Assessing Public Preferences and Holistic Economic Value for Multifunctional Agriculture in the U.S.

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Multifunctionality of agriculture is gaining momentum in academics as a concept that plays a growing role in shaping public policies concerning agriculture around the world (Bergstrom, 2002; Burrell, 2001; Vanzetti and Wymen, 2004; Libby 2002; Vatn, 2002; Batie, 2003).[1] Multifunctional agriculture is a term integrating the nontrade concerns (NTCs) that have been coined during the Uruguay Round trade talks in the 1990s (preamble and article 20 of AoA) and the European Model of Agriculture (EMA) that has been in support of EU's Common Agricultural Policy (CAP) since 1980s. From a broader perspective, multifunctional agriculture is being suggested as a way of viewing agriculture's changing role in industrialized nations in the 21st century from a base solely for food production to a more inclusive one that encompasses ecosystem/environmental, cultural, rural development, and recreational management (Potter, 2002; Dobbs, 2002; Dobbs and Pretty, 2004).

The ultimate question about the concept of multifunctional agriculture is whether it can be legitimately institutionalized into WTO trade rules. The green box of the Uruguay Round trade talks was a major breakthrough in officially recognizing the demand for multifunctional agriculture and a critical step toward incorporating the concept into the design of domestic farm policies and trade rules. Yet, the system stirred a great deal of controversies because it was lacking detailed principles/guidelines determining the scope of the policies and the types of nonmarket goods and services permitted to be included in the box (Swinbank, 2001; Hudson et al, 2005; Paarlberg, Bredahl, and Lee, 2002).

[1] Multifunctional agriculture refers to nonmarket benefits (positive externalities) that agriculture produces jointly with varying degrees of jointness with either farmlands or market commodities. Such nonmarket benefits include national food security, rural amenities, recreational opportunities, cultural heritage, viability of rural communities, and a broad range of ecosystem services such as nutrient recycling, carbon sequestration, or groundwater recharge.

From an economic standpoint, three preconditions need to be met for the concept of multifunctional agriculture to be legitimately incorporated into domestic farm policies and global trade rules, thereby resolving the controversies surrounding the green box: (i) verifying the existence of social demand for each type of nonmarket goods and services of agriculture in a particular country and measuring the magnitude of such demand, if any, (ii) assessing whether the nonmarket goods and services are jointly produced either with farm commodities, or farm/rural lands (Abler, 2001), and (iii) assessing transaction costs associated with policies decoupled from production and targeted at specific nonmarket goods and services. [2] The second precondition is required to determine whether or not production (or farmlands/rural lands)-linked subsidies should be permitted, while the third is needed to compare the efficacy of decoupled and targeted policies with traditional ones in inducing optimal supply of nonmarket goods and services of agriculture.

This article undertakes to make a contribution to the first task in consideration that the assessment of the latter two tasks hinges on credible knowledge of public demand for the nonmarket goods and services of agriculture. Specifically, this article pursues two objectives: (1) assessing public preferences about the multifuncitional roles of the U.S. agriculture and USDA farm policies, and (2) holistically measuring monetary value of the entire set of multifunctional roles at the national level.

We use the contingent valuation method to address these two objectives in light of the strategy proposed by Randall (2002) that involves valuing the whole good and utilizing such a value as an upper bound to the sum of the values of all the local and particular component goods. The holistic approach is necessary given that there are likely to be

[2] Transaction costs refer to costs involved in designing and implementing the policies and monitoring results as well as costs to farmers such as learning about the program, deciding whether to apply for payments, and complying with audits and other reporting requirements. See Vatn (2001) for more details about transaction costs of targeted policies.

upward biases associated with individual valuation and summation (IVS) for the large number of multifunctional outputs geographically widely dispersed (Hoehn and Randall, 1989; Hoehn, 1991; Santos, 2000).[3]

We organize the article as follows. The next section provides a review of literature valuing multifunctional agriculture around the world. The third section presents the theoretical model, contingent valuation survey design, sampling, and survey administration process, followed by the fourth section describing how Yea-saying tendency associated with closed-ended format is addressed in our study. The fifth section shows WTP empirical model specifications using social psychological approach that combines Fishbein's model with mediation hypothesis. Estimation results are discussed in the sixth section, followed by concluding remarks.

Multifunctionality Valuation Literature

The literature on the valuation of multifunctional agriculture has been growing in recent decades particularly in Europe. Hall, McVittie, and Moran (2004) present a comprehensive review of research valuing multifunctionality of agriculture in the U.K. They reviewed 22 studies for the U.K. that use an array of methods including public opinion polls, experts survey, or nonmarket valuation methods such as contingent valuation and choice modeling approaches. The review overall presents a strong case for the existence of a considerable demand for the multifunctional roles of the U.K. agriculture.

There are some notable studies valuing multifunctional agriculture in other parts of the Europe. For example, using contingent valuation methods, Drake (1992) estimated the Swedes' willingness to pay to preserve the agricultural landscape and found that Swedish

[3] The IVS bias may arise primarily from three reasons: (i) failure to consider substitution effects on geographically separated multifunctional goods, (ii) aggregating the effects of a public policy on the large number of multifunctional outputs of agriculture, and (ii) people's psychological tendency to overvalue part of a whole good and undervalue the whole.

people were willing to pay 78 ECU per person annually. Brouwer and Slangen (1998) estimated the public benefits of agricultural wildlife management (peat meadow) in Netherlands and showed that visitors were willing to pay 84 Dutch guilders per household annually, while non-visitors were willing to pay 53 Dutch guilders. Consequently, 70 percent of a household's total WTP consists of a value that is not related to any past or present use of the amenities involved.[4] More recently, using choice experiments, contingent valuation, and Analytical Hierarchy Process, Kallas, Gomez-Limon, and Arriaza (2007) and Kallas, Gomez-Limon, and Hurle (2007) reported the existence of a significant demand for the multifunctional agriculture in Spain (*cereal steppes in Tierra de Campos*) with the demand heterogeneous across soci-economic characteristics.

Evidence is presented that Australian public (particularly urban dwellers) are willing to pay to maintain rural populations, demonstrating a positive nonuse (existence) value associated with rural communities (Bennett, Buren, and Whitten, 2004). This research focusing on Austrailia is noteworthy because it demonstrates that the demand for multifunctional agriculture is not exclusively unique to developed countries with high density of population. Oh (2003) estimated the nonmarket value of rice production in Korea using multiple valuation methods. He showed that its combined nonmarket value including food security, farmland amenities, flood control, purification of water and air, and ground water recharge was $ 8.75 billion, 98 percent of national gross revenue of rice, and 51 percent of agricultural GDP.

