in agriculture with the potential to increase production, to reduce environmental impact through a lesser need for chemical inputs, to produce crops in harsh conditions, as well to increase the efficiency of current agronomic inputs. Moreover, the benefits that GM technology can provide are not limited to producers. GM technology presents potential advantages to consumers through improved food product shelf-life, improved or enhanced nutritional quality of foods, and the production of vaccines and drugs, among other potential benefits. Despite all of these constructive probable outcomes, GM's potential will be lost if a lack of consumer approval and acceptance exists.

The level of consumer acceptance varies with the nature of the product being created by genetic modification. Furthermore, consumers' approval and acceptance of the use of GM technology for the creation of food products is developed through several factors including their understanding of technology, as well as their exposure to the issue.

Survey research results suggest that consumers are more approving of using GM technology to create plant-based food products than they are of using it to create animal-based food products. Results also indicate that consumers' understanding of science and technology is limited. Despite this limited understanding, most consumers have had at least some exposure to the issue of genetic modification. An improvement in consumers' understanding of technology, specifically GM technology, is likely to result in a greater level of approval. The findings revealed that those consumers with an accurate knowledge of the outcomes of GM technology were more likely to approve of its use for the creation of both plant- and animal-based food products. Thus, if consumers' understanding of technology could be increased to meet their level of exposure to the issue their approval level may be increased.

Labeling was shown to be a significant factor in consumers' approval of the use of genetic modification in the creation of food products. Those who believe that food products containing GM ingredients should be labeled as such were more likely to disapprove of the genetic modification of both plant- and animal-based foods. It is likely that many of consumers feel GM labeling necessary because they intend to avoid GM products.

U.S. consumers were found to be more approving of using GM technology to create plant-based foods than were South Korean consumers. They were also found to be more approving of the use of GM for the creation of animal-based foods; however the divergence was much less than in the case of using GM to create plant-based foods.

United States Consumer Profile

This study revealed a profile of U.S. consumers most likely to approve of the use of GM in the creation of plant-based food products. Probit analysis, binary and ordered, identified the variables that are significant factors in consumers' likelihood of approval. Overall, results suggest that U.S. consumers most likely to approve of creating plant-based foods using GM are those who (1) are male, (2) are Caucasian, (3) are non-Hispanic, (4) have a household income of $100,000 or above, (5) have some college education or greater, (6) have heard some or a great deal about genetic modification, (7) possess an accurate actual knowledge of specific outcomes of GM, and (8) don't believe the labeling of GM food products to be necessary.

A profile of U.S. consumers most likely to approve of animal-based food products was also made clear by the results. The factors involved in the approval decision were indicated by their significance in the probit models. Findings suggest that U.S. consumers most likely to approve of using GM technology to create animal-based foods include (1) males, (2) Caucasians, (3) non-Hispanics, (4) those with a household income of $75,000- $99,999, (5) those who classify themselves as liberal, (6) those with a poor to fair understanding of food production, (7) those with a good or better understanding of science and technology, (8) those with an accurate knowledge of specific outcomes of GM, (9) those who have heard some or a great deal about genetic modification, and (10) those who don't believe the labeling of GM food products to be necessary.

The combination of these profiles indicates that consumers who (1) are male, (2) are Caucasian, (3) are not Hispanic, (4) possess an accurate knowledge of specific outcomes of GM applications, (5) those who have heard some or a great deal about GM, and (6) those who don't believe the labeling of GM food products to be necessary, are most likely to approve of the use of GM technology for the creation of both plant- and animal-based foods.

South Korean Consumer Profile

A profile of South Korean consumers most likely to approve of using genetic modification to create plant-based food products was developed in consideration of the results of this study. The factors included in the profile are indicative of the significant variables found in the probit models. The results indicate that South Korean consumers most likely to approve of the use of GM technology for the creation of plant-based foods include (1) males, (2) individuals ages 20 to 29, (3) individuals with a high school diploma or less (4) those who classify themselves as liberal, (5) those with household incomes below 20 million Won and above 40 million Won, (6) those who have heard some or a great deal about genetic modification, (7) those with a good or better understanding of science and technology, (8) those with an accurate knowledge of specific outcomes of GM, and (9) those who don't believe the labeling of GM food products to be necessary.

A profile of South Korean consumers most likely to approve of using GM to create animal-based food products was also developed. The profile is the result of the significant variables found in the probit models. The findings suggest that South Korean

consumers most likely to approve the creation of animal-based food products via GM are those who (1) are male, (2) are ages 20 to 29, (3) have a high school diploma or less, (4) classify themselves as liberal, (5) have a household income above 40 million Won, (6) have a poor to fair understanding of food production, (7) haven't heard a great deal about genetic modification, (8) have an accurate actual knowledge of specific outcomes of GM, and (9) don't believe labeling of GM food products to be necessary.

The combination of these profiles indicates that consumers who (1) are male, (2) are ages 20 to 29, (3) classify themselves as liberal, (4) have a high school diploma or less, (5) have a household income of over 40 million Won, (6) have an accurate actual knowledge of specific outcomes of GM, and (7) don't believe labeling of GM food products to be necessary are most likely to approve of the use of GM technology for the creation of both plant- and animal-based foods.

Industry Implications

The results of this study have important implications for the entire agricultural industry. Consumer expectations and demands must be addressed and met for the products of genetic modification to be commercially successful. The research and development, production, and distribution sectors within the system must all be aware of the needs and wants of consumers. This study can aid industry to develop better awareness by consumers, which will in turn lead to profitable decisions. The profiles of those consumers most likely to approve GM technology used in food production and their likelihood of approval relative to the different applications of the technology could be used as a guide for targeting specific consumer groups. For example, the findings

indicating those least likely to approve and the factors influencing their approval decision could be used to develop programs which would address the factors so as to increase approval and expand the consumer base. The information provided by this study will aid industry to develop strategies capable of better anticipating, and perhaps bring about, changes in market demand relative to product innovation.

The results of all the models showed that consumers with an accurate knowledge of specific outcomes of genetic modification were more likely than those with inaccurate or no knowledge to approve of the use of genetic modification for the creation of plant- and animal-based foods products. Industry should therefore invest in educational campaigns targeting those segments of the population with inaccurate or no knowledge of genetic modification. Promotional and marketing efforts should strive to increase public awareness of the applications and outcomes of the use of genetic modification for the creation of food products so as to increase consumer approval thus increasing consumer demand for GM food products. Additionally, for those in the industry involved in the South Korean export market a promising finding from this study was that South Korean consumers ages 20 to 29 years old were more likely than consumers ages 50 to 59 to approve of using GM to create both plant- and animal- based foods. This could be the sign of a paradigm shift within South Korean society. If so, it would indicate that those in future generations will be more accepting of GM food products thus expanding the demand base for those products in South Korea. Industry should therefore, allocate resources toward influencing younger South Korean consumers in an

effort to maintain and potentially increase their approval of GM food products which will in turn secure a demand base for GM products for years to come.

Trade Implications

Democratic governments represent the interests of the people. South Korea is a democracy and as such must consider the demands of the general population when formulating policy. The results of this study could serve as a resource for the government of South Korea in the legislative process. It may also prove beneficial to the U.S. government, providing insight as to policies that could potentially be created by the South Korean government in response to consumer demands. Additionally, trade policies favorable to both governments could be developed using the information from this study as the basis for recognizing the desires of both U.S. and South Korean consumers. Policies developed with both populations' characteristics in would likely be highly effective and efficient in creating strong trade relationships between the two countries.

The findings of this study indicated that South Korean consumers are somewhat less likely than U.S. consumers to approve of the use of GM technology for the creation of plant- and animal-based foods. The U.S. government and exporters must therefore acknowledge the potential for greater resistance to U.S. GM products in the South Korean market than in the U.S. market. Rather than pushing U.S. GM food products on the South Korean market arbitrarily, the U.S. government and exporters should focus on increasing South Korean consumer approval of GM foods, which could lead to an increase in demand.

The findings of this study indicate that accurate knowledge of GM increases the likelihood of approval of the technology. Those involved with trade should therefore develop education campaigns similar to those that the industry should develop to increase consumers' accurate knowledge of GM. Their campaigns however, should focus not only on the end consumers but on South Korean policymakers and importers as well.

