

The KBA Consulting Group Pty Limited ACN 065 438 879

Level 11, 492 St Kilda Road Melbourne Victoria 3004 Australia

Telephone 61 3 9867 1477 Facsimile 61 3 9867 1733

Email kba@kba.com.au Website www.kba.com.au



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31 January, 2002

Professor Thomas G Parry Chairman Independent Pricing and Regulatory Tribunal Level 2 44 Market Street SYDNEY NSW 2000

Dear Professor Parry

Enclosed are two copies of a submission by The KBA Consulting Group to the current IPART Review of the Costs, Benefits and Funding for Undergrounding Electricity Cables.

KBA is a Melbourne-based strategy and value-based management consulting boutique with a strong reputation for innovation. We work primarily in Australia and the USA.

You are probably aware of the work that KBA undertook in 1998 and 1999 in helping electricity distributors in NSW and Victoria to understand how their customers derive value from the various attributes of their electricity supply, as well as their willingness to pay for incremental improvements to service quality. We were involved in four separate studies of this nature.

In undertaking these studies, KBA was able to draw on extensive experience to develop and refine an analytical technique that provided a very robust estimate of the value derived by customers from (and their willingness to pay for) incremental improvements to service quality. No analytical technique can ever predict customer behaviour with absolute certainty and the best that can be expected is to eliminate the possibility of making a wrong decision based on the results of the analysis. However this technique did overcome most of the concerns about customer value analysis methodologies outlined in IPART's Review of Willingness to Pay Methodologies released in August 2001. It employed a combination of Choice Modelling (CM) to establish explicit customer preferences and Adaptive Conjoint Analysis (ACA) to help explain those preferences.



Included in the technique was an innovative method of adjusting ACA utility scores so as to match the CM outcomes. **This** enabled us to include nearly twice as many attributes as can be safely incorporated into a CM study (an important issue since there were ten or more attributes that made up the customer utility function in all four studies). It also enabled us to analyse the data at both an individual customer level and at a segment level, without being vulnerable to underestimating customer price sensitivity through what has come to be known as the ACA Price Effect.

The technique was presented at an international market research conference held at Hilton Head Island, South Carolina, in March 2000. It was extremely well received by an audience that included some of the world's leading market research academics and practitioners. A copy of the paper, together with a summary of the peer review conducted by Dick McCullough (the President of Macro Consulting based in Palo Alto) is provided as **an** appendix to our submission. McCullough's stature in this field is readily apparent from the bibliography and other information contained in the Macro website (www.macroinc.com).

We believe that the review that you are conducting is most important for the people of NSW and we have developed this submission in an effort to provide you with an understanding of both the methodology that we employed and some of the results that we obtained. Detailed findings from the studies should be sought from the four distributors by whom we were engaged. However I believe that most of this material has already been submitted to either IPART or the ORG as part of various pricing review submissions.

We have also taken the opportunity to use the issue of undergrounding electricity cables to offer KBA's perspective on how a regulatory framework can impact on the ongoing creation of customer value and shareholder wealth in the electricity distribution industry.

As was the case during the 1999Electricity Pricing Review, KBA is more than happy to provide any assistance that IPART might require in completing this review.

Kind regards

Alich lea Denis Kilrov

ManagingDirector



# INDEPENDENT PRICING AND REGULATORY **TRIBUNAL**

Review of Costs, Benefits and Funding For Undergrounding of Electricity Cables

Submission from The KBA Consulting Group

January 2002

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The KBA Consulting Group Pty Ltd Level 11, 492 St Kilda Road Melbourne VIC 3004

> Tel: +613 9867 1477 Fax: +613 9867 1733 E-mail: kba@kba.com.au Web Site: www.kba.com.au

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## INTRODUCTION

This submission to the IPART Review of Costs, Benefits and Funding for Undergrounding Electricity Cables has two objectives. The first is to summarise the relevant findings of a series of studies undertaken in 1998 and 1999 to understand the value that electricity consumers placed on various attributes of their electricity supply and to determine the willingness of those consumers to pay for either improved reliability and/or an enhanced electricity supply infrastructure. The second is to apprise IPART of the methodology employed in arriving at these conclusions.

