An Analyst's Guide to Willingness-to-pay for Use in Cost-Benefit Analyses

This paper defines, illustrates and critiques the different ways that researchers have contemplated and estimated a consumer's willingness-to-pay for a particular attribute of a good or service. Particular attention is given to the case in which the attribute in question is the information about the good or service. A model cost-benefit analysis is presented and discussed as an example of how the measurement of willingness-to-pay can demonstrate market failure, thereby helping to inform consumer policy.

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Introduction

Over the past several years, a number of articles have appeared in consumer-related journals attempting to measure willingness to pay for given attributes of a particular consumer good. While the majority of these articles have been careful empirical examinations, and included insights into the particular market and attribute concerned, what has been missing from this literature is a careful and exhaustive treatment of willingness to pay as a construct and as a policy tool. In the majority of the articles previously mentioned, the different ways of measuring a consumer's willingness-to-pay, and the advantages and disadvantages of each strategy, is given little attention. Few efforts have been devoted to the theoretical construct which willingness-to-pay is designed to measure. Several chapters of Caswell (1991) give a good review of the former, but a well-developed theoretical discussion of willingness to pay, particularly as it applies to information attributes, is hardly seen. This paper is an attempt to fill this gap.

Section II introduces the concept of willingness-to-pay and it's measurement in abstraction. Section III is a catalogue of different ways that researchers have used to measure a consumer's willingness-to-pay for a product with enhanced attributes. Section IV illustrates the importance of willingness-to-pay by using it in a hypothetical cost-benefit analysis. In the process, this last section illustrates the importance of willingness-to-pay with respect to consumer policy analysis, and the theoretical and empirical hurdles that arise when the attribute being analyzed is information about a product. Section V is a summary of the main points of the article.

Modeling Willingness-to-pay

The Case of a Price Change

The theoretical literature has paid much more attention to willingness-to-pay for a price change than willingness-to-pay for any other attribute of a good. Consumer's willingness to pay for a price change is equal to the amount of change in consumer surplus caused by a price change, holding utility constant. Therefore, the area under the Hicksian (compensated) demand curve is an exact measure of consumer's willingness to pay, while the area under the Marshallian (uncompensated or ordinary) demand curve can be regarded as only an approximation.

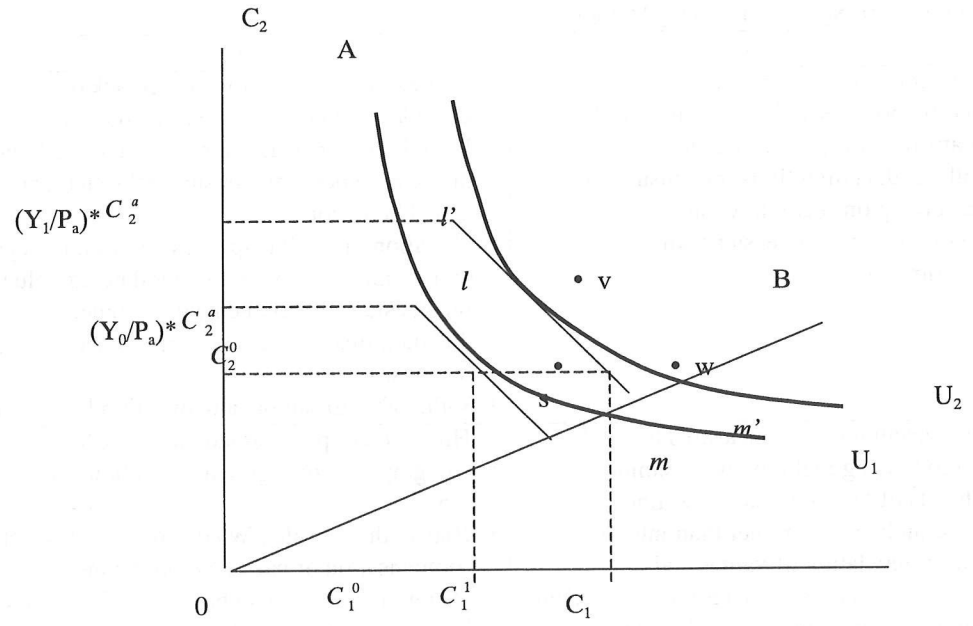
Depending on the underlying consumer's utility level, that is, whether based on an original or a subsequently proposed level, we can employ *compensating variation* or *equivalent variation* to measure consumer's willingness-to-pay. By definition, compensating variation is the amount of income that should be taken away from (or paid to) the consumer to make her remain at the initial level of welfare, whereas equivalent variation is the amount of income that should be given to (or received by) the consumer to make her as well off after as before the change. Hence, the compensating variation for a price fall can be interpreted as the maximum amount of money income the consumer would be willing to pay for the price reduction, while the equivalent variation for a price rise can be interpreted as the maximum amount of money the consumer would be willing to pay to avoid the higher price (Just, Hueth, & Schmitz, 1982).

