

From Willingness to Pay to Behavioral Prediction: Exploring the Interconnection among CVM, CE, and PLS-SEM

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Abstract: This article reviews three related methods extensively used in non-market valuation research, namely, contingent valuation method (CVM), choice experimental method (CE) and partial least squares structural equation model (PLS-SEM). CVM measures the maximum monetary amount of willingness to pay (WTP) that people are willing to pay for non-market goods, CE analyses the preference trade-offs at the attribute level, and PLS-SEM explores the potential psychological mechanism underlying behavioral intention. This article refers to recent cross-disciplinary research to trace the historical process of development, complementarity of methods and integration of theories.

This article believes that the integration of CVM, CE and PLS-SEM has entered a new stage in valuation research, it goes beyond the static monetary valuation and turns to a behavioral valuation path that connects economic, cognitive and social aspects of decision-making. This article discusses the convergence of methodology, as well as the challenges in data compatibility, sampling requirements and differences in model assumptions. In addition, this article also focuses on the future research direction, including hybrid survey design, data integration and interdisciplinary theoretical expansion. Finally, this article advocates establishing an empirical framework to predict and explain public preferences in the field of heritage and environment. Even if it is impossible to make direct policy adjustments, such as price adjustment, this comprehensive assessment model can still play a predictive and strategic role, thus providing decision-makers with an empirical basis for sustainable and inclusive management.

Keywords: CVM; CE; PLS-SEM; Non-market Valuation Model; Behavioral Economics; Total Economic Value

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1. Introduction

In economics, the short-term market value of commodities is determined by supply and demand, while their long-term economic value reflects the intrinsic utility and social utility of commodities^[1]. Based on this distinction, the concept of total economic value (TEV) is usually broken down into two parts: use value and non-use value. Use value includes the direct and indirect benefits of consumption or ecosystem services, while non-use value covers the legacy value and existential value that reflect moral, cultural or intergenerational factors.

When a commodity cannot be traded in the traditional market - such as clean air, natural landscape or cultural heritage - its value must be inferred through a non-market valuation model. Among them, the Contingent valuation method (CVM) has become the main method for estimating individuals' willingness to pay for intangible commodities based on the principle

of utility maximization^[2], CVM assumes that rational individuals seek utility maximization under their own preferences and income constraints^[3].

However, although the contingent valuation method (CVM) can determine the monetary upper limit of willingness to pay (WTP), it cannot explain the psychological or behavioral mechanism behind willingness. What the determinants of satisfaction are, whether it is caused by the attributes of goods or past experience, is still unknown. To make up for the deficiency of CVM, the determinants of satisfaction are still unknown, the Choice experiment (CE) and the partial least squares structural equation model (PLS-SEM) are used to complement the research. The CE analyzes the preference trade-offs at the attribute level of multiple products, and PLS-SEM explores the potential cognitive and attitude factors that affect behavioral intention. These two methods are integrated to have a better understanding of how people value non-market commodities and then connect the economic estimates and behavioral intentions.

Early questionnaire valuation research usually adopted a single methodological framework, such as CVM or travel cost method (TCM). With the development of research paradigm, scholars are gradually focusing on a comprehensive approach, that is, two or more models are integrated into one survey design^[4]. For example, some scholars combined the CVM with the CE to measure the overall WTP and the preference at the attribute level at the same time^{[5][6]}; or combined the CE with the partial least squares structural equation model (PLS-SEM) to integrate the preference of the statement and the potential psychological mechanism^[7].

However, the research on combining CVM with PLS-SEM is still lacking. The theoretical gap in this research direction provides a promising prospect for future research, because this integration can connect the monetary valuation of commodities and the behavioral and cognitive aspects of individual decision-making.