In structuring this submission, we have also taken the opportunity to offer our perspective on the issue of ongoing customer value creation and shareholder wealth creation in the electricity distribution industry.

During 1998 and 1999, KBA was engaged in four separate studies to assist electricity distributors in NSW and Victoria to understand how their customers derived value from the various attributes of their electricity supply, as well as their willingness to pay for incremental improvements to service quality. Two studies were conducted for distributors whose franchise areas were in NSW, and two for Victorian distributors.

KBA's principal business is in the implementation of value-based management – in particular the establishment of a capability within its clients to measure, create and manage both customer value and shareholder wealth on an ongoing basis. Our focus on customer value creation has provided us with a great deal of experience in the use of a range of stated preference techniques to help understand customer utility or value. For some members of the firm, this experience dates back to the mid-1980s and the early application of PCs to this type of research task.

In undertaking these studies, KBA was able to draw on its experience to develop and refine an analytical technique that provided a very robust estimate of the value derived by customers from (and their willingness to pay for) incremental improvements to service quality. No analytical technique can ever predict customer behaviour with absolute certainty. The best that can be expected is to eliminate the possibility of making a wrong decision based on the results of the analysis. However this technique did overcome most of the concerns about customer value analysis methodologies outlined in IPART's Review of Willingness to Pay Methodologies released in August 2001.

It employed a combination of Choice Modelling (CM) to establish explicit customer preferences and Adaptive Conjoint Analysis (ACA) to help



explain those preferences.<sup>1</sup> Included in the technique was an innovative method of adjusting ACA utility scores so as to match the CM outcomes. This enabled us to include all of the ten or more attributes that made up the customer utility function in each case – something that would not have been possible with a full profile CM methodology. It also enabled us to analyse the data at both an individual customer level and at a segment level, without being vulnerable to underestimating customer price sensitivity through what has come to be known as the ACA Price Effect.

The technique was presented at an international conference held at Hilton Head Island, South Carolina, in March 2000. It was extremely well received by an audience that included some of the world's leading market research academics and practitioners.

We believe that the review that you are conducting is most important for the people of NSW and we have developed this submission in an effort to provide you with an understanding of both the methodology that we employed and some of the results that were obtained. The key findings, a summary of the methodology employed, and KBA's perspective on the issue that IPART has been asked to address, are contained in the three sections that follow. The appendices include the technique paper presented in March 2000, a review of the KBA technique that was presented at the conference by a leading US practitioner, and an internal KBA training presentation that some readers may find easier to understand than the formal paper.

<sup>&</sup>lt;sup>1</sup> There were either ten or eleven attributes in each of the four studies.

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# **KEY FINDINGS OF KBA STUDIES**

## **The KBA Studies**

Four main studies were undertaken in 1998 and 1999. The first two were conducted for NSW distributors. These were followed by two separate studies undertaken for Victorian distributors. All four studies employed the same fundamental research technique which involved the use of a combination of Choice Modelling and Adaptive Conjoint Analysis.

The NSW studies comprised:

- A survey of approximately 1,000 customers drawn from 155 different postcode regions for a large NSW distributor. Details of this study were provided to IPART as part of that distributor's 1999 Electricity Pricing Review submission and were subsequently posted on the IPART website. It was also referenced in the IPART Review of Willingness to Pay Methodologies published in August 2001.
- A study similar in content but smaller in scope covering slightly more than 200 customers of another distributor. The findings from this study were also presented to IPART as part of this distributor's submission during the 1999 Electricity Pricing Review.

The two Victorian studies were both quite similar in size and scope. During the survey design phase, consideration was given to merging these two studies, but it soon became apparent that different attributes needed to be tested in each franchise area. This difference was driven in large part by the sensitivity of customers in one franchise area to bushfire related problems arising from their electricity supply infrastructure. Approximately 400 customers were interviewed in each of the Victorian studies. Both were used in submissions to the ORG's pricing review in 1999. Material from at least one of these studies has been made public and was quoted in the SAIIR Information Paper on Electricity Tariffs and Security of Supply issued in June 2000.