In contrast to the studies above conducted at the national level, most studies in the U.S. have been conducted at the state or county level. Bergstrom and Ready (2009) present a review of such studies valuing farmland amenity in an effort to identify factors driving

[4] Such a value is called "nonuse value and first introduced by Krutilla (1967) in his seminal paper entitled "Conservation Revisited".

consumers' willingness to pay for farmland preservation programs. They show that estimated willingness to pays for farmland amenity are influenced by increasing acreage, regional scarcity, alternative land uses, public accessibility, productivity quality, human food plants, active farming, and intensive agriculture. While most studies used nonmarket valuation methods including stated and revealed preference techniques to measure the demand for the multifunctional roles of agriculture, Kline and Wichelns (1994) and Kahn and Matsusaka (1997) used referenda voting records on farmland conservation programs in the Northeast region and on various environmental propositions in California, respectively. Similarly, Hellerstein et al (2002) probed legislations enabling farmlands preservation programs in 48 states in an effort to indirectly assess public demand for various nonmarket goods and services of agriculture, presuming that such legislations are reasonable manifestations of public preferences.

The above research presents evidence that the public in the U.S., particularly in some regions (e.g., Northeast and Pacific) value the non-market outputs associated with farmlands. However, there has been little systematic effort to measure public preferences or economic value for the nonmarket goods and services of agriculture at the national level in the US. The only exception is research by Variyam, Jordan, and Epperson (1990) investigating public attitudes toward governmental involvement in agriculture and policies to protect small farms using a national survey, although their study was not designed to assign economic value on farm policies or nonmarket goods and services of agriculture.

Valuation Design of Multifunctional Agriculture

Theoretical Model

To derive conceptual model underlying the valuation of multifunctional outputs of the U.S. agriculture, assume that an individual's utility is shaped by two types of goods: market goods $\mathbf{X}_i = (X_{i1}, X_{i2}, \ldots\ldots X_{iN})$ with prices $\mathbf{P} = (P_1, P_2 \ldots\ldots P_N)$ and multifunctional

(nonmarket) goods $\mathbf{Z_i} = (Z_1, Z_2, \ldots\ldots Z_M)$ available at zero price (Santos, 2000). The individual *i*'s utility function can be stated as,

(1) $\mathbf{U_i} = U_i (X_{i1}, X_{i2}, \ldots\ldots..X_{iN} ; Z_1, Z_2, \ldots\ldots Z_M) = \mathbf{U_i} (\mathbf{X_i}, \mathbf{Z_i})$

The individual is expected to maximize his/her utility given income constraint (y_i), prices (**P**), and the vector of multifunctional outputs (**Z**) as determined externally by farming practices and/or farm policies. Indirect utility function ($\mathbf{V_i}$) is obtained by substituting optimally determined vector $\mathbf{X_i^*}$ (**P**, yi, **Z**) into the direct utility function

(2) $\mathbf{V_i}\ [\mathbf{X_i^*}\ (\mathbf{P}, y_i, \mathbf{Z}), \mathbf{Z}] = \mathbf{Vi\ (P}, y_i, \mathbf{Z})$

Consider USDA farm policies that alters the quantity/quality of both market and nonmarket goods. As a consequence of such multidimensional policies, utility difference between the initial and alternative level can arise as shown below

(3) Welfare Change = $\mathbf{V_i^0 - Vi^1 = V_i^0\ (P^0}, yi^0, \mathbf{Z^0}) - \mathbf{Vi^1\ (P^1}, yi^1, \mathbf{Z^1})$

Given equation (3), the economic value that the consumer *i* place on the USDA policies can be defined using the welfare change measure of Hicksian compensating variation (HC_i)

(4) $\mathbf{V_i^0\ (P^0}, yi^0, \mathbf{Z^0}) = \mathbf{Vi^1\ (P^1}, yi^1 - HC_i, \mathbf{Z^1})$

HC_i denotes welfare change for consumer *i* that arises from the USDA policies, representing the amount of income that should be taken away (given) from the consumer *i* to restore welfare back to the initial utility. When the USDA policies increases the consumer's welfare, HC_i would denote the maximum amount of money (taxes) that the consumer is willing to pay for the policy, and the minimum amount of money (compensation) that the consumer is willing to accept when it decreases the consumer's welfare. Hence, maximum WTP (minimum WTA) represents the economic value that the consumer assigns to the USDA policies. Summing over individual taxpayers ($\sum HC_i = \mathbf{HC}$) gives the aggregate value of the USDA policies.

Survey Instrument Design and Ipsos Web-based Sampling

Contingent valuation survey instrument was designed to holistically measure the aggregate value **HC** (maximum WTP) for the multidimensional USDA public policies and to shed new light on the general public's perceptions and attitudes about the multifunctional roles of the U.S. agriculture.[5] The final questionnaire was administered as an online survey in June 2008 to a nationally representative web-based household panel maintained by the Ipsos-Observer, a market research/consulting firm specializing in research of consumer behavior on various social issues.

The sample was stratified by geographic regions, household income, education, and age in accordance with 2000 U.S. Census. Questionnaires were emailed to a sub-sample of 5,000 participants of this panel that was representative of the U.S. population. A total of 1,070 consumers completed the online survey within seven days, accounting for an impressive 39 % response rate. The on line survey elicited sociodemogprahic information including respondents' age, education, income, household size, geographic region, gender, and ethnic background.

The permission-based research approach is often used to explore consumer behavior because it offers two advantages-higher response rate and disclosure of demographic information for nonrespondents as well as respondents, thereby facilitating assessment of potential nonresponse bias. Comparison of socio-demographic characteristics between respondents and nonrespondents shows that males were more likely to choose not to respond (62 % vs. 56 %) and whites were slightly more prone to respond to our survey (87 % vs. 80.6). Other than these two categories, there are no major discrepancies between respondents and nonrespondents, suggesting that there is little reason to be concerned about potential biases due to systematic nonresponses from particular groups of nonrespondents.

The survey instrument consists of two major parts: (i) general survey, (ii) contingent

[5] The full survey instrument is available upon request.

valuation scenario. The general survey part includes various sets of questions on issues pertinent to the concept of multifunctional agriculture (e.g., family farm, farmland preservation, or government intervention in agricultural markets). In order to measure such concepts, some question items were drawn from Variyam, Jordan, and Epperson (1990) investigating citizens' preferences about U.S. farm policies. Additional set of 15 questions known as new ecological paradigm (NEP) in the literature was incorporated to measure respondents' perceptions of our ecology (Dunlap and Van Liere, 2008; Dunlap et al, 2000).

Contingent Valuation Scenario

The CV part of the survey instrument focused on measuring how consumers value the multifunctional roles of the U.S. agriculture. Specifically, the CV section asked respondents to consider the current U.S. agriculture with a particular emphasis on the positive and negative externalities associated with it and the role of USDA farm policies in dealing with them (see the Appendix for the entire information box). Further, the information box succinctly characterizes the USDA's policy goals as manifested in its strategic plan framework (USDA, 2008).[6] This strategic plan is directly connected with the preservation of the multifunctional roles of the U.S. agriculture. Given this information box, respondents were asked the following question.