As mentioned above, there are limitations in each of valuation models. Researchers continue to attempt to overcome these limitations by developing new methods. For instance, CVM is weak in explaining the psychological mechanisms underlying the behavior of choice^[8]. However, PLS-SEM can compensate for this limitation by identifying other structures that influence the willingness to pay (such as attitude, trust or perceived value). Similarly, CE can make up for the limitation of CVM in explaining the multi-attribute trade-offs in order to gain deeper understanding of how people make trade-offs among the various characteristics of commodities^[9].

In recent years, these mixed questionnaire models have been used more and more widely in interdisciplinary fields such as tourism, environmental management and education, reflecting the broader trend of combining economic value assessment with behavioral analysis^[10].

Although methodological progress has been made in recent decades, the research on CVM, CE and PLS-SEM is still limited and scattered. The lack of a unified framework limits the potential for a comprehensive capture of economic and behavioral dimensions of non-market value assessment. Therefore, this article aims to integrate the evolution, complementarity and integrity of these three methods, focusing on their theoretical connection and empirical application. By systematically examining the interaction of CVM, CE and PLS-SEM, this paper strives to build a unified behavioral value evaluation perspective to link monetary estimation, preference structure and cognitive mechanism. The following chapters will introduce the evolution of the value assessment model, explore the conceptual interconnection, and put forward the research direction to promote interdisciplinary applications in the fields of environmental and cultural economics in the future.

2. Evolution of Valuation and Behavioral Analysis Methods

2.1 The Rise of Stated Preference Techniques

Under the framework of overall economic value (TEV), valuation methods can be roughly classified into two categories: revealed preference (RP) and stated preference (SP) technology. The display preference method depends on the observed market data and existing price information to infer individuals' valuations of commodities. For example, TCM uses the actual travel time and cost of tourists to estimate the leisure value of scenic spots. The pleasure pricing model infers the value of environmental attributes by relying on the changes of property or wage data.

In contrast to the declarative preference method - including CVM and CE - which is applicable to goods and services with prices^[11], the method is designed for goods and services without market prices. Therefore, the declarative preference

method depends on hypothetical situations and simulated market to draw out the psychological expectations and preferences of respondents. By asking how people will do or how much they are willing to pay under the hypothetical condition, the declarative preference method can draw out the subjective values and preference of respondents and further understand individuals' preferences for non-market commodities such as environmental quality, cultural heritage or ecosystem services.

2.2 Contingent Valuation Method (CVM): From Monetary Value to Behavioral Intent

CVM is one of the most widely used methods of expression of will^[12]. It constructs a hypothetical market that requires respondents to express their maximum willingness to pay (MWTP) for maintaining, improving or obtaining a non-market commodity. Through this mechanism, CVM transforms psychological preferences into monetary value, thus directly linking economic welfare theory with behavioral response^[13].

A) Initial quotation question: "Are you willing to pay X (initial quotation) for the proposed improvement or project?"

B1) Subsequent higher quotation questions: If the respondents answer "yes" to the initial quotation, they will be asked if they are willing to pay a higher offer (for example, $X + \Delta$).

B2) Subsequent lower quotation questions: If the respondents answer "no" to the initial quotation, they will be asked whether they are willing to pay a lower quotation (for example, $X - \Delta$).

C) Maximum willingness to pay (MWTP) problem - this is the core of the CVM which requires respondents to determine the maximum amount they are willing to pay before refusing further payment.

The MWTP derived from these answers represents the upper limit of perceived economic value and serves as the basis for estimating the average or med-level willingness of the population to pay.

In order to ensure statistical validity, researchers usually design multiple initial bids (for example, 10 yuan, 15 yuan, 20 yuan) and randomly allocate these bids in different survey versions. This diversity allows researchers to use econometric models such as logit, probit or interval regression in software such as STATA to estimate, so as to obtain a continuous distribution of willingness to pay, rather than a single point estimate.