The Case of an Attribute Change

Although the amount of consumer's willingness to pay for an attribute change may be different from that in the case of a price change, the underlying theoretical logic is identical. Consumers are willing to pay the amount of money represented by the difference between consumer surplus before and after the attribute change. To model the concept of willingness-to-pay for an attribute change, some efforts have been made. For example, Van Ravenswaay and Wohl (1995), and Halbrendt, Sterling, Snider, and Santoro (1995) developed willingness-to-pay models for a change in the attributes related to food safety. Both models are based on Lancaster model where consumers are hypothesized to derive utility not directly from goods, but from attributes produced by those goods (For the details, see Van Ravenswaay & Wohl (1995) and Halbrendt et al. (1995)).

A theoretical approach suggested here is as follows. Consider a consumer with preferences for characteristics, C_1 and C_2. Suppose there are two goods, A and B, which possess C_1 and C_2, and the price of which is P_a and P_b, respectively. According to the preferences for C_1 and C_2, a consumer can choose a single good (i.e., A or B) or a mixture of A and B. Let's assume that a consumer ends up with a point "s" where she can get C_1^0 and C_2^0, given the initial income, Y_0. Considering that utility is influenced by the level of attributes, if, holding C_2 constant, the level of a characteristic C_1 increases by one unit from C_1^0 to C_1^1, a consumer's utility level increases from U_1 to U_2. And holding the prices of the characteristics constant, it would take Y_1 income to generate U_2 at v (relating the location at v to s is irrelevant with respect to willingness-to-pay). This is shown by the upward shift of the budget line from $\overline{lm}$ to $\overline{l'm'}$ in Figure 1, which indicates a consumer's income should increase enough to afford C_1^1 level and to reach U_2. In other words, a consumer is indifferent between one unit increase in C_1 and an income change from Y_0 to Y_1. Therefore, in this case, a consumer's willingness to pay for one unit change in C_1 is given by the amount of "Y_1-Y_0".

Figure 1
Willingness-to-pay Model for an Attribute Change



Measuring Willingness-to-pay

Two major methods are now in frequent use to measure or estimate a consumer's willingness-to-pay for product's attributes: contingent valuation and experimental auction method. Among all of the measurement methods available, contingent valuation has been the most widely used and recently received more attention.

Contingent Valuation

Contingent valuation (CV) can be performed by telephone, mail surveys, or face-to-face interviews to elicit consumers' willingness to pay for the goods unobservable or not directly traded in the market, given a hypothetical scenario. Faced with this situation, consumers give the answers about their willingness to pay for a specified level of a good, or a change in the quality or attribute of a good.

Example of study using contingent valuation. In their CV surveys, Buzby, Fox, Ready, & Crutchfield (1998) provided respondents with a contingent choice situation of reduced pesticide residues on fresh produce. The given hypothetical scenario was as follows: there are two grocery stores. Store A do not examine whether its fresh produce has pesticide residues or not, but Store B sells only the fresh produce where pesticide residues are reduced or eliminated. Store B costs more than Store A by one of seven different levels: $1, $3, $5, $8, $10, $15, and $25. Then they asked respondents two consecutive valuation questions: "At which store would you purchase groceries, given the price difference?" and then "What maximum amount of money would you pay for shopping at Store B?"