Policy Implications

A major policy implication of this study pertains to the labeling of GM products. Findings indicated that an overwhelming majority of both U.S. and South Korean consumers feel the labeling of GM products to be necessary. Results also indicated that those who felt labeling to be necessary were less likely to approve of the use of GM technology for the creation of food products than those who didn't feel it necessary. It is therefore reasonable to assume that enacting a policy that requires the labeling of GM food products would cause a decrease in demand via a leftward shift of the demand curve. A labeling policy would also result in an upward shift of the supply curve. This shift would occur as a result of the increased costs associated with the labeling of GM food products. These costs are incurred because of the newly-created need for the segregation of GM and non-GM foods throughout the supply chain so as to preserve the identity of the non-GM products. GM ingredients would require separate production, processing, handling, transportation, and storage to avoid cross-contamination with non-GM products so as to ensure accurate labeling of end products. While the findings of this study indicate the shift in demand, the magnitude of the shift is not made clear.

Despite this fact, it would be prudent of policymakers to consider the potential welfare effects associated with this shift in demand prior to the creation of a GM labeling policy.

If a labeling policy were enacted, the labeling effect on demand could be offset somewhat through programs geared toward providing the public with an accurate knowledge of GM. The knowledge provided by these programs, as indicated by the findings of this study, would likely cause an increase in demand. However, the extent to which the increase would offset the decrease in demand due to labeling is not clear.

Areas for Further Research

Since many benefits of the use of GM technology for the creation of food products are environmental and social in nature it would be interesting to conduct research comparing countries' levels of approval of GM with their efforts toward sustainability. Such a comparison could be made using consumer approval levels in individual nations and the ranking of those nations in the Envrionmental Sustainability Index.

Additionally, research examining the level of consumer approval of GM in other countries such as Japan, Australia, and in South America could be conducted and compared to the level of consumer approval found in South Korea. These comparisons could be used to determine if South Korea is representative of other nations and, if so, what are the implications in terms of the relationship between the U.S. and those other countries.

Finally, it would be interesting to estimate the specific welfare effects of policies pertaining to GM food products that are likely to be created. These policies may include

the labeling of GM food products, as well as the trade of GM food products both domestically and internationally.

Indeed many questions surround the issue of using GM technology in the creation of food products. This study has examined in depth some of those questions, namely whether consumers' level of approval will vary with the application of the technology and whether consumers in the U.S. and South Korea will differ in their levels of approval of GM.

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APPENDIX A

COEFFICIENT AND STANDARD ERROR TABLES

The following tables contain the coefficient and standard error values from the binary and ordered probit models.

A-17. Coefficients and Standard Errors of U.S. Plant Approval Binary Probit Model

Variable	Coefficient	Standard Error
Constant	0.967	0.522
FEMALE	-0.243	0.099
GUNDPROD	-0.004	0.119
HEARDSOM	0.138	0.103
LABEL	-1.259	0.282
PUNDSCI	0.167	0.105
GENEMOD	0.289	0.116
TOMFISH	0.234	0.111
AGE	-0.008	0.016
AGESQ	0.00008	0.0002
ASBSGRAD	0.257	0.107
CONSERV	0.006	0.098
NONHISP	0.292	0.224
AFAMER	-0.276	0.155
OTHERACE	-0.129	0.220
INCOME1	-0.43	0.185
INCOME2	-0.269	0.180
INCOME3	-0.141	0.183
INCOME4	-0.223	0.160
INCOME5	-0.087	0.180

A-18. Coefficients and Standard Errors of U.S. Animal Approval Binary Probit Model

Variable	Coefficient	Standard Error
Constant	0.381	0.496
FEMALE	-0.476	0.102
GUNDPROD	-0.230	0.123
HEARDSOM	0.249	0.111
LABEL	-0.929	0.200
PUNDSCI	-0.049	0.110
GMBIGGER	0.335	0.114
TRANSGEN	0.011	0.102
AGE	-0.006	0.017
AGESQ	0.0001	0.0002
ASBSGRAD	-0.110	0.111
CONSERV	0.085	0.102
NONHISP	-0.041	0.237
AFAMER	0.018	0.170
OTHERACE	0.344	0.220
INCOME1	-0.102	0.191
INCOME2	-0.013	0.186
INCOME3	0.054	0.188
INCOME4	0.059	0.160
INCOME5	-0.019	0.184

A-19. Coefficients and Standard Errors of South Korean Plant Approval Binary Probit Model

Variable	Coefficient	Standard Error
Constant	-0.193	0.313
FEMALE	-0.151	0.092
GUNDPROD	-0.095	0.129
HEARDSOM	0.068	0.127
LABEL	-0.118	0.238
PUNDSCI	-0.085	0.095
GENEMOD	0.382	0.092
TOMFISH	0.006	0.092
AGE1	0.335	0.162
AGE2	-0.131	0.152
AGE3	-0.173	0.151
ASBSGRAD	-0.119	0.101
CONSERV	-0.209	0.120
INBETWN	-0.019	0.111
INC1	0.098	0.142
INC2	-0.065	0.129
INC3	0.060	0.125

A-20. Coefficients and Standard Errors of South Korean Animal Approval Binary Probit Model

Variable	Coefficient	Standard Error
Constant	-0.346	0.337
FEMALE	-0.214	0.998
GUNDPROD	-0.207	0.136
HEARDSOM	-0.133	0.134
LABEL	0.125	0.264
PUNDSCI	-0.096	0.103
GMBIGGER	0.256	0.110
TRANSGEN	0.062	0.103
AGE1	0.059	0.171
AGE2	-0.238	0.162
AGE3	-0.277	0.161
ASBSGRAD	-0.127	0.109
CONSERV	-0.049	0.132
INBETWN	0.118	0.121
INC1	-0.068	0.154
INC2	-0.146	0.140
INC3	-0.011	0.134

A-21. Coefficients and Standard Errors of U.S. Plant Approval Ordered Probit Model

Variable	Coefficient	Standard Error
Constant	2.0427	0.4052
FEMALE	-0.1222	0.0821
GUNDPROD	-0.0616	0.0998
HEARDSOM	0.1889	0.0862
LABEL	-1.2335	0.1771
PUNDSCI	0.0709	0.0873
GENEMOD	0.3091	0.0993
TOMFISH	0.1255	0.0938
AGE	-0.0183	0.0133
AGESQ	0.0002	0.0001
ASBSGRAD	0.1715	0.0889
CONSERV	-0.0519	0.0811
NONHISP	0.1732	0.1859
AFAMER	-0.3412	0.1331
OTHERACE	-0.3172	0.1884
INCOME1	-0.3283	0.1518
INCOME2	-0.2947	0.1485
INCOME3	-0.0846	0.1503
INCOME4	-0.0990	0.1291
INCOME5	0.0102	0.1458

A-22. Coefficients and Standard Errors of U.S. Animal Approval Ordered Probit Model

Variable	Coefficient	Standard Error
Constant	1.3733	0.4036
FEMALE	-0.3988	0.0838
GUNDPROD	-0.1670	0.1018
HEARDSOM	0.1616	0.0888
LABEL	-0.8343	0.1637
PUNDSCI	-0.0966	0.0889
GMBIGGER	0.2106	0.0905
TRANSGEN	0.0447	0.0826
AGE	-0.0168	0.0136
AGESQ	0.0002	0.0001
ASBSGRAD	-0.0247	0.0904
CONSERV	0.0891	0.0828
NONHISP	-0.1262	0.1896
AFAMER	-0.1679	0.1388
OTHERACE	0.1081	0.1860
INCOME1	-0.0819	0.1537
INCOME2	0.0259	0.1498
INCOME3	0.0424	0.1526
INCOME4	-0.0550	0.1317
INCOME5	0.0844	0.1482

A-23. Coefficients and Standard Errors of South Korean Plant Approval Ordered Probit Model

Variable	Coefficient	Standard Error
Constant	0.6821	0.2618
FEMALE	-0.1256	0.0765
GUNDPROD	-0.0576	0.1070
HEARDSOM	0.0657	0.1046
LABEL	-0.0993	0.1972
PUNDSCI	-0.0707	0.0784
GENEMOD	0.3808	0.0770
TOMFISH	0.0106	0.0757
AGE1	0.4161	0.1364
AGE2	0.0105	0.1258
AGE3	-0.0514	0.1255
ASBSGRAD	-0.0884	0.0827
CONSERV	-0.1718	0.0991
INBETWN	-0.0489	0.0925
INC1	0.0806	0.1184
INC2	-0.0810	0.1056
INC3	0.9681	0.1034

A-24. Coefficients and Standard Errors of South Korean Animal Approval Ordered Probit Model

Variable	Coefficient	Standard Error
Constant	0.8794	0.2628
FEMALE	-0.2277	0.0776
GUNDPROD	-0.1575	0.1080
HEARDSOM	-0.0760	0.1054
LABEL	-0.0953	0.1986
PUNDSCI	-0.0274	0.0794
GMBIGGER	0.1279	0.0874
TRANSGEN	-0.0152	0.0812
AGE1	0.2201	0.1368
AGE2	-0.1145	0.1269
AGE3	-0.0700	0.1264
ASBSGRAD	-0.1187	0.0842
CONSERV	-0.1377	0.1011
INBETWN	0.0199	0.0937
INC1	-0.0784	0.1202
INC2	-0.1942	0.1075
INC3	-0.0707	0.1048

APPENDIX B

CROSS-TABULATION TABLES

The following tables contain cross tabulation data of significant variables from the U.S. and South Korean binary and ordered probit models. Tables B-24 through B-41 pertain to the U.S. models, while tables B-42 through B-59 pertain to the South Korean models.