Although the CVM has certain practicality, it still faces the following persistent challenges:

I) Hypothetical bias - because the payment is not real, respondents may overestimate or underestimate their willingness to pay (WTP);

II) Starting point deviation and anchoring effect - the initial bid will affect the willingness of the respondents to pay;

III) Strategic bias - individuals may deliberately distort their preferences to affect the results;

IV) Information and understanding effect - participants' understanding of the situation will affect the reliability of the answer;

V) Lack of insight at the attribute level - CVM provides the overall value, but it cannot reveal which specific attributes drive this valuation.

These limitations have prompted people to develop more sophisticated methods, especially the CE model. CE expands the scope of application of CVM by decomposing commodities into their constituent attributes and presenting a variety of alternative combinations to respondents. This allows researchers to estimate the marginal willingness of each attribute and analyze the trade-offs in individual preferences - thus overcoming the static and holistic defects of traditional CVM.

2.3 Choice Experiments (CE): The Multi-Attribute Evolution of Preference Measurement

The Choice experiment (CE) method is a major methodological progress within the framework of the Discrete Choice model (DCM)^[14]. Unlike the CVM, which focuses on obtaining a single maximum willingness to pay (MWTP), CE allows respondents to evaluate multiple hypothetical options, each of which consists of a series of attributes and their levels.

In a typical CE design, respondents will see several selection cards, each showing two or more options (for example, protection projects, travel packages or environmental improvement programs), which are defined by different attribute sets, such as price, accessibility, cultural value and environmental quality. Participants need to choose their preferred options in each situation, so as to reveal their trade-offs between different attributes. This mechanism captures the preferred multi-dimensional structure, so that the marginal willingness to pay (MWTP) of each attribute can be estimated through the logical regression model or the mixed logical regression model^[15].

Including price in one of the attributes enables CE to generate an economic value estimate equivalent to conditional value

assessment CVM. In practice, researchers usually use the price level obtained from the initial bid of CVM as the monetary attribute in CE design, thus establishing a direct connection between the two methods^[16]. In this sense, CE is a supplementary extension of CVM: CVM measures the overall value of commodities, and CE breaks down the value into the contributions of each attribute, thus providing more detailed and policy-related insights.

However, although CE can capture how individuals weigh between different characteristics, it cannot explain why these choices occur - what is the cognitive or attitude mechanism that drives these behaviors^[17]. This limitation prompted researchers to introduce the partial least squares structural equation model (PLS-SEM) as an analysis extension. By integrating potential structures such as attitude, trust, satisfaction and perceived behavior control, PLS-SEM can model the psychological path behind the statement selection and transform behavioral data into a more comprehensive cognitive-behavioral value assessment framework.

2.4 Partial Least Squares Structural Equation Modeling (PLS-SEM): Explaining the Cognitive Mechanism

Partial least squares structural equation model (PLS-SEM) is a variance-based statistical technique used to test the relationship between potential structures - usually involving independent variables, intermediary variables and dependent variables. In the field of non-market valuation and behavioral research, PLS-SEM is particularly suitable for building attitude-intention-behavior association models and identifying psychological mechanisms that affect individual preferences and willingness to pay^[18].

Compared with the covariance-based structural equation model (CB-SEM) aimed at reproducing the observational covariance matrix and evaluating the fit of the model, PLS-SEM focuses on maximizing the explanatory variance (R^2) of dependent variables, emphasizing prediction rather than verification^[19]. This predictive orientation is highly in line with the goal of valuation research, because valuation research aims to understand how various psychological and situational factors affect behavioral intentions, rather than verifying a fixed theoretical model.

Another practical advantage of PLS-SEM is its flexibility in data distribution and sample size. CB-SEM requires a large sample size and assumes a multivariate normal distribution, and these conditions are often difficult to meet in field surveys such as environmental or tourism research. In contrast, PLS-SEM does not have a strict distribution hypothesis and can run steadily even in small and medium sample sizes ($n = \text{number of projects} * 10$), making it a better choice for exploratory or predictive research^[20].