Experimental Auction

For the purpose of valuing non-market goods, experimental auctions attempt to simulate a real market situation where consumers' decision-making and purchase occur, by using real goods, real money exchange, and repeated market participation. The bid or auction mechanism and the repeated participation in the auction market induce consumers to reveal their true valuation.

Example of study using experimental auction. Fox, Shogren, Hayes, and Kliebenstein (1995) conducted an experimental auction to elicit willingness-to -pay for reductions in *Salmonella* risk. In the first step, they collected the data on attitudes and behaviors about food safety and demographic information. Second, a candy bar auction was performed for practice and then lastly, a "food safety" auction was conducted. In the food safety auction, they initially provided each subject with a Type I (typical) chicken sandwich and $15, and offered an opportunity of bidding for an upgrade to a Type II (stringently screened) chicken sandwich.

Table 1

Pros and Cons of Willingness-to-pay Measurement Methods

Method	Pros	Cons
Contingent Valuation Method	• A flexible tool to be used to analyze specific policies and to measure WTP for an attribute or quality change • Collects data directly from consumers, not relying on secondary data • Less expensive and easier than experiments	• Overestimation: due to general lack of considering budget constraints, the stated WTP higher than actual paying and the large divergence between consumers' statement and actual behavior • Variation in WTP responses, conditional upon on the familiarity with the good being valued • Inconsistencies between closed-ended (or dichotomous choice) and open-ended responses • Vulnerable to sample and question format bias
Experimental Auction Method	• More accurate WTP measures than CV method, using real money to remind subjects of their budget constraints, and based on behavior rather than intentions • Honest revelation of values and preferences by a real incentive mechanism • Control for external distractions and strategic behavior • The absence of non-response bias	• Higher costs per respondent than CV • Geographical or regional restrictions on samples • Bias in the revealed WTP caused by financial compensation or participation payments • Difference between behaviors in the lab and in real life, due to artificial settings of experiments

Advantages and Disadvantages of Willingness-to-pay Measurement Methods

When measuring consumers' willingness to pay, the analysts can choose one of the methods described above, a compromised version of both, or another alternative method, according to their purposes and given resources. The caveat here is that they should take into account the type of good or attribute being valued (e.g.,

whether or not involving the information, uncertainty, or risk issues), the variations in estimates from different techniques (i.e., over- or under-estimations), and other advantages and disadvantages. The choice of willingness-to-pay measurement method will influence the estimates of consumer's valuation, which further affects the decision on optimal consumer policy. Hence, willingness-to-pay measurement issues cannot be overemphasized. The strengths and weaknesses of each willingness-to-pay measurement method are summarized in Table 1.

Case Study: Food Dating Regulation

Food Dating System

Although a food date is important as information to consumers, there is no mandatory requirement for food product dating at the federal level, except for infant formula and some baby food. There is no uniform federal food dating system in the U.S., but there are different regulations from state to state. Furthermore, since dating expressions used can be different between and even within food product categories, there is ample room for consumers to be confused over these expressions (e.g., sell by, best before, use by, etc.). Both factors may contribute to decreasing consumers' benefits from the food consumed. Therefore, it remains the responsibility of analysts and policy makers to investigate the appropriateness of current food dating practice and to find the optimal solution for food dating regulation. From the perspective of modern information theory (Hadfield, Howse, & Trebilcock, 1998), as long as the benefits associated with food dating regulation outweigh the costs and the net gain of the regulation exceeds that of free market from a societal standpoint, food dating regulation by the federal government should be considered to cope with the underlying asymmetrical information in consumer transactions.