B-24. Cross-Tabulation: GM Plant Approval vs. Gender

	GENDER		
PLANT APPROVAL	**Male**	**Female**	**Total**
Strongly Approve	60	55	115
Somewhat Approve	171	176	347
Somewhat Disapprove	58	111	169
Strongly Disapprove	60	99	159
Strongly Approve	7.59%	6.96%	14.56%
Somewhat Approve	21.65%	22.28%	43.92%
Somewhat Disapprove	7.34%	14.05%	21.39%
Strongly Disapprove	7.59%	12.53%	20.13%

B-25. Cross-Tabulation: GM Plant Approval vs. Level of Exposure to GM Issue

	LEVEL OF EXPOSURE TO GM ISSUE				
PLANT APPROVAL	**Nothing at all**	**Not much**	**Some**	**A great deal**	**Total**
Strongly Approve	6	15	60	34	115
Somewhat Approve	25	97	192	33	347
Somewhat Disapprove	20	51	91	7	169
Strongly Disapprove	20	42	77	20	159
Strongly Approve	0.76%	1.90%	7.59%	4.30%	14.56%
Somewhat Approve	3.16%	12.28%	24.30%	4.18%	43.92%
Somewhat Disapprove	2.53%	6.46%	11.52%	0.89%	21.39%
Strongly Disapprove	2.53%	5.32%	9.75%	2.53%	20.13%

B-26. Cross-Tabulation: GM Plant Approval vs. Attitudes Toward GM Labeling

	ATTITUDES TOWARD GM LABELING		
PLANT APPROVAL	**Want labeling**	**Don't want labeling**	**Total**
Strongly Approve	87	28	115
Somewhat Approve	328	19	347
Somewhat Disapprove	166	3	169
Strongly Disapprove	158	1	159
Strongly Approve	11.01%	3.54%	14.56%
Somewhat Approve	41.52%	2.41%	43.92%
Somewhat Disapprove	21.01%	0.38%	21.39%
Strongly Disapprove	20.00%	0.13%	20.13%

B-27. Cross-Tabulation: GM Plant Approval vs. Accurate Knowledge of GM

	ACCURATE KNOWLEDGE OF GM			
PLANT APPROVAL	**Correct**	**Incorrect**	**Don't Know**	**Total**
Strongly Approve	6	105	4	115
Somewhat Approve	42	273	32	347
Somewhat Disapprove	30	114	25	169
Strongly Disapprove	40	100	19	159
Strongly Approve	0.76%		0.51%	14.56%
Somewhat Approve	5.32%	34.56%	4.05%	43.92%
Somewhat Disapprove	3.80%	14.43%	3.16%	21.39%
Strongly Disapprove	5.06%	12.66%	2.41%	20.13%

B-28. Cross-Tabulation: GM Plant Approval vs. Accurate Knowledge of GM

	ACCURATE KNOWLEDGE OF GM			
PLANT APPROVAL	**Correct**	**Incorrect**	**Don't Know**	**Total**
Strongly Approve	16	93	6	115
Somewhat Approve	69	259	19	347
Somewhat Disapprove	49	100	20	169
Strongly Disapprove	48	97	14	159
Strongly Approve	2.03%	11.77%	0.76%	14.56%
Somewhat Approve	8.73%	32.78%	2.41%	43.92%
Somewhat Disapprove	6.20%	12.66%	2.53%	21.39%
Strongly Disapprove	6.08%	12.28%	1.77%	20.13%

B-29. Cross-Tabulation: GM Plant Approval vs. Education Level

	EDUCATION LEVEL								
PLANT APPROVAL	**No formal schooling**	**1st thru 7th**	**8th**	**Some H.S.**	**H.S. grad/GED**	**Some college/A.S.**	**B.S./B.A.**	**Post-grad**	**Total**
Strongly Approve				7	24	27	32	25	115
Somewhat Approve		1	2	12	92	91	95	54	347
Somewhat Disapprove		1	1	11	63	37	37	19	169
Strongly Disapprove	1	1	1	9	53	39	37	18	159
Strongly Approve	0.00%	0.00%	0.00%	0.89%	3.04%	3.42%	4.05%	3.16%	14.56%
Somewhat Approve	0.00%	0.13%	0.25%	1.52%	11.65%	11.52%	12.03%	6.84%	43.92%
Somewhat Disapprove	0.00%	0.13%	0.13%	1.39%	7.97%	4.68%	4.68%	2.41%	21.39%
Strongly Disapprove	0.13%	0.13%	0.13%	1.14%	6.71%	4.94%	4.68%	2.28%	20.13%

B-30. Cross-Tabulation: GM Plant Approval vs. Ethnicity

	ETHNICITY		
PLANT APPROVAL	**Hispanic**	**Non-Hispanic**	**Total**
Strongly Approve	5	110	115
Somewhat Approve	13	334	347
Somewhat Disapprove	12	157	169
Strongly Disapprove	9	150	159
Strongly Approve	0.63%	13.92%	14.56%
Somewhat Approve	1.65%	42.28%	43.92%
Somewhat Disapprove	1.52%	19.87%	21.39%
Strongly Disapprove	1.14%	18.99%	20.13%

B-31. Cross-Tabulation: GM Plant Approval vs. Race

	RACE					
PLANT APPROVAL	**White**	**Black**	**Asian**	**Native American**	**Other**	**Total**
Strongly Approve	104	8	1		2	115
Somewhat Approve	303	28	8	5	3	347
Somewhat Disapprove	147	16	2	3	1	169
Strongly Disapprove	112	34	4	3	6	159
Strongly Approve	13.16%	1.01%	0.13%	0.00%	0.25%	14.56%
Somewhat Approve	38.35%	3.54%	1.01%	0.63%	0.38%	43.92%
Somewhat Disapprove	18.61%	2.03%	0.25%	0.38%	0.13%	21.39%
Strongly Disapprove	14.18%	4.30%	0.51%	0.38%	0.76%	20.13%

B-32. Cross-Tabulation: GM Plant Approval vs. Income

	INCOME							
PLANT APPROVAL	**<$25K**	**$25K-$34.9K**	**$35K-$49.9K**	**$50K-$74.9K**	**$75K-$99.9K**	**$100K-$124.9K**	**$125K or more**	**Total**
Strongly Approve	13	12	10	39	19	9	13	115
Somewhat Approve	43	55	51	84	54	36	24	347
Somewhat Disapprove	37	25	27	41	23	6	10	169
Strongly Disapprove	32	37	18	40	13	6	13	159
Strongly Approve	1.65%	1.52%	1.27%	4.94%	2.41%	1.14%	1.65%	14.56%
Somewhat Approve	5.44%	6.96%	6.46%	10.63%	6.84%	4.56%	3.04%	43.92%
Somewhat Disapprove	4.68%	3.16%	3.42%	5.19%	2.91%	0.76%	1.27%	21.39%
Strongly Disapprove	4.05%	4.68%	2.28%	5.06%	1.65%	0.76%	1.65%	20.13%

B-33. Cross-Tabulation: GM Animal Approval vs. Gender

	GENDER		
ANIMAL APPROVAL	**Male**	**Female**	**Total**
Strongly Approve	34	14	48
Somewhat Approve	100	78	178
Somewhat Disapprove	80	120	200
Strongly Disapprove	137	259	396
Strongly Approve	4.14%	1.70%	5.84%
Somewhat Approve	12.17%	9.49%	21.65%
Somewhat Disapprove	9.73%	14.60%	24.33%
Strongly Disapprove	16.67%	31.51%	48.18%