In addition, PLS-SEM allows the estimation of the measurement model (the relationship between the potential structure and its indicators) and the structural model (the relationship between the structure) at the same time^[21], thus providing reliability diagnosis and hypothesis testing within a single framework. This double-layer model capability enables researchers to quantify abstract psychological variables (such as attitude, trust, perceived value and satisfaction) and assess how these structures together affect behavioral intent and actual behavior.

3. Integrating CVM, CE, and PLS-SEM: Toward a Unified Behavioral Valuation Framework

3.1 Theoretical Complementarity and Hierarchical Logic

CVM, CE and PLS-SEM constitute a complementary methodological level. They link economic value assessment, behavioral choice and psychological cognition together. Each of them represents different behavior in the process of decision-making. It helps to understand the individuals' preference for non-market commodities more deeply.

At the first level, CVM can be seen as a dominant currency threshold. It is the price that individuals are willing to pay for the proposed goods or services. It directly expresses value in money. However, it is only the result of superficial behavior^[22].

At the second layer, the CE extends this idea to break down commodities into multiple attributes and attribute levels. Respondents are allowed to trade-off between competing characteristics. Through the preference measurement of commodity attributes and attribute levels, CE reveals the composition of value (which cannot be identified by CVM). This result enriches the interpretation of consumer heterogeneity and marginal utility^[23].

At the third level, PLS-SEM goes beyond measurable preferences and examines possible cognitive drivers - such as attitude,

trust, satisfaction or perceived behavior control - which explain the existence of the above decision-making. PLS-SEM explains why people value or choose the alternatives and connects economic behavior and psychological intentions to form an integrated causal structure. From a mathematical point of view, using PLS-SEM also relaxes the restrictive assumptions inherent in the traditional DCM. In particular, CE is typically based on the assumption of independence of irrelevant alternatives (IIA), which is often not satisfied in real-world decision-making situations^[24]. The common ways to overcome this problem include applying nested Logit (NL) or mixed Logit (ML) or PLS-based structural methods. The latter provides a more flexible way to model the heterogeneity and the related decision-making behavior.

Generally speaking, these three methods can form a hierarchy of value evaluation: CVM describes the price threshold of the selection, CE explains the structural trade-offs within the selection, and PLS-SEM reveals the production mechanism of the choice is born. This multi-level logic not only adds depth to the system, but also ensures its coherence, allowing researchers to move from descriptive value evaluation to a predictive and explanatory view of human behavior in non-market situations.

3.2 Empirical Integration and Application Pathways

Although CVM, CE and the PLS-SEM come from different analytical traditions, they can be logically integrated to gain a more comprehensive understanding of value assessment and behavior. In empirical studies, these models are typically applied sequentially and are rarely applied in combination directly. Each method is applied at a different level of analysis.

In this integrated path, CVM is typically used to estimate the willingness to pay for certain policies or non-market commodities (WTP) and therefore provides a real indicator of economic preferences. Although the WTP value cannot be used as a dependent variable directly in PLS-SEM (because PLS-SEM is focused on modeling behavioral intentions and actions rather than numerical results), it conceptually represents the external manifestation of potential attitudes and motivations. Thus, PLS-SEM complements CVM by explaining why individuals express certain preferences and attitudes and finds cognitive and emotional determinants that cause the emergence of observed value evaluation patterns.

Similarly, CE creates a bridge between value evaluation and cognition by embedding psychological factors such as attitude, satisfaction or perceived value in the experimental design. Cognitive engineering allows respondents to choose from multi-attribute options and therefore captures behavioral trade-offs that reflect deeper motivational structures, which are then analyzed by PLS-SEM to find their potential causal path.

In recent years, such integrated multi-method frameworks have been increasingly applied in cross-disciplines such as heritage management^[25], tourism^[26] and environmental^[27], which indicate that the economic value assessment can not be totally comprehended without combining behavioral and psychological aspects in recent years. Combined with these methods, we can have a more comprehensive understanding of how people evaluate and treat non-market commodities in two aspects and multiple levels.