> Suppose that government decides to hold a referendum designed to determine whether to keep spending [$ X billion] for agriculture for the foreseeable future. The referendum would indicate if you agree with the idea that agriculture provides intangible benefits/nonmarket goods and services and if you agree that the government should spend [$ X billion] of your annual taxes for continuing to support agriculture programs/subsidies that offset the negative environmental effects of farming, enhance rural economies, and boost farm incomes. If the referendum were rejected, your annual income taxes will be lowered accordingly. In short, this is asking how much the intangible benefits of agriculture are worth to you

[6] The strategic framework includes; (i) Enhancing international competitiveness of American agriculture, (ii) Enhancing the competitiveness and sustainability of rural and farm economies, (iii) Supporting increased economic opportunities and improved quality of life in rural America, (iv) Enhancing protection and safety of the Nation's Agriculture and Food supply, (v) Improving the Nation's Nutrition and Health, and (vi) Protecting and enhancing the Nation's Natural Resource Base and Environment

and how much of your tax dollars would you be willing to pay for them.

In this CV section, respondents face a tradeoff between the two choices: (i) paying [$X] taxes to continue to enjoy the benefits of nonmarket goods and services of the US agriculture and (ii) rejecting the referendum (paying reduced taxes by $X) and living without government subsidies for farming. The amounts of outlays designed to support agriculture [$ X billion, cost of farm policies] were varied from $20 billion to $220 billion. These numbers were determined based on annual USDA budget, focus group studies, and pretest result. The USDA annual overall budget ranged from $88 billion to $93 billion during the period of 2006-2008 (table 1 shows USDA budgets for various programs). To place these dollar figures in perspectives, the full value of farm production was ranging from $220 billion in 2000 to nearly $300 billion in 2007, while the net farm income was $66.6 billion in 2007. Pilot test result indicated that nearly 75 % of respondents (n=198) were willing to endorse the government to spend $60 billion annually (all of the 198 respondents faced the identical bid amount of $60 billion).

The above survey instrument was created, revised, and finalized through several preliminary steps including focus group studies, cognitive interviews, and pilot testing. To facilitate the researchers to understand how the general public viewed the issues related to the multifunctionality of the U.S. agriculture and to gain insights into designing survey instrument, four focus groups were convened through the Applied Research Consultants (ARC) group affiliated with the Department of Psychology at a University in Midwest. As a result of the completion of four focus groups, a survey instrument was developed for use during a series of 13 cognitive interviews in cooperation with the ARC group. The cognitive interview process involved two major steps: (i) administering draft survey questions, and (ii) collecting additional verbal information about the survey responses. The information gained was used to determine whether the questions were generating intended

information. Further, pre-test with a sample of 198 participants was conducted as an additional check prior to finalizing the survey instrument.

Closed-Ended Format and Yea-Saying Tendency

An array of approaches can be used to elicit consumers' willingness-to-pay for the multifunctional role of the U.S. agriculture. We chose closed-ended referendum format to avoid the problems associated with open-ended format and to take advantage of its merit of resembling actual referendum/market behavior.[7] Indeed, this property of the closed-ended format motivated the National Oceanic Atmospheric Administration (NOAA) panel to strongly recommend it when they convened in 1993 to evaluate the pros and cons of various CV survey question formats (NOAA 1993). The closed-ended format can be presented either in single-bounded or double-bounded formats, although the latter has been shown to be statistically more efficient when compared to the former.

A major controversy with the application of the contingent valuation method is potential hypothetical bias whereby respondents overstate the amount they are willing to pay for public or private goods of research interest. A number of studies present evidence that transactions typically addressed in CV questions are associated with hypothetical bias (e.g., Cummings, Harrison, and Elisabet, 1995; Loomis, Gonzalez-Caban, and Gregory, 1994). When it comes to hypothetical bias associated with closed-ended format, the problem is often manifested in the form of Yea-saying tendency (Holmes and Kramer, 1995). Brown et al (1996) argue that the closed-ended format is not likely to fulfill respondents' two objectives in responding to a WTP question: (1) respondents want to truthfully answer the question, and (2) they want to indicate how favorably they view the good at issue. While open-ended or

[7] The open-ended format usually produces an unacceptably large number of non-responses or "protest zero" responses given the cognitive challenge of ascribing a dollar value to say, a public good. Moreover, this format may encourage strategic underbidding or overbidding of WTP responses in an attempt to influence public policies related to the good in question.

payment card formats satisfy both these objectives, only "yes" responses indicate a positive attitude toward the good in the closed-ended format. If it is more important to indicate a favorable impression of the good than to indicate a truthful WTP, the respondent will say "yes". Hence, the two objectives may conflict with each other, causing Yea-saying tendency.

To address this yea-saying problem, we adopted DM (dissonance-minimizing) elicitation method as proposed by Blamey et al (1999). The DM elicitation method allows respondents to express multiple attitudes in closed-ended format question in anticipation of reducing respondents' dissonance between the two objectives above. Specifically, the CV survey presented the following four options;

(i) I agree agriculture provides intangible benefits and they are worth [$ X] per year to me and I would be willing to endorse the government to spend [$ X] out of my annual taxes,

(ii) I agree agriculture provides intangible benefits and the use of tax dollars but they are not worth per year to me

(iii) I agree agriculture provides intangible benefits but oppose the use of any public tax dollars.

(iv) I disagree agriculture provides intangible benefits regardless whether it costs me anything

If the referendum format were presented with binary options including only yes and no, we conjecture that some respondents who chose option (ii) would have chosen 'Yes' due to Yea-saying tendency. Hence, estimating willingness to pay with option (ii) treated as 'Yes' may produce an estimate that is likely to embed bias due to Yea-saying tendency. This research treats only respondents who chose option (i) as 'Yes'.

The option (iii) is considered as protest responses and a follow-up question was asked to distinguish those who are not true protesters;

i. I would allow our society to spend [$ X] for the intangible benefits provided by agriculture, if an alternative, acceptable way of collecting the money could be found.

ii. I would be willing to endorse the government to use tax dollars if I am convinced that is the only way of ensuring the intangible benefits provided by agriculture.

iii. I believe that the cost to pay for the intangible benefits provided by agriculture should be paid by market demand instead of by the government

Only those respondents who chose option (iii) were dropped from the data analysis.