B-34. Cross-Tabulation: GM Animal Approval vs. Understanding of Food Production

	UNDERSTANDING OF FOOD PRODUCTION					
ANIMAL APPROVAL	**Poor**	**Fair**	**Good**	**Very Good**	**Excellent**	**Total**
Strongly Approve	2	9	17	8	12	48
Somewhat Approve	4	36	68	43	27	178
Somewhat Disapprove	4	34	77	61	24	200
Strongly Disapprove	9	74	132	121	60	396
Strongly Approve	0.24%	1.09%	2.07%	0.97%	1.46%	5.84%
Somewhat Approve	0.49%	4.38%	8.27%	5.23%	3.28%	21.65%
Somewhat Disapprove	0.49%	4.14%	9.37%	7.42%	2.92%	24.33%
Strongly Disapprove	1.09%	9.00%	16.06%	14.72%	7.30%	48.18%

B-35. Cross-Tabulation: GM Animal Approval vs. Level of Exposure to GM Issue

	LEVEL OF EXPOSURE TO GM ISSUE				
ANIMAL APPROVAL	**Nothing at all**	**Not much**	**Some**	**A great deal**	**Total**
Strongly Approve	4	3	21	20	48
Somewhat Approve	16	38	103	21	178
Somewhat Disapprove	19	61	97	23	200
Strongly Disapprove	35	117	211	33	396
Strongly Approve	0.49%	0.36%	2.55%	2.43%	5.84%
Somewhat Approve	1.95%	4.62%	12.53%	2.55%	21.65%
Somewhat Disapprove	2.31%	7.42%	11.80%	2.80%	24.33%
Strongly Disapprove	4.26%	14.23%	25.67%	4.01%	48.18%

B-36. Cross-Tabulation: GM Animal Approval vs. Attitudes Toward GM Labeling

	ATTITUDES TOWARD GM LABELING		
ANIMAL APPROVAL	**Want labeling**	**Don't want labeling**	**Total**
Strongly Approve	39	9	48
Somewhat Approve	156	22	178
Somewhat Disapprove	189	11	200
Strongly Disapprove	389	7	396
Strongly Approve	4.74%	1.09%	5.84%
Somewhat Approve	18.98%	2.68%	21.65%
Somewhat Disapprove	22.99%	1.34%	24.33%
Strongly Disapprove	47.32%	0.85%	48.18%

B-37. Cross-Tabulation: GM Animal Approval vs. Understanding of Science and Technology

	UNDERSTANDING OF SCIENCE AND TECHNOLOGY					
ANIMAL APPROVAL	**Poor**	**Fair**	**Good**	**Very Good**	**Excellent**	**Total**
Strongly Approve	1	14	16	11	6	48
Somewhat Approve	29	74	46	17	12	178
Somewhat Disapprove	35	85	50	21	9	200
Strongly Disapprove	79	168	96	50	3	396
Strongly Approve	0.12%	1.70%	1.95%	1.34%	0.73%	5.84%
Somewhat Approve	3.53%	9.00%	5.60%	2.07%	1.46%	21.65%
Somewhat Disapprove	4.26%	10.34%	6.08%	2.55%	1.09%	24.33%
Strongly Disapprove	9.61%	20.44%	11.68%	6.08%	0.36%	48.18%

B-38. Cross-Tabulation: GM Animal Approval vs. Accurate Knowledge of GM

	ACCURATE KNOWLEDGE OF GM			
ANIMAL APPROVAL	**Correct**	**Incorrect**	**Don't Know**	**Total**
Strongly Approve	7	35	6	48
Somewhat Approve	26	138	14	178
Somewhat Disapprove	45	129	26	200
Strongly Disapprove	94	236	66	396
Strongly Approve	0.85%	4.26%	0.73%	5.84%
Somewhat Approve	3.16%	16.79%	1.70%	21.65%
Somewhat Disapprove	5.47%	15.69%	3.16%	24.33%
Strongly Disapprove	11.44%	28.71%	8.03%	48.18%

B-39. Cross-Tabulation: GM Animal Approval vs. Ethnicity

	ETHNICITY		
ANIMAL APPROVAL	**Hispanic**	**Non-Hispanic**	**Total**
Strongly Approve	3	45	48
Somewhat Approve	8	170	178
Somewhat Disapprove	11	189	200
Strongly Disapprove	18	378	396
Strongly Approve	0.36%	5.47%	5.84%
Somewhat Approve	0.97%	20.68%	21.65%
Somewhat Disapprove	1.34%	22.99%	24.33%
Strongly Disapprove	2.19%	45.99%	48.18%

B-40. Cross-Tabulation: GM Animal Approval vs. Race

	RACE					
ANIMAL APPROVAL	**White**	**Black**	**Asian**	**Native American**	**Other**	**Total**
Strongly Approve	42	2	1		3	48
Somewhat Approve	151	17	6	3	1	178
Somewhat Disapprove	179	15	2	3	1	200
Strongly Disapprove	322	52	10	5	7	396
Strongly Approve	5.11%	0.24%	0.12%	0.00%	0.36%	5.84%
Somewhat Approve	18.37%	2.07%	0.73%	0.36%	0.12%	21.65%
Somewhat Disapprove	21.78%	1.82%	0.24%	0.36%	0.12%	24.33%
Strongly Disapprove	39.17%	6.33%	1.22%	0.61%	0.85%	48.18%

B-41. Cross-Tabulation: GM Animal Approval vs. Income

	INCOME							
ANIMAL APPROVAL	**<$25K**	**$25K-$34.9K**	**$35K-$49.9K**	**$50K-$74.9K**	**$75K-$99.9K**	**$100K-$124.9K**	**$125K or more**	**Total**
Strongly Approve	6	8	4	15	10	2	3	48
Somewhat Approve	26	25	26	50	21	17	13	178
Somewhat Disapprove	35	36	29	35	32	17	16	200
Strongly Disapprove	68	69	50	111	48	22	28	396
Strongly Approve	0.73%	0.97%	0.49%	1.82%	1.22%	0.24%	0.36%	5.84%
Somewhat Approve	3.16%	3.04%	3.16%	6.08%	2.55%	2.07%	1.58%	21.65%
Somewhat Disapprove	4.26%	4.38%	3.53%	4.26%	3.89%	2.07%	1.95%	24.33%
Strongly Disapprove	8.27%	8.39%	6.08%	13.50%	5.84%	2.68%	3.41%	48.18%

B-42. Cross-Tabulation: GM Plant Approval vs. Gender

	GENDER		
PLANT APPROVAL	**Male**	**Female**	**Total**
Strongly Approve	22	16	38
Somewhat Approve	149	125	274
Somewhat Disapprove	166	174	340
Strongly Disapprove	120	131	251
Strongly Approve	2.44%	1.77%	4.21%
Somewhat Approve	16.50%	13.84%	30.34%
Somewhat Disapprove	18.38%	19.27%	37.65%
Strongly Disapprove	13.29%	14.51%	27.80%

B-43. Cross-Tabulation: GM Plant Approval vs. Level of Exposure to GM Issue

	LEVEL OF EXPOSURE TO GM ISSUE				
PLANT APPROVAL	**Nothing at all**	**Not much**	**Some**	**A great deal**	**Total**
Strongly Approve	4	3	15	16	38
Somewhat Approve	12	29	183	50	274
Somewhat Disapprove	13	40	238	49	340
Strongly Disapprove	18	30	158	45	251
Strongly Approve	0.44%	0.33%	1.66%	1.77%	4.21%
Somewhat Approve	1.33%	3.21%	20.27%	5.54%	30.34%
Somewhat Disapprove	1.44%	4.43%	26.36%	5.43%	37.65%
Strongly Disapprove	1.99%	3.32%	17.50%	4.98%	27.80%

B-44. Cross-Tabulation: GM Plant Approval vs. Attitudes Toward GM Labeling

	ATTITUDES TOWARD GM LABELING		
PLANT APPROVAL	**Want labeling**	**Don't want labeling**	**Total**
Strongly Approve	37	1	38
Somewhat Approve	262	12	274
Somewhat Disapprove	328	12	340
Strongly Disapprove	244	7	251
Strongly Approve	4.10%	0.11%	4.21%
Somewhat Approve	29.01%	1.33%	30.34%
Somewhat Disapprove	36.32%	1.33%	37.65%
Strongly Disapprove	27.02%	0.78%	27.80%

B-45. Cross-Tabulation: GM Plant Approval vs. Understanding of Science and Technology

	UNDERSTANDING OF SCIENCE AND TECHNOLOGY					
PLANT APPROVAL	**Poor**	**Fair**	**Good**	**Very Good**	**Excellent**	**Total**
Strongly Approve	2	13	9	13	1	38
Somewhat Approve	24	101	103	46		274
Somewhat Disapprove	30	140	104	65	1	340
Strongly Disapprove	32	97	71	48	3	251
Strongly Approve	0.22%	1.44%	1.00%	1.44%	0.11%	4.21%
Somewhat Approve	2.66%	11.18%	11.41%	5.09%	0.00%	30.34%
Somewhat Disapprove	3.32%	15.50%	11.52%	7.20%	0.11%	37.65%
Strongly Disapprove	3.54%	10.74%	7.86%	5.32%	0.33%	27.80%