## Key Findings

#### Overview

There were a number of key findings that were common to all four studies and which might serve to guide IPART in its thinking during the current review.

- Survey respondents placed significant value on both reliability and infrastructure aspects of their electricity supply. While they would no doubt appreciate the lower prices that the current regulatory regime encourages, their responses showed that they also valued higher reliability, greater safety and enhanced aesthetic amenity. Many indicated that they were prepared to pay for these benefits.
- The majority of customers indicated a willingness to meet the cost of enhancing their electricity supply infrastructure and either maintaining or enhancing their current level of reliability.
- Approximately 25 percent of customers indicated that they were prepared to meet the full economic cost of their supply being relocated underground.
- A further 55 percent indicated that they were prepared to meet the cost of having their low voltage supply delivered via Aerial Bundled Conductor (ABC) and having high voltage cables relocated underground.
- Many of these respondents indicated that they chose ABC to enable them to access a number of the benefits associated with an underground supply, but at a lower cost. Had the cost of undergrounding been lower (for example as a result of cost sharing with the roll-out of telecommunications infrastructure), these respondents are likely to have opted for an underground supply.

#### **Examples of Survey Output**

Even though detailed results of most if not all of the studies undertaken by KBA have been submitted to public hearings conducted by regulators in either NSW or Victoria, in a document of this nature it is only appropriate for us to present sufficient of the results of each study to convey the broad thrust of the findings and at the same time to confine ourselves to information that has already been made available in public hearings. In doing so we have not revealed the identity of the individual distributors – since IPART is almost certainly aware of their identity anyway. It is far more important to ensure that the reader understands the rigour of the methodology employed and the fact that very similar results were obtained in all four studies. If appropriate, further details can be sought from the distributors who commissioned the original studies.

The research methodology employed both Choice Modelling (CM) and Adaptive Conjoint Analysis (ACA). The CM output was used to gain a direct understand of customer preferences. The ACA output was only used after each respondent's utility function had been adjusted to align with the CM output.

Figures 1 and 2 present graphs that use pure CM output to demonstrate that almost irrespective of the choice combinations presented, approximately 20 percent of respondents chose Overhead Bare Wire at

prices (and at a level of reliability) similar to that at which they were currently being supplied, approximately 55 percent chose Aerial Bundled Conductor at a higher price, and approximately 25 percent chose Underground Cable at a cost economically equivalent to the cost of putting cables underground.<sup>2</sup> This outcome was evident in all four studies.



FIGURE 1. Example of CM Output for 1,000 Respondent NSW Study





<sup>2</sup> The cost of putting cables underground was estimated by NSW distributors to be \$6,000 per property. Victorian distributors estimated a figure between \$4,000 and \$4,500 - the lower cost being attributable to different physical issues to be overcome in each franchise area.

One of the principal challenges confronted in each of the four studies was the fact that the respondent utility function was made up of ten or more attributes. This meant that full profile techniques would not be appropriate (There is extensive research indicating that respondents cannot cope with more than six attributes when using full profile research techniques.) This meant that ACA was almost certainly the best approach to use, but it was necessary to develop a means by which ACA could be used without the study being vulnerable to what is known as the ACA Price Effect (in which ACA can tend to understate price sensitivity for some respondents in certain situations).

The technique that KBA developed also enabled ACA to be used to both help explain why respondents had made certain choices, and to simulate a value price associated with each infrastructure offer. Figures 3 and 4 demonstrate the results of this simulation for the same two studies that were illustrated in Figures 1 and 2. In relative terms, the overhead bare wire infrastructure offered very little in the way of non-price benefits to consumers. The underground infrastructure offered significant non-price benefits. Both were offered at the same price under the existing regulatory regime. But if a fair or equitable utility is struck at a point equivalent to that derived by customers supplied by overhead bare wire (i.e. most country and outer suburban customers) then inner city customers supplied by an underground infrastructure derived a disproportionate amount of value for the price that they paid. The difference was equivalent to \$140 per guarter in NSW and \$70 per guarter in Victoria.



