

**Foundations of Stated
Preference Elicitation:
Consumer Behavior and
Choice-based Conjoint
Analysis**

Foundations of Stated Preference Elicitation: Consumer Behavior and Choice-based Conjoint Analysis

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ABSTRACT

Stated preference elicitation methods collect data on consumers by “just asking” about tastes, perceptions, valuations, attitudes, motivations, life satisfactions, and/or intended choices. Choice-Based Conjoint (CBC) analysis asks subjects to make choices from hypothetical menus in experiments that are designed to mimic market experiences. Stated preference methods are controversial in economics, particularly for valuation of non-market goods, but CBC analysis is accepted and used widely in marketing and policy analysis. The promise of stated preference experiments is that they can provide deeper and broader data on the structure of consumer preferences than is obtainable from revealed market observations, with experimental control of the choice environment that circumvents the feedback found in real market equilibria. The risk is that they give pictures of consumers that do not predict real market behavior. It

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is important for both economists and non-economists to learn about the performance of stated preference elicitation and the conditions under which they can contribute to understanding consumer behavior and forecasting market demand. This monograph re-examines the discrete choice methods and stated preference elicitation procedures that are commonly used in CBC, and provides a guide to techniques for CBC data collection, model specification, estimation, and policy analysis. The aim is to clarify the domain of applicability and delineate the circumstances under which stated preference elicitation can provide reliable information on preferences.

Preface

Information on consumer preferences and choice behavior is needed to forecast market demand for new or modified products, estimate the effects of product changes on market equilibrium and consumer welfare, develop and test models of consumer behavior, and reveal determinants and correlates of tastes. Direct elicitation of stated preferences, perceptions, expectations, attitudes, motivations, choice intentions, and well-being, supplementing or substituting for information on revealed choices in markets is potentially a valuable source of data on consumer behavior, but can mislead if the information environments and decision-making processes invoked by direct elicitation differ from the settings for revealed choices in real markets.

The purpose of this monograph is to provide the reader with stated preference data collection methods, discrete choice models, and statistical analysis tools that can be used to forecast demand and assess welfare impacts for new or modified products or services in real markets, and summarize the conditions under which the reliability of these methods has been demonstrated or can be tested. One focus is the collection of preference and related data from consumer responses in hypothetical choice experiments, particularly choice-based conjoint analysis (CBC) methods that have proven useful in market research. Another is the economic theory and statistical analysis of choice behavior, revealed or stated, and an economic framework for forecasting market demand

and measuring consumer welfare. Stated choice data can be collected and combined with a broad spectrum of models of consumer behavior. This monograph will focus on the standard economic model of utility-maximizing consumers. Our treatment is informed by and benefits from experiments on perceptions and decision-making behavior in cognitive science and behavioral economics, and includes methods that can accommodate features of consumer choice that impact forecast reliability such as anchoring, adaptation to the status quo, and sensitivity to context. However, we will only touch on the implications of behavioral consumer theory for elicitation and analysis of stated preference data.

There are a number of good introductions to discrete choice analysis (Ben-Akiva and Lerman, 1985; Train, 1986; Train, 2009; McFadden, 1999; McFadden, 2001; McFadden, 2014b; Brownstone, 2001; Boyce and Williams, 2015), and to stated preference and conjoint analysis methods and market research applications (Louviere, 1988; Fischhoff and Manski, 1999; Louviere *et al.*, 2000; Wittink and Bergestuen, 2001; Hauser and Rao, 2002; Rossi *et al.*, 2005; Chandukala *et al.*, 2007; Raghavarao *et al.*, 2010; Rao, 1977; Rao, 2014; Green and Srinivasan, 1978; Green and Srinivasan, 1990). This monograph complements these introductions by filling in technical and behavioral backgrounds for these topics.

1

Some History of Stated Preference Elicitation

Stated preference methods date from the 1930s. The originator of empirical demand analysis, Henry Schultz, persuaded his University of Chicago colleague, the iconic psychologist Leon Thurstone (1931), to present a paper at the second meeting of the Econometric Society with this proposal for direct elicitation of indifference curves:

“Perhaps the simplest experimental method that comes to mind is to ask a subject to fill in the blank space [to achieve indifference] in a series of choices of the following type:

‘eight hats and eight pairs of shoes’ versus ‘six hats and ___ pairs of shoes’

One of the combinations such as eight hats and eight pairs of shoes is chosen as a standard and each of the other combinations is compared directly with it.”

Thurstone postulated that responses would obey Fechner’s law, a common psychophysical regularity in the sensation produced by a stimulus. This turns out to be equivalent to postulating that respondents maximize a log-linear utility function. He collected experimental data on hats

vs. shoes, hats vs. overcoats, and shoes vs. overcoats, fit the parameters of the log-linear utility function to data from each comparison, treating responses as bounds on the underlying indifference curves, and tested the consistency of his fits across the three comparisons.