We varied the amount of government outlays on agriculture from $20 billion to $ 220 billion in six steps including $60 billion, $100 billion, $140 billion, and $180 billion. They translate into $100, $300, $500, $700, $900 and $1100 per person 20 years old or older among the U.S. population. With the closed-ended question, a dichotomous choice (probit) model with modified likelihood function to allow for the varying sizes of threshold value (bid size) is estimated using the maximum likelihood procedure proposed by Cameron and James (1987). The modified discrete choice model to measure WTP for the multifunctional roles of the U.S. agriculture can be described as follows:

(1) $WTP_i^* = \mathbf{X\beta}_. + u_i$

$D_i = 1$ if $WTP_i^* => P_j$

$= 0$ otherwise i = 1, 2, .. , n; # of obs: j = 1, 2, .6: # of bids

where WTP_i^* denotes a continuous latent variable representing the maximum willingness to pay for the multifunctional roles of agriculture: ***X*** is a vector of explanatory variables shaping consumers' WTP^*; the error term u_i is distributed normally; and D_i is a binary variable indicating whether or not WTP_i^* exceeds P_j (bid size confronted by each individual ranging from $100 to $1100). Hence, the probability function can be expressed as,

(2) $Prob\ (D_i = 1) = Prob\ (WTP_i^* > P_j) = Prob\ (u_i > Pi - \mathbf{X\beta})$

$= Prob\ (ui/\Phi - (P_j - \mathbf{X\beta})/\sigma)$

$= 1 - \mathbf{\Phi}\ (P_j - \mathbf{X}\ \boldsymbol{\beta})/\sigma$

where Φ (.) is the cumulative standard normal distribution function: ϙ is standard deviation of error terms. The modified log likelihood function becomes,

(3) $log\ L = D_i \log [1 - \mathbf{\Phi}\ (P_j - \mathbf{X\beta})/\sigma]$

$+ (1 - D_i) \log [\mathbf{\Phi}\ (P_j - \mathbf{X\beta})/\sigma]$

In contrast to the conventional probit model, the log likelihood function can be maximized with respect to both the vector of parameters (**β**) and the standard deviation (σ), using general nonlinear function optimization programs. The presence of P_j in the log likelihood function enables us to identify the scale of the underlying continuous measures of willingness-to-pay

for the multifunctional roles of agriculture (Cameron and James 1987). Therefore, the conditional mean WTP can be calculated simply with $\mathbf{X}\hat{\boldsymbol{\beta}}$ evaluated at the mean values of the vector ($\mathbf{X}$).

Model Specification

Social Psychological Approach

We use social psychological approach as a theoretical framework to guide our empirical model specification for the multifunctional roles of agriculture. Social psychological approach has been frequently applied to environmental valuation studies. For example, Kotchen and Reiling (2000) combine attitude-behavior theory with economic valuation technique to explore the relationship among environmental attitudes, nonuse values for endangered species, and underlying motivations for CV responses. Hyytia and Kola (2006) examines Finnish citizen's attitudes towards multifunctional agriculture and link them to consumers' willingness to pay. In general, social psychology literature refers primarily to the tradition of Ajzen-Fishbein's theory of reasoned behavior.

Under the premise that stated willingness-to-pay represents behavioral intentions toward nonmarket goods and services of the U.S. agriculture, Fishbein's theory implies that consumers' WTP is determined by their attitudes toward multifunctional agriculture. Such attitudes are in turn determined by consumer perceptions about salient attributes associated with the multifunctional roles of the U.S. agriculture. The theory implies causal flows from attributes to attitudes and from attitudes to behavioral intentions (Moon et al, 2004).

Mediation Model

We use mediation model as proposed by Baron and Kenny (1986) to operationalize Fishbein's theory in modeling the linkages among behavioral intentions, attitudes, and attributes. The central idea of the mediation model, when coupled with Fishbein's theory, is that attitudes mediate the effects of attributes on behavioral intentions (willingness to pay).

To test this hypothesis, Baron and Kenny suggest that four criteria be examined (as shown in Figure 1): (i) attitudes have a significant effect on behavior (path c); (ii) attributes have a significant effect on attitudes (path b) ; (iii) attributes have a significant effect on WTP (path a), and (iv) when both attitudes and attributes are included in the WTP model, attitudes are significant, while attributes are no longer significant or the size of effect is diminished. In accordance with these criteria, four conceptual models are developed below.

(4) Attitudes = f (Attributes associated with multifunctionality of agriculture)
(5) Willingness to pay = f (Attitudes toward multifunctional roles of agriculture)
(6) Willingness to pay = f (Attributes)
(7) Willingness to pay = f (Attitudes, Attributes)

Attitudes toward the multifunctional roles of agriculture (**Att_M**) are constructed from two question items: (i) agriculture produces intangible goods and services, and (ii) government should compensate farmers for their supply of such intangible goods and services. These questions were asked immediately after respondents were exposed to the information box of the U.S. agriculture (see Appendix for the full script) and before the willingness to pay questions were asked.

Attributes of Multifunctional Agriculture

Four attributes are identified as salient that underlie public attitudes and behavioral intentions toward the multifunctional agriculture: government involvement in agricultural markets (**Gov_Int**), family farms (**F_farms**), farmland preservation (**Farmland**), and environmental/ecological integrity (**Eco_sys**).

Government involvement in agricultural market has been seriously contested and debated since 1980s in the U.S. given the argument of the market-oriented reformers that returns to farm resources (labor and capital) became comparable to those in nonagricultural sectors. The market-oriented reformers indicate that government intervention should be replaced with risk management tools, while advocates of traditional government support

argue that farming sector is not viable without government involvement because of intrinsic uncertainties in farm production and prices (Tweenten, 2002). We hypothesize that respondents who are in favor of government involvement are more likely to be willing to endorse the government to spend taxes for supporting agriculture.

There is a sentiment among some people that farmland represents an important national asset that needs to be protected from poorly considered development plans (Libby, 2002). In support of this sentiment, there is a broad range of farmland preservation programs/policies at federal, state, and local government levels. Such farmland preservation programs are in recognition of the various ecological and amenity services associated with actively farmed land (Hellerstein et al, 2002). We anticipate a positive relationship between respondents' perceptions about the farmland preservation programs and willingness-to-pay taxes.

Concern has been growing about corporate-style farms increasingly replacing family farms (Rosset, 2000). USDA recognizes the protection of family farms as one of its missions in acknowledgment of the benefits that they offer to our society in the form of fostering diversity (ownership, cropping systems, landscape, biological organization, culture and traditions), environmental benefits, and empowerment and community responsibility. We hypothesize that respondents who sympathize that family farms should be preserved would be more likely to be willing to endorse the government to use tax monies to support agriculture.