#### FIGURE 3. Value Pricing for Undergrounding Power – NSW Study

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• 30 minutes or less total blackouts



The value price associated with an underground infrastructure was very similar for both the Victorian studies, but much lower than people in certain parts of NSW were prepared to pay. Demographic analysis suggested that this difference in willingness to pay was related to a wealthier population and much higher real estate values – particularly in Sydney where respondents had the potential to experience a much greater positive impact on house prices from a change to a more aesthetically pleasing underground infrastructure.

· 4 hours total blackouts

#### Interpretation

It is important to appreciate that the studies were undertaken for four independent organisations. Their intention was to help devise new strategies that would create greater value for the customers and wealth for the shareholders of each organisation. While extremely rigorous and very carefully structured, they were not designed with the intention of influencing social policy. Nor were they designed with the intention that the Victorian studies would be compared directly with those conducted in NSW.

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## SUMMARY OF METHODOLOGY EMPLOYED

## Survey Design

Each of the four studies was designed to explicitly address the primary research objective which was:

"To determine the value that electricity customers derive from the various attributes or features of their electricity supply, and their willingness to pay for an enhanced level of service."

Each study was built around the use of a series of explicit choices (or Choice-Based Holdouts) in relation to the key attributes of an electricity supply (the CBH component) together with an ACA component that sought to understand the drivers of those choices.

Explicit "holdout choices" were used so that we could control exactly which choices were put to respondents. This level of control is not possible in techniques such as Choice-Based Conjoint (CBC) because the need for an orthogonal design means that customers are presented with choices involving meaningless alternatives (such as a high priced overhead wire supply versus a low cost underground supply). This tends to undermine the integrity of the interview from the respondent's perspective.

ACA was used to understand the drivers of choice because:

- The number of attributes was simply too high for a full profile approach. In all four studies, we were unable to reduce the number of attributes below ten (although in Figures 3 and 4 they are summarised under the five headings of price, cable location, tree trimming, cable safety and blackout frequency). Full profile approaches do not work well when the number of attributes is more than six.
- Utility scores allow products to be simulated that weren't tested by the explicit choices.
- The combination of the two approaches provided an excellent means by which to test the internal consistency of each respondent.
- All data could be reviewed at the level of the individual respondent. This avoided the "independence of irrelevant alternatives" (IIA) assumption that must be made when using aggregate *logit* models. This would have been a large issue due to the similarities between the products tested.

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 ACA is an excellent technique for uncovering a respondent's "microstructure of preferences", or how a respondent would choose given sufficient information and time (Huber et al., 1992). An elaborate choice process such as deciding on an electricity supply infrastructure is likely to be better represented by the depth of processing required by ACA.

The survey also included a series of demographic questions, and direct questions about electricity supply, to assist in the analysis of the research data.

## Sampling Procedure

The sampling procedure used was developed by KBA in conjunction with each of the four distributors and Taylor Research – a Sydney-based market research firm.

The first step was to identify a series of regions within each company's franchise area which management believed would cover the full spectrum of different supply infrastructures and the full range of reliability experience over the last few years. Taylor Research then recruited respondents to participate in interview sessions at between 10 and 20 different locations. These locations were chosen to ensure that the travelling time from respondents' homes was no more than 30 minutes each way.

The recruitment process followed methodologies approved by the Market Research Society of Australia (MRSA) and Interviewer Quality Control Australia (IQCA). Many respondents were drawn from database listings – a standard industry practice used in most market research studies (including the often-quoted Value of Lost Load or VoLL study). Others were recruited using a series of other industry-approved techniques.

This methodology avoided any confidentiality or privacy issues that could have been associated with the use of a supplier's actual customer listings for non-standard purposes. While this approach resulted in a sample that might not have been perfectly random, it was the closest we could get to a random sample given the need for respondents to agree to travel to a central location. It certainly did produce a wide range of respondents from differing regional and socio-economic backgrounds who had experienced the full spectrum of network performance levels.

#### Interviewing Procedure

The interviews were structured around PC-based questionnaires administered in groups of approximately 20 respondents.