B-46. Cross-Tabulation: GM Plant Approval vs. Accurate Knowledge of GM

	ACCURATE KNOWLEDGE OF GM			
PLANT APPROVAL	**Correct**	**Incorrect**	**Don't Know**	**Total**
Strongly Approve	8	22	8	38
Somewhat Approve	74	138	62	274
Somewhat Disapprove	93	137	110	340
Strongly Disapprove	108	69	74	251
Strongly Approve	0.89%	2.44%	0.89%	4.21%
Somewhat Approve	8.19%	15.28%	6.87%	30.34%
Somewhat Disapprove	10.30%	15.17%	12.18%	37.65%
Strongly Disapprove	11.96%	7.64%	8.19%	27.80%

B-47. Cross-Tabulation: GM Plant Approval vs. Age

	AGE				
PLANT APPROVAL	**20-29**	**30-39**	**40-49**	**50-59**	**Total**
Strongly Approve	13	11	8	6	38
Somewhat Approve	88	79	68	39	274
Somewhat Disapprove	71	124	105	40	340
Strongly Disapprove	30	89	85	47	251
Strongly Approve	1.44%	1.22%	0.89%	0.66%	4.21%
Somewhat Approve	9.75%	8.75%	7.53%	4.32%	30.34%
Somewhat Disapprove	7.86%	13.73%	11.63%	4.43%	37.65%
Strongly Disapprove	3.32%	9.86%	9.41%	5.20%	27.80%

B-48. Cross-Tabulation: GM Plant Approval vs. Education

	EDUCATION LEVEL				
PLANT APPROVAL	**Middle school and below**	**High school grad**	**Attending college**	**College grad or above**	**Total**
Strongly Approve	5	15	8	10	38
Somewhat Approve	31	126	37	80	274
Somewhat Disapprove	31	163	39	107	340
Strongly Disapprove	35	118	16	82	251
Strongly Approve	0.55%	1.66%	0.89%	1.11%	4.21%
Somewhat Approve	3.43%	13.95%	4.10%	8.86%	30.34%
Somewhat Disapprove	3.43%	18.05%	4.32%	11.85%	37.65%
Strongly Disapprove	3.88%	13.07%	1.77%	9.08%	27.80%

B-49. Cross-Tabulation: GM Plant Approval vs. Beliefs

	BELIEFS			
PLANT APPROVAL	**Conservative**	**Liberal**	**Somewhere in between**	**Total**
Strongly Approve	11	12	15	38
Somewhat Approve	73	71	130	274
Somewhat Disapprove	80	114	146	340
Strongly Disapprove	52	93	106	251
Strongly Approve	1.22%	1.33%	1.66%	4.21%
Somewhat Approve	8.08%	7.86%	14.40%	30.34%
Somewhat Disapprove	8.86%	12.62%	16.17%	37.65%
Strongly Disapprove	5.76%	10.30%	11.74%	27.80%

B-50. Cross-Tabulation: GM Plant Approval vs. Income

	INCOME				
PLANT APPROVAL	Below 20 mil Won	20-30 mil Won	30-40 mil Won	Over 40 mil Won	Total
Strongly Approve	12	10	10	6	38
Somewhat Approve	62	67	80	65	274
Somewhat Disapprove	65	95	94	86	340
Strongly Disapprove	51	79	72	49	251
Strongly Approve	1.33%	1.11%	1.11%	0.66%	4.21%
Somewhat Approve	6.87%	7.42%	8.86%	7.20%	30.34%
Somewhat Disapprove	7.20%	10.52%	10.41%	9.52%	37.65%
Strongly Disapprove	5.65%	8.75%	7.97%	5.43%	27.80%

B-51. Cross-Tabulation: GM Animal Approval vs. Gender

	GENDER		
ANIMAL APPROVAL	**Male**	**Female**	**Total**
Strongly Approve	14	11	25
Somewhat Approve	98	73	171
Somewhat Disapprove	189	173	362
Strongly Disapprove	157	190	347
Strongly Approve	1.55%	1.22%	2.76%
Somewhat Approve	10.83%	8.07%	18.90%
Somewhat Disapprove	20.88%	19.12%	40.00%
Strongly Disapprove	17.35%	20.99%	38.34%

B-52. Cross-Tabulation: GM Animal Approval vs. Understanding of Food Production

	UNDERSTANDING OF FOOD PRODUCTION					
ANIMAL APPROVAL	**Poor**	**Fair**	**Good**	**Very Good**	**Excellent**	**Total**
Strongly Approve	1	2	5	9	8	25
Somewhat Approve	5	27	41	49	49	171
Somewhat Disapprove	8	45	95	126	88	362
Strongly Disapprove	4	38	66	118	121	347
Strongly Approve	0.11%	0.22%	0.55%	0.99%	0.88%	2.76%
Somewhat Approve	0.55%	2.98%	4.53%	5.41%	5.41%	18.90%
Somewhat Disapprove	0.88%	4.97%	10.50%	13.92%	9.72%	40.00%
Strongly Disapprove	0.44%	4.20%	7.29%	13.04%	13.37%	38.34%

B-53. Cross-Tabulation: GM Animal Approval vs. Level of Exposure to GM Issue

	LEVEL OF EXPOSURE TO GM ISSUE				
ANIMAL APPROVAL	**Nothing at all**	**Not much**	**Some**	**A great deal**	**Total**
Strongly Approve	2	3	11	9	25
Somewhat Approve	9	23	107	32	171
Somewhat Disapprove	15	44	254	49	362
Strongly Disapprove	21	33	223	70	347
Strongly Approve	0.22%	0.33%	1.22%	0.99%	2.76%
Somewhat Approve	0.99%	2.54%	11.82%	3.54%	18.90%
Somewhat Disapprove	1.66%	4.86%	28.07%	5.41%	40.00%
Strongly Disapprove	2.32%	3.65%	24.64%	7.73%	38.34%

B-54. Cross-Tabulation: GM Animal Approval vs. Attitudes Toward GM Labeling

	ATTITUDES TOWARD GM LABELING		
ANIMAL APPROVAL	**Want labeling**	**Don't want labeling**	**Total**
Strongly Approve	24	1	25
Somewhat Approve	165	6	171
Somewhat Disapprove	345	17	362
Strongly Disapprove	339	8	347
Strongly Approve	2.65%	0.11%	2.76%
Somewhat Approve	18.23%	0.66%	18.90%
Somewhat Disapprove	38.12%	1.88%	40.00%
Strongly Disapprove	37.46%	0.88%	38.34%

B-55. Cross-Tabulation: GM Animal Approval vs. Accurate Knowledge of GM

	ACCURATE KNOWLEDGE OF GM			
ANIMAL APPROVAL	**Correct**	**Incorrect**	**Don't Know**	**Total**
Strongly Approve	10	5	10	25
Somewhat Approve	72	55	44	171
Somewhat Disapprove	181	82	99	362
Strongly Disapprove	173	78	96	347
Strongly Approve	1.10%	0.55%	1.10%	2.76%
Somewhat Approve	7.96%	6.08%	4.86%	18.90%
Somewhat Disapprove	20.00%	9.06%	10.94%	40.00%
Strongly Disapprove	19.12%	8.62%	10.61%	38.34%

B-56. Cross-Tabulation: GM Animal Approval vs. Age

	AGE				
ANIMAL APPROVAL	**20-29**	**30-39**	**40-49**	**50-59**	**Total**
Strongly Approve	6	5	8	6	25
Somewhat Approve	52	51	40	28	171
Somewhat Disapprove	89	116	113	44	362
Strongly Disapprove	55	131	106	55	347
Strongly Approve	0.66%	0.55%	0.88%	0.66%	2.76%
Somewhat Approve	5.75%	5.64%	4.42%	3.09%	18.90%
Somewhat Disapprove	9.83%	12.82%	12.49%	4.86%	40.00%
Strongly Disapprove	6.08%	14.48%	11.71%	6.08%	38.34%

B-57. Cross-Tabulation: GM Animal Approval vs. Education

	EDUCATION LEVEL				
ANIMAL APPROVAL	**Middle school and below**	**High school grad**	**Attending college**	**College grad or above**	**Total**
Strongly Approve	6	12	3	4	25
Somewhat Approve	21	75	24	51	171
Somewhat Disapprove	35	169	48	110	362
Strongly Disapprove	42	166	25	114	347
Strongly Approve	0.66%	1.33%	0.33%	0.44%	2.76%
Somewhat Approve	2.32%	8.29%	2.65%	5.64%	18.90%
Somewhat Disapprove	3.87%	18.67%	5.30%	12.15%	40.00%
Strongly Disapprove	4.64%	18.34%	2.76%	12.60%	38.34%