Another important attribute of multifunctional agriculture is environmental/ecological conservation (Antle and Valdivia, 2006; Antle and Stoorvogel, 2006). In fact, agri-environmental programs of the USDA has been expanding rapidly in recent years as demonstrated in the creation of conservation security payment (CSP) and environmental quality incentive payment (EQIP) on working agricultural landscapes in

contrast to conservation reserve program (CRP) of 1980s which was targeted at idling highly erodible land. We used revised version of NEP (new ecological paradigm) to measure consumers' perceptions about ecological issues (Dunlap and Van Liere, 2008; Dunlap et al, 2000). Revised NEP consists of 15 questions measuring five aspects of environmental attitudes: (i) reality of limits to growth; (ii) anti-anthropocentrism; (iii) the fragility of nature's balance; (iv) rejection of the idea that humans are exempt from the constraints of nature; and (v) the possibility of an eco-crisis or ecological catastrophe (Kotchen and Reiling, 2000). From these 15 question items, we developed an index consisting of seven question items reflecting optimistic views (**Eco_sys**).

Table 2 shows question items used to construct indices measuring respondents' attitudes toward multifunctionality of agriculture and perceptions about each of the four attributes along with summary statistics.

Empirical Analysis

Table 3 presents the distribution of responses to WTP questions across the six different sizes of taxes. The Ipsos sample (N=1076) was divided into six groups with each of them being exposed to different bid amounts ($100, $300, $500, $700, $900, $1100). The size of the subgroups were n=176, 180, 200, 163, 167, and 184, respectively. The percentage of respondents saying 'Yes' decreases from 64.2 % (for $100) to 38.3 % (for $900) and to 40.2 % (for $1100). Consistent with our prior expectation, the percentage of respondents (corner solutions) indicating that they believe the multifunctional agriculture has certain value to them but not quite the amount of dollars given in the questionnaire increases from 13.6 % (for $100) to 34.8 (for $1100). The percentage of protest responses were fairly stable (ranging from 19.3 % to 22.8 %) across the six different sizes of annual taxes, whereas those of "no" responses increases from 2.8 % and 3.9 % (for $100 and $300) to 6.5 % for $1100. Table 4 shows the distribution of responses to two questions measuring respondents'

attitudes toward the multifunctionality of the U.S. agriculture. About 64 % of respondents (combining response options of 5, 6, and 7) agree that agriculture produces intangible goods and services beyond market commodities. However, when it comes to the question of whether the government should compensate farmers for such nonmarket goods and services, the percentage decreases to 45.6 %. The decrease indicates that attitudes toward multifunctionality of agriculture differ from those toward government involvement designed to address market failures associated with multifunctional agriculture.

WTP Regression Models

Corresponding to conceptual models (4) through (7), we estimate the following four regression models that shed light on individual characteristics driving willingness to pay for the multifunctional roles of the U.S. agriculture.

(8) $\mathbf{Att\_M} = \beta_0 + \beta_1 \boldsymbol{\Gamma} + \boldsymbol{\gamma}\, \mathbf{Z} + \boldsymbol{\varepsilon}$

(9) $\mathbf{WTP} = \beta_0 + \beta_1\, \mathbf{Bid} + \beta_2\, \mathbf{Atti\_M} + \boldsymbol{\varepsilon}$

(10) $\mathbf{WTP} = \beta_0 + \beta_1\, \mathbf{Bid} + \beta_2\, \boldsymbol{\Gamma} + \beta_3\, \mathbf{Z} + \boldsymbol{\varepsilon}$

(11) $\mathbf{WTP} = \beta_0 + \beta_1\, \mathbf{Bid} + \beta_2\, \mathbf{Atti\_M} + \beta_3\, \boldsymbol{\Gamma} + \beta_4\, \mathbf{Z} + \boldsymbol{\varepsilon}$

Dichotomous willingness-to-pay models (**WTP**) commonly include **Bid** as an explanatory variable. $\boldsymbol{\Gamma}$ is a vector including the four attributes that underlie consumers' attitudes toward multifunctionality of agriculture: $\boldsymbol{\Gamma}$**= [Gov_Int, F_farm, Farmland, Eco_sys**]; **Z** is a vector that involves socio-economic, demographic, and geographic regional variables: **Z = [Income, Age, Geographic regions, Ethnicity**]. Equation (8) links attitudes toward multifunctional roles of the U.S. agriculture to attributes hypothesized to underlie such attitudes; equation (9) estimates the relationship of WTP to bid size and attitudes; equation (10) links WTP to only attributes; and equation (11) incorporates both attitudes and attributes in explaining WTP.

Estimation Results

Testing Mediation Hypothesis

Table 5 presents estimated results of the four regression models from (8) to (11).

Comparing estimated coefficients across equations (8) through (11) allows us to assess whether **Att_M** mediates the effects of the four attribute variables on WTP. Upon applying the four criteria of Baron and Kenny, the following two conclusions can be drawn as to the mediation hypotheses. First, attitudes almost completely mediate the effect of **F_farms**; i.e., the size of coefficient for **F_farms** decreases from β=0.04896 (t=2.76) in equation (10) only with attributes to β=0.01353 (t=0.718) in equation (11) with both attitudes and attributes. The coefficient in equation (11) is not statistically different from zero, indicating that **F_farm** affects WTP only indirectly through **Att_M**. Second, the size of coefficients for **Farmland** and **Gov_Int** decreases modestly from β=0.0825 (*t*=6.11) and β=0.0735 (*t*=6.769) in equation (10) to β=0.0467 (*t*=3.218) and β=0.0586 (*t*=5.193), respectively, in equation (11). These results indicate that **Farmland** and **Gov_Int** affect WTP directly as well as indirectly through **Att_M**. In other words, the effects of **Farmland** and **Gov_Int** are partially mediated by **Att_M**.

Estimated Coefficients of Attributes

We use the estimation results of equation (11) for interpretation and calculation of mean WTPs for the multifunctional roles of the U.S. agriculture. Two variables (**Bid** and **Income**) related to economic incentives are of particular significance given the results of these variables play an important role in evaluating the validity of nonmarket valuation research using stated preference methods. The size of bids (**Bid**) is highly significant, clearly indicating that respondents were sensitive to the size of bids in their decisions of whether or not to endorse the government to use taxes to support agriculture. Using the estimated coefficients of equation (11), we simulated how the cumulative probability of willingness to pay changes in response to the six different bid sizes. Figure 2 shows that the likelihood of willingness to endorse the government to use their taxes is about 74 percent when the bid size is $100, and such likelihood decreases to 44 percent when the bid size

increases to $1100. This represents nearly 30 % difference in the probability of willingness to pay between consumers exposed to bid sizes $100 and $1100. Income is a significant determinant of consumers' preferences about the multifunctional roles of agriculture, suggesting that as income increases, so does the likelihood of willingness to pay.

In sum, the results of these two variables (**Bid** and **Income**) indicate that respondents considered the cost of farm programs and stated their preferences in line with their financial ability, presenting an internal validity to our contingent valuation design.

Compatible with the Fishbein's theory, consumers' attitudes toward the multifunctional roles of agriculture (**Att_M**) was exerting highly significant impact on their WTP. Drake (1991) shows that willingness to pay for the preservation of agricultural landscapes is significantly correlated with positive attitudes towards the idea of preserving agricultural landscapes. Brouwer and Slangen (1998) show that attitude toward paying for public environmental goods is a significant variable explaining willingness to pay for the agricultural wildlife management (peat meadow) in Netherlands.