At the time of Thurstone's presentation, empirical demand analysis was in its early days. Pioneering studies of market demand for a single commodity (sugar) had been published by Frisch (1926), Schultz (1925), and Schultz (1928), but there were no empirical studies of multi-product demands. Least-squares estimation was new to economics, and required tedious hand calculation. Consolidation of the neoclassical theory of demand for multiple commodities by Hicks (1939) and Samuelson (1947) was still in the future. Given this setting, Thurstone's approach was path-breaking. Nevertheless, his estimates were rudimentary, and he failed to make a connection between his fitted indifference curves and market demand forecasts.¹ Most critically, he did not examine whether the cognitive tasks of stating indifferent quantities in his experiment and of choosing best bundles subject to a budget constraint in real markets were sufficiently congruent so that responses with respect to the first would be predictive for the second.

According to Moscati (2007), Thurstone's presentation was criticized from the floor by Harold Hotelling and Ragnar Frisch. First, they objected that Thurstone's indifference curves as constructed were insufficient to forecast market demand response to price changes; this objection failed to recognize that extending Thurstone's comparisons to include residual expenditure could have solved the problem. Second, they pointed out that the knife-edge of indifference is not well determined

¹In retrospect, these two flaws were correctable: Denote by H , S , C , respectively, the numbers of hats, pairs of shoes, and coats consumed, let M denote the money remaining for all other goods and services after paying for the haberdashery, and let Y denote total income. Suppose Thurstone had asked subjects for the amounts M that made a comparison bundle (H, S, C, M) indifferent to a standard bundle (H_0, S_0, C_0, M_0) . Then, he could have estimated the parameters of the log-linear utility function $u = \log M + \theta_H \log H + \theta_S \log S + \theta_C \log C$ by least squares regression of $\log(M/M_0)$ on $\log(H_0/H)$, $\log(S_0/S)$, and $\log(C_0/C)$. From this, he could have forecast demands, e.g., hat demand at price p_H and income Y would have been given by the formula $H = \theta_H Y / p_H (1 + \theta_H + \theta_S + \theta_C)$ that comes from utility maximization subject to the budget constraint.

in comparisons of bundles of discrete commodities.² Beyond these objections, Frisch and Hotelling were generally skeptical that stated indifference points, or non-market responses more generally, could be used to predict market behavior. The orthodoxy of that era, formed partly as a reaction to the casual introspections of Bentham and the utilitarians, was that empirical economics should rely solely on revealed market data; in the words of Irving Fisher (1892), *“To fix the idea of utility, the economist should go no further than is serviceable in explaining economic facts. It is not his province to build a theory of psychology.”* Wallis and Friedman (1942) summarized this attitude in an attack that forcefully dismissed Thurstone’s method or any other attempt to use experimental data for market demand analysis, pointing out difficulties in designing experiments that mimic the environment of real market choices: *“[Thurstone’s] fundamental shortcomings probably cannot be overcome in any experiment involving economic stimuli and human beings.”*

For 40 years following Thurstone’s paper, consumer experiments were mostly limited to testing axioms for choice under uncertainty, and there was no systematic attempt to incorporate stated preference (SP) methods in demand analysis. There was some reason for this lack of interest. The language of economic analysis, then and now, is prediction of market demand and assessment of market failures in terms of dollars of equivalent lost income. Any measurement method that uses experimental data on preferences has to produce convincing results in this language by showing that stated preferences collected outside the market have the same predictive power for market behavior as implied preferences reconstructed from market data. With the advent of behavioral economics, we have learned that people are often not relentless utility maximizers, either in markets or in experiments, undermining the tight links neoclassical consumer theory postulates between consumer utility and demand behavior. This has led to calls for less focus on

²Additional objections could have been raised about the applicability of Fechner’s law and the restrictiveness and realism of the log linear utility specification, lack of accounting for heterogeneity across consumers, and lack of explicit treatment of consumer response errors. Decades later, when this demand system was fitted to revealed preference (RP) data, these issues did arise.

assessment of consumer welfare in dollars of lost income deduced from market demand behavior, and more research on benchmarking stated satisfaction to psychological or neurological measures of well-being. This approach may eventually succeed, but at present market prediction and valuation remain the yardsticks against which any method for eliciting consumer preferences and inferring consumer welfare has to be judged.

The first sustained use of stated preference methods came out of the theory of conjoint measurement pioneered by Luce and Tukey (1964) and Luce and Suppes (1965), and developed as *conjoint analysis* by market researchers like Green (1974), Johnson (1974, 1999), Huber (1975, 1987), Srinivasan (1988) and Louviere (1988) and applied to the study of consumer preferences among familiar market products (e.g., carbonated beverages, automobiles). Good introductions to conjoint experiments, data, and analysis methods are Louviere *et al.* (2000) and Rossi *et al.* (2005). A central feature of conjoint analysis is the use of experimental designs that allow at least a limited mapping of the preferences of each subject, and multiple measurements that allow estimates of preferences to be tested for consistency and refined when necessary.