B-58. Cross-Tabulation: GM Animal Approval vs. Beliefs

	BELIEFS			
ANIMAL APPROVAL	**Conservative**	**Liberal**	**Somewhere in between**	**Total**
Strongly Approve	10	7	8	25
Somewhat Approve	37	48	86	171
Somewhat Disapprove	92	111	159	362
Strongly Disapprove	77	125	145	347
Strongly Approve	1.10%	0.77%	0.88%	2.76%
Somewhat Approve	4.09%	5.30%	9.50%	18.90%
Somewhat Disapprove	10.17%	12.27%	17.57%	40.00%
Strongly Disapprove	8.51%	13.81%	16.02%	38.34%

B-59. Cross-Tabulation: GM Animal Approval vs. Income

	INCOME				
ANIMAL APPROVAL	Below 20 mil Won	20-30 mil Won	30-40 mil Won	Over 40 mil Won	Total
Strongly Approve	6	5	9	5	25
Somewhat Approve	38	42	48	43	171
Somewhat Disapprove	78	96	99	89	362
Strongly Disapprove	69	109	100	69	347
Strongly Approve	0.66%	0.55%	0.99%	0.55%	2.76%
Somewhat Approve	4.20%	4.64%	5.30%	4.75%	18.90%
Somewhat Disapprove	8.62%	10.61%	10.94%	9.83%	40.00%
Strongly Disapprove	7.62%	12.04%	11.05%	7.62%	38.34%

APPENDIX C

UNITED STATES SURVEY QUESTIONNAIRE

Hello, I'm (first and last name) calling for the Food Policy Institute at Rutgers University. We're conducting a survey on food, health and technology for the U.S. Department of Agriculture. We're interested in your opinions. All of your answers during the phone survey will remain confidential. Because we must interview an equal number of males and females, may I please speak: **[CATI ROTATE RESPONDENT SELECTION CHOICE "A" AND "B"]**

A. …with a male, 18 years of age or older who had the most recent birthday in your household? **[IF MALE NOT AVAILABLE ARRANGE CALLBACK. IF NO MALES EXIST, ASK:]** May I speak to the female who is 18 years or older who had the most recent birthday?

B. …with a female, 18 years of age or older who had the most recent birthday in your household? **[IF FEMALE NOT AVAILABLE ARRANGE CALLBACK. IF NO FEMALES EXIST, ASK:]** May I speak to the male who is 18 years or older who had the most recent birthday?

INTERVIEWER RECORD SEX OF RESPONDENT: 1 – Male 2 – Female

1. Would you say that you do most of the food shopping for your household, that someone else does most of the food shopping, or would you say that the task is equally divided?
1 – Yes, I do most of the food shopping
2 – Someone else does most of the shopping
3 – Equally divided
8 – Don't know
9 – Refused

2. On average, how many times a week do you prepare, or help to prepare, your main meal of the day? Would you say: **(READ LIST)**
1 – Never,
2 – Rarely,
3 – Sometimes,
4 – Frequently, or
5 – Always?
8 – (vol) Don't know
9 – (vol) Refused

3. Would you rate your own basic understanding of how food is grown and produced as: **(READ LIST AND LIMIT TO ONE RESPONSE)**
1 – Poor,
2 – Fair,
3 – Good,
4 – Very good, or

5 – Excellent?
8 – (vol) Don't know
9 – (vol) Refused

4. My next question involves word association. For example, when I mention the word *baseball*, you might think of the World Series, Babe Ruth, or summertime. When you think about (insert one of the four terms), what is the first thought or image that comes to mind? **[RECORD VERBATIM]**
[CATI INSERT ONLY ONE OF THE FOUR WORDS IN EACH, SO THAT EACH WORD IS ASKED 25% OF THE TOTAL SAMPLE]
a. **Organic?**
b. **Natural?**
c. **Farming?**
d. **Nature?**

5. Would you say this thought or image is positive, negative, or neutral? **[IF RESP. ANSWERS "POS" OR "NEG" ASK: Is that extremely or somewhat (positive/negative?)**
1 – Extremely negative,
2 – Somewhat negative,
3 – Neutral,
4 – Somewhat positive, or
5 – Extremely positive?
8 – (vol) DK
9 – (vol) REF

6. Now I'd like you to think about the role of food in your life. Please tell me whether you agree or disagree with the following statements about food.
[CATI RANDOMIZE ORDER OF STATEMENTS]
a. I think about food a lot?
b. I consider eating one of life's great pleasures?
c. Food is an important part of my family traditions?
d. I eat primarily to stay healthy?
e. I think that cooking is an expression of love?
f. I like to cook?
g. I consider myself to be a good cook?
[STATEMENTS H TO P "A" VERSION ONLY]
h. The way food looks is less important than the way it tastes?
i. Food is a good way to learn about different cultures?
j. Food should not take a lot of effort to eat?
k. I like to give food as gifts?
l. Food should not take a lot of time to make?
m. Food should be kept simple?
n. My family has a secret recipe?
o. I like to watch cooking shows?
p. I like to subscribe to cooking magazines?

7. Now I'd like to ask you about the kinds of things you consider important when deciding what to eat. For each of the following please tell me what is important to you when deciding what to eat. On a scale from 1 to 10 where 1 is "not at all important" and 10 is "extremely important," how important is it that (insert statement) in deciding what to eat? **[IF RESP. SAYS "IT DEPENDS ON THE ITEM/ WHAT I'M BUYING, ETC" SAY: I realize some of the items I read may be more applicable to some food products more than others….think about each statement in more general terms….that is your overall decisions."**
[CATI RANDOMIZE ITEMS. DK = 98 REF =99 RATINGS 1 TO 10]
a. It's a food you've had before?
b. It's grown in the USA?
c. It's produced organically?
d. It doesn't contain artificial colors?
e. It doesn't contain artificial flavors?
f. It's a familiar brand?
g. It's vegetarian?
h. It doesn't contain any ingredients you're allergic to?
i. It's Kosher or Halal (Hah – lal)?
j. It's not been processed?
k. It's vegan? (vee'-gan) **[NOTE: IF ASKED FOR DEFINITION. A VEGAN CONSUMES NO ANIMAL PRODUCTS OR ANIMAL BY-PRODUCTS]**
[STATEMENTS L TO R "B" VERSION ONLY]
l. It has a low calorie content?
m. It has a low cholesterol content?
n. It has a low sodium content?
o. It has a low fat content?
p. It has a high vitamin content?
q. It has a low sugar content?
r. It has a high protein content?
s. It's easy to get?
[STATEMENTS T TO Y "B" VERSION ONLY]
t. It's already been prepared?
u. It's easy to prepare?
v. It's inexpensive?
w. It's on my diet?
x. It's not very spicy?
y. It's grown locally?

8. Please tell how often you eat the following food products? Do you eat **(insert from list)** regularly, frequently, occasionally, or never?
[REPEAT SCALE AS NEEDED]
a. Corn flakes cereal?
b. Ground beef?
c. Bananas?
[STATEMENTS D TO N "A" VERSION ONLY]
d. Snack foods?
e. Sodas, pop, or soft drinks?

f. Coffee or tea?
g. Alcoholic beverages?
h. Sports drinks (like Gatorade or Powerade)?
i. Energy drinks (like Red Bull, (So-Be, or Burn)?
j. Power, energy, or protein bars?
k. Vitamin supplements?
l. Herbal supplements?
[IF NEEDED: LIKE BEE POLLEN, GINGKO, ST. JOHN'S WORT]
m. Sugar substitutes?
n. Meal replacements
[IF NEEDED: SLIMFAST, ENSURE, INSTANT BREAK-FASTS]

9. Are you allergic to particular food or food products?
1 – Yes 2 – No 8 – DK 9 - REF

10. Is anyone else in your household allergic to particular foods or food products?
1 – Yes 2 – No 8 – DK 9 – REF

[QUESTIONS 12 TO 14 VERSION "A" ONLY]

12. Now I would like to ask you a few questions concerning food labels. Beyond just looking at the brand name, how often do you read food labels? Do you read them never, rarely, sometimes, frequently, or always?
1 – Never
2 – Rarely
3 – Sometimes
4 – Frequently
5 – Always
8 – Don't know
9 – Refused

13. Thinking about the way food is currently labeled, is there any additional information you would like to see included on food labels?
1 – Yes
2 – No **[GO TO Q.15]**
8 – DK **[GO TO Q.15]**
9 – REF **[GO TO Q.15]**

14. What additional information would you be interested in seeing on food labels?
[DO NOT READ LIST. CHECK ALL THAT APPLY. PROBE: "ANYTHING ELSE?"]
1 – Contains pesticides
2 – Contains GMO's
3 – Fat content
4 – Health benefits
5 – Grown locally
6 – Country of origin

7 – Certified Organic
8 – Irradiation (food was irradiated)
9 – More information about ingredients
17 – Other (specify)
18 – DK
19 - REF

15. How often do you buy food products labeled specifically as “Organic?” Would you say: **[READ LIST]**
1 – Never,
2 – Rarely,
3 – Sometimes,
4 – Frequently, or
5 – Always?
8 – (vol) DK
9 – (vol) REF

11. Please tell me whether the following statements about your eating habits are true or false? **[RANDOMIZE]**
a. I’m careful about the foods I put into my body?
b. I consider my diet to be mostly “meat and potatoes”?
c. People say I am a picky eater?
d. I am usually willing to try new foods?