The coefficient of **Gov_Int** had a negative and statistically significant effect, suggesting that respondents not favorable to government involvement in agricultural markets are predisposed to be less willing to pay for the multifunctional roles of agriculture. Indirectly supporting our result, Variyam et al (1990) reported that Democrats and Independents were more likely to favor farm support policies compared to Republicans. Respondents who are in support of the idea of farmland conservation programs (**Farmland**) turned out to be more willing to pay taxes to ensure that agricultural sector continues to play the role of supplying nonmarket goods and services it produces jointly with market commodities. Foltz and Larson (2002) present a similar result that residents in Connecticut in support of preserving farms for future generations are more likely to endorse PDR (purchase of development rights) program.

Comprising of seven question items, **Eco_sys** is an index variable that represents how optimistically respondents view the environmental/ecological state of our world. **Eco_sys** had a statistically significant and negative sign, indicating that consumers who have optimistic views of our environment are predisposed to be less willing to pay for the multifunctional roles of the U.S. agriculture. Kotchen and Reiling (2000) show that NEP scale had a statistically significant effect on willingness to pay for the preservation of endangered species (peregrine falcon and shortnose sturgeon).

When combined with the results of **Bid** and **Income,** statistically significant and theoretically consistent effects of these attribute variables reinforce the construct validity of this study.

The coefficient estimates for geographic regional dummies indicate significant differences in willingness to pay taxes between New England and other regions: i.e., consumers from the region of New England were more likely to be willing to pay taxes to support the multifunctional roles of agriculture than any other regions. This result is consistent with prior studies: i.e., Variyam et al (1990) showed that individuals from the Northeast were likely to be more supportive of a governmental role in agriculture; and Hellerstein et al (2002) found that the greatest interest in preserving rural amenities are in the farmland protection legislation of the more densely populated States such as Northeast or Pacific regions.

Mean WTP Estimate

Based on the estimated coefficients of equation (11), we computed mean WTP. The estimated mean WTP was $515 per person annually. We constructed confidence interval for the estimated mean WTP using bootstrapping method and it ranges between [$ 381.94, $ 622.56] at α=0.05 % level. Aggregation of individual WTPs across the U.S. taxpayers above 20 years old amounts to $105 billion. Note that the estimated WTP is conditional on

several factors specific to our research design including: (i) the information given by our CV scenario, (ii) the particular bid design, and (iii) the referendum WTP elicitation format used in this study. With these conditions in mind, the amount of $105 billion represents a crude estimate of the economic value that the U.S. consumers place on the multifunctional roles of the U.S. agriculture. The estimated aggregate value of multifunctional agriculture is about one-third of the value of total farm production ($300 billion) in 2007.

To visualize how sensitive the estimated WTPs are to changes in explanatory variables used in this study, we conducted simulations using the estimated coefficients of equation (11) with regard to **Gov_Int**. Figure 3 shows simulated WTP in response to the scale of **Gov_Int** ranging from 3 (no opposition to government involvement in agriculture) to 21 (strong opposition). Consumers with no opposition are willing to pay $ 1089 to compensate farmers for their supply of the multifunctional outputs of agriculture, while the amount of willingness to pay is $179 when consumers are strongly opposed to government intervention in agriculture. The simulation analysis demonstrates that the amount of taxes consumers would be willing to pay vary widely in association with consumers' beliefs about salient attributes that underlies their behavior toward the multifunctional roles of agriculture.

Conclusions

This study used contingent valuation method to shed light on public preferences about and to present a crude estimate of the economic value of the nonmarket goods and services of the U.S. agriculture. We used referendum format to elicit the amount of taxes that respondents would be willing to pay to compensate farmers for their supply of various nonmarket goods and services associated with agriculture. Dissonance Minimizing method was adopted to cope with 'Yea'-saying tendency associated with referendum format. Social psychological approach and mediation hypothesis was combined to model the relationship between behavioral intentions (WTP) and sets of explanatory variables including attitudes,

perceived attributes (about family farms, farmland preservation programs, government involvement in agricultural markets, and ecological state of our world), and socio-demographic profiles.

Estimated results show that consumers' willingness to pay taxes for the multifunctional roles of the U.S. agriculture is shaped by how they view family farms, farmland conservation programs, government intervention in agricultural markets, and ecological state of our world. Further, the results show that, while exerting a highly significant impact on WTP, attitudes mediate the effects of the four attribute variables on WTP: i.e., the four attributes influence WTP directly as well as indirectly through attitudes. In particular, the significant association of **Eco_sys** with willingness to pay taxes for the multifunctional roles of the U.S. agriculture is noteworthy given that this article is the first attempt linking NEP (new ecological paradigm) index to economic valuation of multifunctional agriculture. The result of **Eco_sys** demonstrates that ecosystem protection is an important component of the nonmarket goods of agriculture that the U.S. general public expects from the governmental intervention in agriculture (Antle and Stoorvogel, 2006; Swinton, 2008; Kraft, 2008; Ruhl, 2008).

The valuation scenario in this research can be interpreted as assessing whether the public approves the current size of USDA outlays designed to subsidize/support agriculture. Estimated value of the multifunctional outputs of the U.S. agriculture ($105 billion) suggests that the public overall renders strong endorsement of the USDA outlays in recent years and justify government involvement in agriculture, although our study offers little insights into the specific question of where the budget should be spent.

In closing, this study represents an effort to holistically measure the monetary value of and expand the body of empirical evidence on public preferences of the multifunctional outputs of the U.S. agriculture. Given the holistic nature of the description of the

multifunctional outputs to be valued in our CV scenario, further research is needed with valuation scenarios that define the multifunctional outputs in a more concrete manner.

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Table 1, United States Department of Agriculture Annual Budgets, 2006-2008.

	2006(in $ million)	2007	2008
Farm and Foreign Agricultural Services	27,910	20,993	19,620
Rural Development	3,254	2,957	2,842
Food, Nutrition, and Consumer Services	53,003	55,401	56,885
Food Safety	838	838	925
Natural Resources and Environment	8,301	8,218	7,366
Marketing and Regulatory Programs	2,190	1,736	1,873
Research, Education, and Economics	2,632	2,646	2,641
Total	$93,533	$88,767	$89,026

Table 2. Description and summary statistics of variables used in estimation.