3.3 Challenges and Future Directions

Although it has become increasingly popular to combine CVM, CE and PLS-SEM into one analytical framework, some methodological challenges still exist. The first challenge is adjustment of sample size. Each method has its own requirement of data. It is always difficult for researchers to combine them together. In practice, the overall sample size is usually determined by the most demanding of the three models. However, this method will complicate the process of survey and raise higher requirements for data collection, which will increase the cost of data collection^[28].

The second challenge exists in the difference of model assumptions. CVM and CE are based on the principle of utility maximization and assume that individuals will make rational economic choice. However, PLS-SEM is based on the behavior prediction paradigm and focuses on possible psychological structure and path relationships. In order to make these contradictory theoretical foundation to reach a certain level of consistency, researchers should be careful in constructing concepts.

Another practical problem exists in the compatibility of design. As for the second challenge, since the combination of valuation and behavioral measurement items will make the questionnaire too long and even increase the degree of fatigue of respondents^[29], researchers can choose to distribute related questionnaires to different groups of respondents. This method

can reduce the cognitive burden of respondents and maintain the statistical correlation between two groups of respondents through common demographic and attitude variables.

In the future, the combination of hybrid questionnaires and multi-layer model framework can be used to integrate valuation results and behavioral structure into one framework. Such innovation will increase the flexibility of analysis and depth of interpretation and promote the integration of economic aspect and psychological aspect in non-market valuation research.

4. Research Gaps

4.1 Theoretical Expansion and Interdisciplinary Connection

The theoretical range of non-market valuation has traditionally been limited in welfare economics and utility maximization, where human behavior is assumed to be rational and self-interest. However, with valuation research increasingly focusing on complex socio-cultural and environment context, this model cannot explain all motivations of people's preferences and behaviors. Therefore, future studies should attempt to extend the current economic rationality theory and expand interdisciplinary theoretical range, which can include interdisciplinary theoretical perspectives that reflect emotional, social and moral aspects.

In this regard, the direction of theoretical expansion usually varies according to the orientation of the discipline. For example, environmental management research can refer to the value-belief-norm (VBN) and planned behavior theory (TPB) frameworks and use them to link personal norms and perceived behavior control with the will to protect. In the study of tourism and cultural heritage, theories such as location attachment, identity reconstruction and symbolic consumption can offer richer insights into how meaning, memory and cultural resonance affect willingness to pay or travel again^[30]. In the field of education and social policy, models that emphasize trust, social capital and equity can reveal the collective or altruistic motives contained in value judgment^[31].

Theoretical scope of non-market value assessment is traditionally founded on welfare economics and utility maximization models in which human behavior is modeled to be rational and self-interested. However, when value assessment studies consider the social, cultural and environmental context involved, this model has been proven inadequate to explain all of the personal preference and behavior motivations. Therefore, future research should attempt to transcend economic rationality and expand into interdisciplinary theoretical extension to reveal the social and moral dimensions of value assessment and the emotional motivations behind them.

In this regard, the direction of theoretical expansion usually varies according to the orientation of the discipline. For example, environmental management research can refer to the value-belief-norm (VBN) and planned behavior theory (TPB) frameworks and use them to refer to the link between personal norms and perceived behavior control with the will to pay. In the field of tourism and cultural heritage, theories such as location attachment, identity reconstruction and symbolic consumption can offer richer insights into how meaning, memory and cultural resonance affect willingness to pay or travel again^[30]. In the field of education and social policy, models that emphasize trust, social capital and equity can reveal the collective or altruistic motives contained in value judgment^[31].

However, any attempt at theoretical integration must first ensure its feasibility and empirical coherence. The introduction of concepts from other fields should be based on clearly conceptualized definitions, reliable measurement indicators and sufficient data structures so as to avoid an excessive mixing and matching of concepts. In this sense, theoretical extension is not just to introduce concepts from other fields but to establish a coherent causal extension and apply it to empirical models such as PLS-SEM.