[STATEMENTS E TO H “B” VERSION ONLY]
e. I tend to eat meals even when I’m not hungry?
f. I often skip meals?
g. When I am sad or upset I eat to make myself feel better?
h. I dislike eating leftovers?

[Q.16 VERSION “B” ONLY]
16. Please tell me whether you tend to strongly disagree, somewhat disagree, neither disagree or agree, somewhat agree, or strongly agree with the following statements.
Compared to what people ate 50 years ago, food available in the grocery store (insert statement).
a. Is healther now?
b. Tastes better now?
c. Is safer now?
d. Is more nutritious now?
e. Has more preservatives now?
f. Is less expensive now relative to the cost of living?
g. Is fresher now?
h. Has more pesticide now?
i. Has a longer shelf life now?

17. My next question again involves word association. When you think about (insert one of the three terms) what is the first thought or image that comes to mind?
[RECORD VERBATIM]
[CATI INSERT ONLY ONE OF THE 3 PHRASES IN EACH, SO THAT EACH IS ASKED OF 1/3 OF THE TOTAL SAMPLE]
a. Genetic engineering?
b. Genetic modification?
c. Biotechnology?

[IF RESPONSE TO Q.17 IS "DK/REF" GO TO Q.18B]

18a. Would you say this thought or image is positive, negative, or neutral?

[IF RESP. ANSWERS "POS" OR "NEG" ASK: Is that extremely or somewhat (positive/negative?)
1 – Extremely negative,
2 – Somewhat negative,
3 – Neutral,
4 – Somewhat positive, or
5 – Extremely positive?
8 – (vol) DK
9 – (vol) REF

18b. Would you say you feel the term (insert term from Q.17) is positive, negative, or neutral? **[IF RESP. ANSWERS "POS" OR "NEG" ASK: Is that extremely or somewhat (positive/negative?)**
1 – Extremely negative,
2 – Somewhat negative,
3 – Neutral,
4 – Somewhat positive, or
5 – Extremely positive?
8 – (vol) DK
9 – (vol) REF

[Q19 VERSION "A" ONLY]

19. Please tell me whether you think the following statements about farming are true or false?
a. Most of the food in the U.S. is produced on small family farms?
b. Most of the farmers in the U.S. work off the farm to supplement their income?
c. There is enough food produced in the U.S. to feed all the people in this country?
d. Most of the bananas sold in the U.S. supermarkets are grown in this country?
e. Most of the corn grown in the U.S. is used to feed animals such as cows?

f. Peanuts grow on trees?
g. The sweetener used in most foods comes
from sugarcane?

20. Now I would like to ask you a question concerning another food production method. Genetic modification involves new methods that make it possible for scientists to create new plants and animals by taking parts of the genes of one plant or animal and inserting them into the cells of another plant or animal. This is sometimes called genetic engineering or biotechnology. How much have you heard or read about these methods? Would you say you've heard or read **(READ LIST)**
1 – Nothing at all,
2 – Not much,
3 – Some, or
4 – A great deal about these methods?
8 – (vol) DK
9 – (vol) Ref

21. Before this interview, have you ever discussed biotechnology, genetic engineering, or genetic modification with anyone?
1 – Yes
2 – No **(GO TO 22a)**
8 – DK **(GO TO 22a)**
9 – REF **(GO TO 22a)**

21a. Would you say you have discussed this issue **(READ LIST):**
1 – Frequently,
2 – Occasionally, or
3 – Only once or twice?
8 – (vol) DK
9 – (vol) REF

22a. How much do you know about biotechnology, genetic engineering, or genetic modification? Would you say you know **(READ LIST):**
1 – Nothing at all, **(GO TO Q.23)**
2 – Very little,
3 – A fair amount, or
4 – A great deal?
8 – (vol) DK
9 – (vol) REF

22b. As it is currently being used, do you believe biotechnology, genetic engineering, or genetic modification is acceptable?
1 – Yes **(GO TO Q.23)**
2 – No
8 - DK **(GO TO Q.23)**
9 – REF **(GO TO Q.23)**

22c. Why do you consider biotechnology, genetic engineering, or genetic modification unacceptable? **[DO NOT READ LIST. PROBE FOR CLARITY AS NEEDED. MULTIPLE RECORD.]**

1 – Violates religious or ethical principles
2 – Is unhealthy for humans
3 – Is unhealthy for animals
4 – Is unhealthy for the environment
5 – Changes the taste or nutritional value of the food
6 – Is just wrong
17 – Other (specify)
18 – DK
19 - REF

[ASK ALL]

23. As far as you know, have you ever eaten any food containing genetically modified ingredients?
1 – Yes 2 – No 8 – DK 9 – Ref

24. As far as you know, are there any foods containing genetically modified ingredients in supermarkets now?
1 – Yes 2 – No 8 – DK 9 – Ref

25. On a scale of 1 to 10 where “1” means it is “not important” and “10” means it is “extremely important”…how important is it when deciding what to eat to have foods that DO NOT contain genetically modified ingredients?
1 2 3 4 5 6 7 8 9 98 (DK) 99 (REF)

26. Do you think that foods that contain genetically modified ingredients should be labeled as such?
1 – Yes 2 – No 8 – DK 9 – Ref

27. If you were shopping and saw that some products were labeled as containing genetically modified ingredients, would you be any more willing or less willing to purchase them, or would it not make a difference?
[IF MORE OR LESS ASK: Is that much (more/less) willing, or somewhat (more/less) willing?]
1 – Much more willing 8 – Don’t know
2 – Somewhat more willing 9 - Refused
3 – Somewhat less willing
4 – Much less willing
5 – Would not make a difference

28. When you are shopping, would you take the time to look at labels to see if genetically modified ingredients are listed?
1 – Yes 2 – No 8 – Don’t know 9 – Refused

29. In general, do you approve or disapprove of using genetic modification to create plant based food products? **[IF APPROVE/DISAPPROVE: Is that strongly or somewhat (approve/disapprove)?]**
1 – Strongly approve 8 – Don’t know
2 – Somewhat approve 9 - Refused
3 – Somewhat disapprove, or
4 – Strongly disapprove?

30. In general, do you approve or disapprove of using genetic modification to create animal based food products? **[IF APPROVE/DISAPPROVE: Is that strongly or somewhat (approve/disapprove)?]**
1 – Strongly approve
2 – Somewhat approve
3 – Somewhat disapprove, or
4 – Strongly disapprove?
8 – DK
9 – Ref

31. From what you know or have heard, do you think genetic modification will make the quality of life for people such as yourself better or worse? **[PROBE: Is that much (better/worse) or somewhat (better/worse)?**
1 – Much better
2 – Somewhat better 8 – Don't know
3 – Somewhat worse 9 – Refused
4 – Much worse

32. Please tell me whether you tend to agree or disagree with the following statements about genetically modified food. **[CATI RANDOMIZE STATEMENTS]**
a. Genetically modified food presents no danger for future generations?
b. Eating genetically modified food will be harmful to my health or my family's health?
c. Genetically modified food threatens the natural order of things?
d. I think it is safe for me to eat genetically modified food?
e. Serious accidents involving genetically modified foods are bound to happen?
f. I am sure about my opinions about genetically modified food?
g. I would buy genetically modified food if it contained less fat than ordinary food?
h. I would pay more for non-genetically modified food?
i. I would buy genetically modified food if it contained less pesticide residues than ordinary food?
j. I would buy genetically modified food if it were grown in a more environmentally friendly way than ordinary food?
k. I would buy genetically modified foods if it tasted better than ordinary food?
l. I would be prepared to take part in public discussions or hearings about biotechnology?
m. I would take time to read articles or watch TV

programs on the advantages and disadvantages
of biotechnology?
n. I would buy genetically modified food if it were
cheaper than ordinary food?
o. I think the potential benefits of genetic modifi-
cation outweigh the potential harms?