Variable	Description	Mean	Alpha	St. Dev.
Attitudes Toward Multifunctional Agriculture **(Att_M)**	1. I agree agriculture provides intangible benefits that can not be sold	5.16		1.44
	2. Government should compensate farmers for the intangible benefits produced by agriculture	4.40		1.45
Government Intervention in Agricultural Markets **(Gov_Int)**	1. The government should reduce their involvement in agriculture to a level comparable with other sectors of the economy	4.25	0.727	1.59
	2. Farmers should compete in a free market without government support	4.18		1.61
	3. Government should guarantee a minimum price to farmers for their products	3.36		1.75
Family Farms **(F_Farms)**	1. The family farm should be preserved because it is a vital part of our cultural heritage	5.32	0.871	1.48
	2. Obtaining greater efficiency in food production is more important than preserving the family farm	3.30		1.59
	3. Government should have a special policy to ensure that family farms survive	4.94		1.58
Farmland Preservation (Farmland)	1. Farmland should be protected from urban sprawl	5.43	0.712	1.35
	2. There should be no developmental restrictions on the use of farmland	4.80		1.44
Environmental/Ecological Issues (Eco_sys)	1. The earth has plenty of natural resources if we just learn to develop them.	3.35	0.893	1.65
	2. Humans have the right to modify the natural environment to suit their needs	3.49		1.82
	3. Humans were meant to rule over nature			
	4. The balance of nature is strong enough to cope with the impacts of modern industrial nations	3.39		1.64
	5. Human ingenuity will ensure that we do not make the earth unlivable	4.00		1.63
	6. Humans will eventually learn enough about how nature works to be able to control it	3.81		1.64
	7. The so-called ecological crisis facing human kind has been greatly exaggerated	3.33		1.87
		3.55		1.49

Socio-Demographics		
Age	In years	39.3
Education		
	1=Grade, 2=Some high, 3=High graduated, 4=Some college, 5=2 year college, 6=4 year college, 7=Some post graduate, 8=Post graduate degree	4.8
Gender	1 if Male; 0 otherwise	0.56
Ethnic Background		
White	1 if Whites; 0 otherwise	0.87
Asian	1 if Asian; 0 otherwise	0.45
Black	1 if Black; 0 otherwise	0.43
Household Income	From 1=under $5000 to 25=over $250,000	13.2
Geographic Regions		
	New England	0.045
	Middle Atlantic	0.143
	East North Central	0.157
	West North Central	0.085
	South Atlantic	0.185
	East South Central	0.057
	West South Central	0.089
	Mountain	0.083
	Pacific	0.153

Note: Seven-point ratings of agreement (1 = strongly disagree; 7 = strongly agree) were used to measure perceived health benefits, taste, convenience and price, health motivation, and nutritional awareness. Alpha represents Cronbach's measure of internal consistency.

Table 3. Distribution of responses to willingness to pay question across the six different sizes of taxes

	$100		$300		$500		$700		$900		$1100	
Yes	113	64.2%	100	55.6%	89	44.5%	72	44.2%	64	38.3%	74	40.2%
Corner solution	24	13.6%	35	19.4%	60	30.0%	51	31.3%	56	33.5%	64	34.8%
Protest	34	19.3%	38	21.1%	38	19.0%	30	18.4%	38	22.8%	37	20.1%
No	5	2.8%	7	3.9%	13	6.5%	10	6.1%	9	5.4%	9	4.9%
Total	176	100.0%	180	100.0%	200	100.0%	163	100.0%	167	100.0%	184	100.0%

Table 4. Distribution of responses to questions measuring attitudes toward multifunctionality of the U.S. agriculture

	(1) Disagree Strongly	(2)	(3)	(4) Neither Agree Nor Disagree	(5)	(6)	(7) Agree Strongly
Agriculture produce intangible goods and services	26 (2.4 %)	18 (1.7 %)	40 (3.7%)	298 28 %)	239 (22 %)	189 18 %)	260 (24 %)
Government should compensate farmers for their supply of such intangible goods and services	58 (5.4%)	43 (4.0 %)	101 (9.4 %)	288 (27 %)	269 (25 %)	121 (11.3 %)	99 (9.3 %)

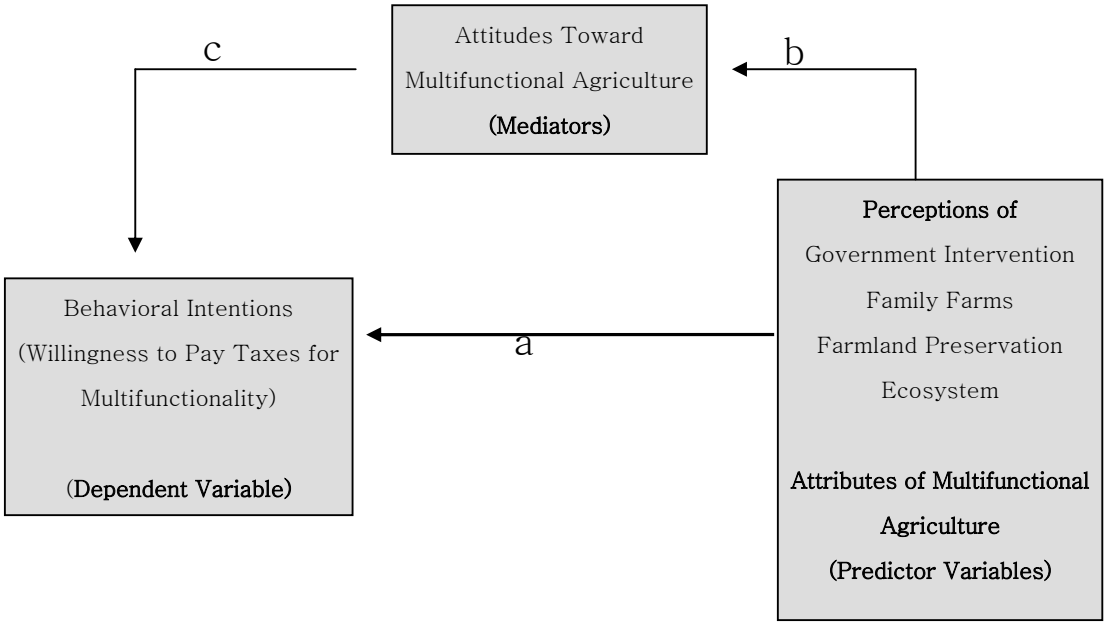

Figure 1. Mediation Model Linking Willingness to Pay to Attitudes and Attributes.