Through the combination of theoretical diversity and the feasibility of methodology, future research should build an assessment framework that links economic value assessment with the psychological and socio-cultural basis of choice.

4.2 Toward Evidence-Based Heritage and Environmental Valuation

Despite the methodological and theoretical advances mentioned above, the practical application of non-market valuation results toward policy and management is still weak. Future research should therefore attempt to build valuation evidence-based frameworks that can directly inform heritage conservation and environmental decision-making. By establishing the link between behavioral insights and economic estimation, this kind of framework can assist policymakers to design

pricing mechanisms and conservation incentives as well as communication strategies based on empirical evidence instead of assumption.

However, the way forward to evidence-based practice is not homogenous for all disciplines. Theoretical expansion and methodological feasibility depend on the research context. For instance, the valuation of heritage management should comply with the cultural policy context and emphasize authenticity, public engagement and identity. Theoretical expansion for the valuation of heritage management should also consider the feasibility of the method and empirical applicability, that is, the feasibility of measuring and applying the concept proposed.

Although the development of methods and theory have enhanced people's understanding of non-market value, their application in practice for policy-making is still limited. Future research should aim at establishing an evidence-based value assessment framework that provides a direct basis for heritage protection and environmental decision-making. Only by bridging the behavioral understanding and economic estimates can the policymakers design pricing mechanisms, protective incentives and protective communication based on the evidence rather than hypothesis.

In fact, the establishment of an evidence-based assessment does not mean that the price should be raised in a political or social level and the protection fee should be levied immediately. Even if it is not possible to raise ticket prices or collect protection fees at the political or social level, assessment studies can still play a predictive role - that is, it can provide decision-makers with expected evidence of the possible behavioral response under other pricing or management schemes. Therefore, even if they are not implemented in the short term, these models will play a strategic role in facilitating the practical policy shift of such measures in the future.

In order to achieve this goal, we suggest that future research can integrate the design of real hybrid evaluation (combined with CVM, CE and PLS-SEM) into real case studies and policy pilots. These methods will allow researchers to quantify tangible and intangible benefits, discover the behavioral mechanism behind protection support and provide data-supported suggestions for sustainable management. Ultimately, the promotion of evidence-based heritage and environment assessment requires not only the integration of methods, but also a pragmatic commitment to achieving feasible policy results in the combination of academic research and feasible policy results.

5. Conclusion

This paper reviews the conceptual and methodological development of three main methods used in non-market valuation-CVM, CE and PLS-SEM-and discusses how the integration of these three methods bridges the economy of human decision-making, Behavioral and cognitive dimensions. Each method provides an unique and complementary perspective: CVM quantifies the monetary threshold of willingness to pay, CE reflects the multi-attribute preference structure, and PLS-SEM reveals the potential psychological mechanism that leads to behavioral intention. They form an integrated whole that connects external valuation and internal motivation.

Through integration, this article highlights the emergence of a unified behavioral valuation perspective in which valuation assessment and psychological interpretation are no longer seen as two independent fields but as two levels that promote each other. This integration enhances theoretical understanding and empirical accuracy so that the valuation research can go beyond static monetary numbers and characterize the dynamic human behavior, cognition and situation.

Although we have made some advances in the methodology, there are still problems to be solved, such as sampling strategy harmonization, harmonizing model assumptions and analytical complexity versus respondents' feasibility. These problems can be solved by designing hybrid questionnaires, multi-level modeling and interdisciplinary cooperation.

Finally, the review stresses that the contribution of these integrated methods is not limited to achieving direct pricing or policy implementation. If direct interventions such as ticket prices adjustments are not feasible, although these models can not be used to gain insights into policy implementation, they can still provide valuable predictions of the public's preferences, behavioral responses and policy outcomes. In this regard, the integration of CVM, CE and PLS-SEM not only benefits academic research, but also enhances the empirical support and provides support for future.

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