Willingness-to-pay and the Value of Information

Conceptualizing and measuring willingness-to-pay is more complicated, and has a different role in a cost-benefit analysis, when the attribute in question is information. One reason for this is the non-exclusive, non-rival nature of information labeling: for most goods and services, labels can be read, and therefore benefits can accrue to consumers regardless of whether they purchase the good. The receipt of benefits to non-purchasers would not be internalized by the firm, which will result in the underproduction of information from a societal standpoint. In a cost-benefit analysis of information attributed, using willingness-to-pay of the purchasing population only (using, for example, the hedonic pricing method) will result in an underestimation of society's benefits. Attempting to ascertain willingness-to-pay of the entire population (say, with a contingent valuation method) will overestimate the benefits of providing information to the private decision-making firm.

The public good aspects of information notwithstanding, there are many real-world situations where neither the theoretical nor the empirical conceptualizations of willingness-to-pay presented to this point are appropriate. Willingness-to-pay is quite a straightforward concept when analyzing a consumer's desire to pay for a characteristic which we know to be desirable. However, willingness-to-pay for information is a bit more difficult to analyze. It is acceptable to assume that the consumer prefers more information about a product or market than less information, but it is not clear that the receipt of such information increases demand in the way that this analysis has assumed.

For example, assume the analyst wishes to know how much an individual is willing to pay to know how many grams of sugar is in a particular fruit drink. Assume that the analyst samples a group of individuals, all of whom have a prior estimate of the number of grams of sugar in this drink. An empirical strategy like contingent valuation would have no problem estimating the value of having access to the real information as opposed to the prior hypothesis. However, say an experiment was conducted, where some consumers were given the true information and some were not. The differences in demand between a group with and a group without would measure two things. First, it would measure the value of the information to the consumer. Second, it would measure the value of the *characteristics level itself*.; namely, the amount of sugar. Furthermore, these two values would be confounded within each other, rendering a value of either impossible.

Therefore, the first lesson to be learned is that an experimental design might not be the most appropriate method of measuring willingness-to-pay for product information. However, the special nature of information goes far beyond empirical concerns and into the realm of public policy. The phenomenon of more informed consumers perhaps decreasing their demand for goods and services, and the effects of this phenomenon on firm decision-making, are at the heart of the argument for information as market failure. Akerlof (1970) first illustrated a situation where markets do not clear because of consumer's inability to judge and the firm's consequent incentive to misrepresent it. This type of market failure should show up in a cost-benefit analysis on product dating as well.

This type of cost benefit analysis should be quite simple. On the one side of the ledger belongs consumer's willingness-to-pay for information, and on the other side belongs the cost of investigating and printing the information for the firm. If the latter is greater than the former, the information will not be produced in the market. It will be produced in the market if the former is greater than the latter. In this context, willingness-to-pay can be used to help inform producers about the benefits of producing the information (see, for example, the conclusions section of Huang, Kan, & Fu (1999)).

If the attribute in question is information, however, there are other considerations. If one poses the question of cost-benefit analysis from the perspective of the firm, whether or not the information will lead to increased or decreased demand for the product in question becomes relevant. If furnishing the information leads to increased demand, then this is added incentive to furnish the information, and we should see it furnished in the private market. If, however, furnishing the information leads to decreased demand, than this provides incentives not to furnish it. These are costs that the private firm would bear only - selling products which otherwise wouldn't have sold represent a transfer from the consumer to the firm, and should *not* be included as a social cost. Therefore, we may have situations where the value of the information is greater than the cost of producing it, but the information would decrease demand to the point where the firm elects not to furnish it, and we have market failure. Measuring willingness-to-pay then becomes a key policy tool - showing that willingness-to-pay exceeds investigation and printing costs is a justification for mandated information disclosure almost by itself.

A Model Cost-Benefit Analysis

The unique nature of information as a quality attribute is highlighted in Table 2, a conceptual example cost-benefit analysis of whether or not to date food. There are three major costs to society for furnishing the information and three major benefits. (A) and (B) are the direct costs to the firm of having to use resources, labor and capital, to investigate and print the information, and the physical costs of furnishing food dates. (D) and (E) are the willingness -to-pay for food dating for purchasers and non-purchasers, respectively. The previous section highlighted some reasons why contingent valuation would probably be an ideal choice for estimating (D) and (E). First, hedonic and experimental designs could easily confound the value of the information and the demand effects arising from the actual receipt of this information. Second, methods besides contingent valuation have no way of assessing the value of such information to non-purchasers. The disadvantage of willingness-to-pay, then becomes the tendency for this type of measure to be an overestimate. We will keep this in mind as we further explore the cost-benefit analysis.