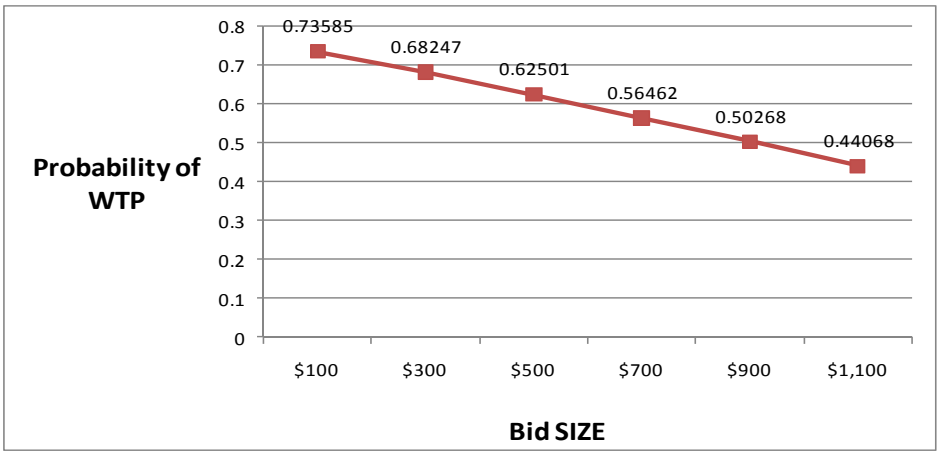

Figure 2. Effect of Bid Sizes on Probability of Willingness to Pay Taxes to Support the Supply of Multifunctional Outputs of Agriculture.

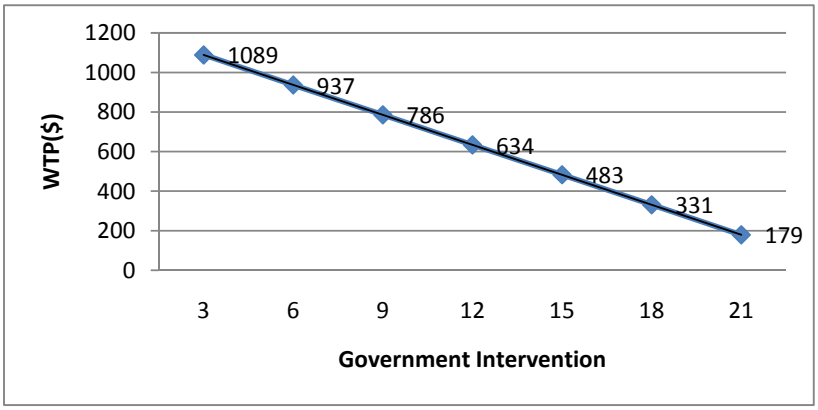

Figure 3. Simulated willingness to pay in connection with the scales of **Gov_Int** (3-21)

Appendix

Less than 2% of the U.S. population is currently engaged in farm production. While the U.S. both imports and exports food, the U.S. is essentially self-sufficient in terms of being able to produce the food it needs for its population. However, some other countries are not so lucky and have a strategic goal of achieving a socially acceptable minimum level of self-sufficiency in terms of food production. This minimum level is desired in order to promote national food security (defined as an access to a sufficient amount of food in crises such as war and disruptions in crop supply due to adverse weather).

Intensively managed farming practices using pesticides, fertilizers, and herbicides can negatively impact the environment, polluting ground and surface water. However, when these negative effects are controlled, the U.S. agricultural system is able to produce a wide range of positive effects on the environment including ground water purification, reduction of carbon in the atmosphere, increase in wildlife habitat areas, and recycling nutrients back into the soil. Some people also believe that farmland increase the amount of open space in the country with the aesthetics and amenities open space provides. And that it also enriches our culture by continuing the farming heritage.

Therefore, U.S. agriculture produces not only products for sale (e.g., market commodities such as corn and soybeans), but also provides us with intangible benefits (such as national food security, positive environmental impact, open space, and cultural heritage) that cannot be traded in markets. While farmers are not paid for providing these intangible goods and services, everyone in our society is able to experience agriculture's direct and indirect benefits. Further, people may attach value to the mere existence of farms in our country. Although it is difficult to place a monetary value or price on these intangible goods and services, people would sorely miss these intangible benefits if they were not there.

U.S. agricultural policies have played an important role in shaping today's agriculture. The policies include programs/subsidies that offset the negative environmental effects of farming, enhance rural economies, and boost farm incomes. These policies are at least partly in place in recognition of the intangible goods and services agriculture provides to our society. While the cost of these programs/subsidies vary year by year, the U.S. government spends on average approximately [$X billion], which translates into about **[**$Y] per each person 20 years and older per year.

Table 5. Estimation Results for Willingness to Pay for Multifunctionality of the U.S. agriculture.

	Attitude: Equation (8)		**WTP: Equation (9)**		**WTP: Equation (10)**		**WTP: Equation (11)**	
	Estimates	*t*-values	Estimates (β_1)	*t*-values	Estimates (β_2)	*t*-values	Estimates (β_3)	*t*-values
Constant	3.7944***		-1.8634***	-9.454	-0.0468	-0.107	-0.7377*	-1.6127
Bid	___	___	-0.0007***	-5.994	-0.0007***	-5.780	-0.0007***	-6.1917
ATT_M	___	___	0.2335***	12.004	__	__	0.1919***	8.1576
Gov_Int	-0.1035***	-6.937			-0.0733***	-6.759	-0.0591***	-5.247
F_Farms	0.2235***	9.172			0.0501**	2.876	0.0117	0.631
Farmland	0.2217***	12.24			0.0835***	6.305	0.0454***	3.170
Eco_sys	0.0073	0.932			-0.0215***	-3.819	-0.0250***	-4.286
INCOME	0.0013	0.142			0.0215***	3.267	0.0224***	3.312
AGE	0.0027	0.719			0.0045*	1.709	0.0042	1.562
Geographic Regions[1]								
MIDATL	-0.2707	-0.864			-0.4446*	-1.983	-0.3927*	-1.716
ENORCEN	0.0274	0.088			-0.4075*	-1.846	-0.4068*	-1.806
WNORCEN	-0.3826	-1.133			-0.4665*	-1.931	-0.4051*	-1.634
SOUATL	0.3271	1.074			-0.4188*	-1.924	-0.4852**	-2.179
ESCEN	-0.4163	-1.137			-0.0721	-0.278	-0.0019	-0.007
WSCEN	-0.0325	-0.096			-0.4326*	-1.799	-0.4289*	-1.746
MOUNTAIN	-0.1778	-0.525			-0.3965*	-1.639	-0.3734	-1.502
PACIFIC	-0.2122	-0.678			-0.5286**	-2.377	-0.4911*	-2.164
Ethnic Background[2]								
BLACK	-0.5646*	-1.93375			-0.2589	-1.199	-0.1700	-0.768
ASIAN	-0.2654	-0.89706			0.2197	1.075	0.2757	1.316
OTHERS	0.5339	0.92772			0.0795	0.192	-0.0133	-0.031
HISPANIC	0.2753	1.5882			-0.0707	-0.599	-0.1353	-1.124
R-Square	0.3479		0.1751		0.1947		0.2559	
Correct Prediction(%)	___		0.6869		0.6747		0.7093	
LR (zero slopes) Test	29.4 [.000]		192.4[.000]		214[.000]		284 [.000]	

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. [1]New England was dropped as a base. [2] White was dropped as a base.