Early conjoint analysis experiments described hypothetical products in terms of price and levels of attributes in various dimensions, and asked subjects to rank attributes in importance, and rate attribute levels. These measurements were used by market researchers to classify and segment buyers, and target advertising, but they were not reliable tools for predicting market demand. However, Louviere and Woodworth (1983) and Hensher and Louviere (1983) introduced choice-based conjoint (CBC) elicitations that directly mimicked market choice tasks, and McFadden *et al.* (1986) and McFadden (1986) showed how these elicitations could be analyzed using the tools of discrete choice analysis and the theory of random utility maximization (RUM).³ Subjects would

³The term “CBC” is used in marketing to include stated choice elicitations without an underlying framework of utility-maximizing discrete choice. More explicit terminology for the approach discussed in this monograph would be “CBC/RUM”, or as suggested by Carson and Louviere (2011), “discrete choice experiments” (DCE). However, we will continue to use the umbrella term “CBC”, leaving it to the reader to distinguish our economic approach from other forms of conjoint analysis.

be presented with a series of menus of products. Each product offered in each menu would be described in terms of price and levels of attributes. Subjects would be asked to choose their most preferred product in each menu. For example, subjects would be offered a menu of paper towels, with each product described in terms of price, number of towel sheets, a measure of the absorption capacity, a measure of strength when wet, and brand name. Choice data from these menus, within and across subjects, could then be handled in the same way as the real market choice data. Choice-based conjoint (CBC) surveys analyzed using discrete choice methods have become widely used and accepted in market research to predict the demand for consumer products, with a sufficient track record so that it is possible to identify some of the necessary conditions for successful prediction; see McFadden *et al.* (1988) and Green *et al.* (2001), Cameron and DeShazo (2013), and McFadden (2014, 2017).

Environmental economists developed independently a simple stated preference method termed *contingent valuation* (CV), and applied it to valuing environmental damage. This method traces its beginnings to a proposal by Ciriacy-Wantrup (1947) and a PhD thesis by Davis (1963a, 1963b) on the use-value of Maine woods. Its first published applications for values of environmental public goods seem to have been Brookshire *et al.* (1976), Bishop and Heberlein (1979), and Brookshire *et al.* (1980). CV can be viewed as a truncated form of conjoint analysis with two important differences. First, it does not have the experimental design features of conjoint analysis that allow extensive tests for the structure and consistency of stated preferences. Second, because of its applications, it usually does not have predictive accuracy in markets as a direct yardstick for reliability. Instead, it relies indirectly on the links between preferences, market demands, and valuations that hold when neoclassical consumer theory is valid, on analogies with stated preference studies of consumer goods in markets, and on limited internal consistency checks. The particular challenges of using contingent valuation for natural resource valuation are discussed by Carson *et al.* (2001), Carson (2012), Hausman (2012), and Kling *et al.* (2012). Its reliability in relation to stated preference elicitation for market goods is discussed by McFadden (2017).

Other elicitation methods for stated preferences, termed *focus groups*, *vignette analysis*, and measurement of *subjective well-being*, are popular among some applied economists and political scientists, see Rossi (1979), King *et al.* (2004), Caro *et al.* (2012), and Kahneman and Krueger (2013). Focus group methods are directed open-end discussions of products and their features in small samples of consumers. Focus groups do not provide direct data for market demand forecasts, but they can be quite useful in designing CBC experiments because of the insights they provide on product perceptions, levels of consumer knowledge, experience, and understanding, and the attributes consumers consider in forming their preferences. Vignette analysis uses detailed story descriptions of alternatives, often visual. Vignette presentations of alternatives can be used within conjoint analysis experiments, and may improve subject attention and understanding of alternatives. Subjective well-being methods elicit overall self-assessments of welfare, often on Likert or rating scales similar to those used in the early days of conjoint analysis. In the instances where vignette and subjective well-being methods have been tested, they prove to be strongly influenced by context and anchoring effects, see Deaton (2012). These effects compromise forecast accuracy in market demand forecasting applications. Psychometrics has developed an array of additional methods for measuring perceptions, attitudes, and motivations. Their usefulness for economic demand forecasting has not been demonstrated, but at least for perceptions and intentions it is clear that further development is potentially quite valuable for economic applications.

The focus of this monograph is market demand forecasting for new or modified products; we do not attempt here any overall assessment of the reliability of contingent valuation, vignette analysis, or subjective well-being methods in their primary uses. We urge readers to not casually pre-judge the use of stated preference methods in economic applications, but rather to acquire the tools needed to conduct and critique CBC studies, investigate how well these methods work under various conditions, and make a reasoned scientific judgement on when their use advances our understanding of consumer behavior and well-being.

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