(C) and (F) represent the phenomenon that arises from product dating specifically and information disclosure generally: There will be some stock of food that goes unsold simply because it's date was furnished. This cost to the firm, however, is essentially transferred to the consumer. Any gain a firm receives from not labeling the date comes at the expense of the misinformed consumer. This is where it becomes important to separate the willingness-to-pay for information regarding an attribute, and demand for the attribute itself. To the casual observer, (F) might seem like it is already incorporated in (D), and is therefore double counting. The difference between (D) and (F), however, is the difference between the willingness-to-pay for information and the benefits which come from an optimal bundle of characteristics. Consumers desire information and are willing to pay (D) for it. Once given new information, consumers respond to it by making optimal decisions. It is this re-optimization that results in the transfer highlighted by (C) and (F).

Table 2
A Cost-Benefit Analysis of Food Dating

Costs	Benefits
A. Tracking Costs - costs associated with having to keep track of food dates (firm)	**D.** Consumers' willingness to pay for information. (purchasers)
B. Printing Costs -costs associated with the materials and labor required to post the date on the product (firm)	**E.** Consumers' willingness to pay for information (non-purchasers)
C. Lost Revenue - cost associated with no longer being able to sell early-dated products (firm)	**F.** Consumer Surplus gained from purchasing the latest-dated product (purchasers)

One also might be tempted to add a benefit column which attempts to account for the *benefits* that could come to a firm from furnishing information. This *is* double counting because these are precisely the benefits which the concept of willingness to pay measure. This is the essence of the information problem - the firm can recover the

benefits which accrue if the label leads to increased demand for the product (namely, they can recover (D)) but the firm cannot recover those same benefits if it results in decreased demand. In fact, in the latter case, they lose (C), which isn't a net social cost since it's just transferred to consumers (via (F)).

How does the firm make its decision? In the absence of government intervention, the firm considers all costs (A), (B) and (C) - they are internalized and real to the firm. The only benefits that are recoverable to the firm, however, are (D), the willingness-to-pay for the information. (E) is not recoverable because of the non-exclusive, non-rival nature of food dating. (F) was actually transferred to consumers *from* the firm; it is unrecoverable. We can imagine a case where the sum of (A)-(C) was less than that of (D)-(F), but not less than (D) by itself, so that food dating was under-produced in a private economy. One could envision government's role in food dating to be two-tiered. On the one hand taxing the public and forcing them to pay for the information they use as non-purchasers, and using the revenue to subsidize food labels, so that the firm internalizes the unrecoverable benefits of consumers' making optimal decisions. A simpler and more widely accepted alternative might be mandating firms to provide food dates.

Conclusions

Even after conducting a well-thought-out plan for assessing willingness-to-pay for a given product or attribute, the analyst is still left with several major problems to consider. First, is the method which was used an overestimate or underestimate of the true consumer benefit which comes from this attribute? If the direction of bias is unambiguous, how does this bias effect the magnitude and direction of any cost-benefit analysis employed? Perhaps even more important is for the analyst to understand that there are plenty of situations where a relatively high estimate of consumer's willingness-to-pay, and a high estimate of net benefit in a cost-benefit analysis, do not directly imply the need for government intervention. A firm's reputation with formal and informal consumer groups, and the incentives for competitors to provide information about *each other,* are examples of situations where consumers may already be getting the information they say they value, even if not from a formal signal such as a label.

These considerations aside, willingness-to-pay is clearly a useful tool for consumer policymakers. It is the author's hope that future analyses using any one of the strategies discussed here will put their findings in the context of consumer protection and public policy; it is our further hope that this paper can aid in that endeavor.

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Endnotes

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