[P1 VERSION A ONLY]
p1. I would be unhappy if I were served genetically
modified food in a restaurant without knowing it?

[P2 VERSION B ONLY]
p2. If food I was eating in a restaurant contained
genetically modified food, I would not mind?

[Q'S 33 TO 35 VERSION B ONLY]

33. I'm now going to ask you about your involvement with the news. During the last week how often did you (insert item a to h individually), would you say never, once, more than once but not everyday, or everyday?
a. Read a newspaper?
b. Watch national news?
c. Watch local news?
d. Listen to talk radio?
e. Listen to public radio?
f. Listen to news radio?
g. Read a news magazine?
h. Get news through the internet?

34. Do you recall any events or news stories concerning genetically modified food?
1 – Yes
2 – No **(GO TO Q.36)**
8 – DK **(GO TO Q.36)**
9 – REF **(GO TO Q.36)**

35. What were they? **[DO NOT READ LIST. MULTIPLE RECORD]**
1 – Starlink
2 – Prodigene
3 – Soybeans
4 – Monarch Butterfly
5 – Pharmaceuticals in food supply
6 – Taco Bell taco-shells/taco-shells
7 – Dolly the Sheep
8 – Mexican Maize
9 – Something to do with corn
17 – Other (specify)
18 – Don't know
19 – Refused

[ASK ALL]

36. Would you rate your own basic understanding of science and technology as

[READ LIST]:
1 – Poor,
2 – Fair,
3 – Good,
4 – Very good, or
5 – Excellent?
8 – (vol) Don't know
9 – (vol) Refused

37. For each of the following statements, please tell me whether you think it is true or false? **[RANDOMIZE]**
a. There are bacteria which live on waste water?
b. Ordinary tomatoes do not contain genes, while genetically modified tomatoes do?
c. By eating a genetically modified fruit, a person's genes could also become modified?
d. It is the mother's genes that determine whether a child is a girl?
e. Yeast for brewing beer consists of living organisms?
f. Genetically modified animals are always bigger than ordinary animals?
g. It is not possible to transfer animal genes to plants?
h. Tomatoes genetically modified with genes from catfish would probably taste fishy?
i. Genetically modified foods are created using radiation to create genetic mutations?
j. The cloning of living things produces genetically identical copies?
k. More than half of the human genes are identical to those of chimpanzees?

38. Finally I have a few questions for classification purposes only. What was your age on your last
birthday?
(97 = 97 or older, 98 = DK, 99 = Ref)
39. **[IF "DK" OR "REF" IN 38:]** I don't need to know exactly. Are you: **[READ LIST]**
1 – 18 to 24
2 – 25 to 34
3 – 35 to 44
4 – 45 to 54
5 – 55 to 64
6 – 65 or older
8 – (vol) Don'tknow
9 – (vol) Refused

40. What is the last year or grade of school you completed? **[INTERVIEWER PROBE FOR THE LAST LEVEL OF FORMAL EDUCATION]**
1 – No formal schooling
2 – 1st thru 7th grade
3 – 8th grade
4 – Some high school (9th but didn't finish 12th)
5 – High school graduate/GED
6 – Some college/2 year Associate Degree
7 – Four year college degree
8 – Post graduate
9 – Refused

41. Are you presently employed full-time, part-time, in the military, unemployed,

retired and not working, a student, a homemaker, or are you disabled or too ill to work.
1 – Employed full-time
2 – Employed part-time
3 – In the military
4 – Unemployed
5 – Retired
6 – Student
7 – Homemaker
8 – Disabled/too ill to work
9 – Refused
42. Are you currently single, married, unmarried but living with a partner, separated, divorced or widowed?
1 – Single
2 – Married
3 – Unmarried but living with a partner
4 – Separated
5 – Divorced
6 – Widowed
8 – Don't know
9 – Refused

43. Including yourself, how many adults, 18 years or older, currently live in your household? **[RESPONSE MUST BE AT LEAST ONE. 98 = DK, 99 = REF]**

44. Do you have any children 17 years or younger living in the household?
1 – Yes 2 – No 8 – Don't know 9 – Refused
[REFER TO Q.41. IF EMPLOYED FULL OR PART TIME ASK:]

45. How many hours a week do you work on average? **[98 = DK, 99 = REF]**

46. During an average month, would you say you attend a church or other house of worship…**[READ LIST]**
1 – At least once a week,
2 – Several times a month,
3 – At least once a month,
4 – Less than once a month,or
5 – Never?
8 – (vol) DK
9 – (vol) REF

47. Regardless of the political party you might favor, do you consider yourself to be a liberal, conservative, or somewhere in between?
1 – Liberal **[GO TO Q.49]**
2 – Conservative **[GO TO Q.49]**
3 – Somewhere in between
8 – DK **[GO TO Q.49]**
9 – REF **[GO TO Q.49]**

48. Do you lean more toward the liberal side or more toward the conservative side?

1 – Liberal
2 – Conservative
3 – Somewhere in between
8 – Don't know
9 – Refused

49. Are you, yourself, of Hispanic origin or descent that is Mexican, Puerto Rican, Cuban, Central American, South American or some other Spanish background?
1 – Yes 2 – No 8 – DK 9 – REF

50. Are you white, black/African-American, Asian or Pacific Islander, Native American or of some other race?
1 – White
2 – Black/African-American
3 – Asian or Pacific Islander
4 – Native American
5 – Other (specify)
8 – Don't know
9 – Refused

51. Would you say your total household income for 2002 was below $50,000 or was it $50,000 or above?
1 – Below $50,000
2 - $50,000 or above
3 – DK
4 – REF

52. **[IF BELOW $50K]** Was it: **[READ CHOICES]**
1 – Under $25,000,
2 - $25,000 to $34,999, or
3 - $35,000 to $49,999?
8 – (vol) DK
9 – (vol) REF

53. **[IF $50K OR ABOVE]** Was it: **[READ CHOICES]**
1 – $50,000 to $74,999
2 - $75,000 to $99,999,
3 - $100,000 to $124,999, or
4 - $125,000 or more?
8 – (vol) DK
9 – (vol) REF

54. **[STATE READ IN FROM SAMPLE]**
[REFER TO Q.8. IF RESPONDENT EATS CORN FLAKES, BANANAS, GROUND BEEF "REGULARLY, FREQUENTLY,
OR OCCASSIONALLY" CONTINUE WITH Q55. IF "NEVER" TO ALL THREE FOODS THIS IS THE END OF THE
INTERVIEW. Say: Thank you very much for your cooperation. Have a nice day/evening.]

55. Your responses have been helpful to us. We are asking a select number of people to participate in a mail survey about food. To thank you for participating

in the mail survey you will receive $5.00. Would you be interested in participating?
1 – Yes 2 – No/Don't know **[END INTERVIEW – Thank you very much for your cooperation. Have a nice day/evening.]**
Please understand at this point I'll need to collect your name and address so that I can mail the questionnaire to you. Also please know that while you are no longer anonymous, your responses will still be. That is your name and address will not be linked to your responses.
[OBTAIN COMPLETE MAILING ADDRESS AND REPEAT TO RESPONDENT. ASK FOR SPELLING FOR VERIFICATION.]

Thank you very much for you cooperation. Please look for the survey in the mail within the next several days.

VITA

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Education:
B.S. Animal and Poultry Science
Virginia Polytechnic Institute and State University
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Work Experience:
Veterinary Assistant
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Graduate Teaching Assistant
Texas A&M University
AGEC 414: Agri-Marketing Analysis
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Graduate Assistant
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Awards, Honors, and Affiliations:
Virginia Tech AgEcon/NAMA club member 2001-2002
Virginia Tech NAMA President 2001-2002
Outstanding New Club Member, Virginia Tech AgEcon/NAMA club 2001-2002
Alpha Zeta Co-Ed National Agricultural Honor Fraternity Member
Herbert and Sylvia Stoevener Study Abroad Scholarship Recipient 2001
Texas A&M Regents Fellowship Recipient 2002-2003
National Capital Area Texas A&M Club Scholarship Recipient 2002-2003
Agricultural Economics Graduate Student Association Social Chairperson 2002-2003
Gamma Sigma Delta International Agriculture Honor Society Member
American Agricultural Economics Association student member 2002-2004