The interviews were extremely closely managed. All interview staff were from either the distributor or KBA. All session leaders and assistants were trained to supervise sessions and assist respondents. Most staff were sourced from local regional areas to provide information and feedback on local issues as required. Most session leaders supervised multiple sessions to ensure continuity, and KBA consultants were used to ensure smooth transitions between session leaders.

Respondents were given a great deal of background information in relation to the purpose of the interview and how to approach it. They were also able to ask questions to clarify the survey requirements, and to better understand various aspects of their current electricity supply.

Respondents were given a detailed verbal and written introduction to the survey technique and a briefing on each of the attributes tested. Each respondent had been asked to bring their bill with them, and were thoroughly briefed on the fixed and variable components of their bill and their electricity consumption level. This allowed them to accurately assess the impact of any price changes in actual dollar terms.

Photographs and other props were also provided to enable them to understand what the possible benefits and costs associated with different types of supply infrastructure might be. These were introduced in a short discussion with each respondent when they reached that section of the interview. This was done to break up the interview, and to ensure that respondents only received information at the stage of the interview where they actually needed it.

#### Analysis of Survey Results

The results of the CBH section of the survey were analysed simply by observing the proportion of respondents who selected each of the alternatives posed. These proportions were further analysed on a demographic basis to gain additional insight.

ACA was then used to understand why these choices were made. It was also used to simulate the response to alternatives that were not directly posed.

The CBH and ACA components of the study were integrated using a calibration technique developed by KBA in consultation with Sawtooth Software. This technique adjusts the ACA derived price attribute to ensure that ACA simulations align with CBH outcomes. In the process, the tendency for ACA to over-predict demand for feature rich expensive products (particularly amongst price-sensitive customer segments) was avoided.

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This calibration methodology employed is relatively sophisticated. It produces a database of adjusted part-worth utilities that can be used to produce simulations that closely match actual choice outcomes.

The part-worth utility database can then be used both to describe "preference segments" (segments comprising customers with similar preferences) and to determine the "value price" associated with current or potential service offerings (i.e. the price customers would be willing to pay). This was important because in some cases another objective of the research was to provide a platform for the development of enhanced value propositions and higher value strategies at an individual customer segment level.

#### Why This Approach Was Selected

A number of alternative approaches were considered in relation to both the survey method and the underlying analytical techniques.

It was clear from the outset that using central locations would be the best way to approach the survey. However a great deal of consideration was given to the question of which analytical technique to employ. Ultimately it became apparent that a form of calibrated conjoint questionnaire based on direct choices (CBH) and ACA was the most appropriate.

#### Survey Method

KBA's experience has shown that recruitment of respondents to central locations is generally the best way to administer consumer interviews using PC-based techniques. The main advantages are in the efficiency of the approach and the ability of the team to minimise measurement error.

The two primary alternatives are:

- A diskette mail-out (or perhaps an Internet-based approach), and
- Face-to-face interviews.

The first is far too prone to measurement error and non-response bias. It also does not provide the opportunity for respondents to touch and feel what is being tested (such as an Aerial Bundled Conductor cable).

The second is far too expensive for this type of consumer research. In a study of this nature, it is desirable to have both technique (KBA) and technical (distributor Network Engineering personnel) experts present at the interview. This is both difficult and expensive in face-to-face consumer interviews – although it is effective with industrial customers. KBA's experience is that the cost of face-to-face interviewing is approximately five times that of the central location method. Even if only

one interviewer were used, the additional time and cost involved would be prohibitive.

The extremely long time period needed to conduct face-to-face interviews would mean that a large number of staff would be needed. In all four cases, Network Engineering staff would not have been able to participate in all of the interviews and it would therefore have been very difficult to maintain continuity and consistency at a level equivalent to that provided by the central location interviews.

#### Analytical Technique

To meet the objectives of the research, KBA was faced with two fundamental questions in relation to which analytical technique to employ.

- Whether to use a full profile technique (such as CBC), or an adaptive technique (ACA)
- If ACA was used, how to overcome the ACA Price Effect

Full profile techniques such as CBC do not work well when the number of attributes is greater than six, or when full transparency is required at the level of the individual respondent (Oliphant et al., 1992). In all four studies, it was not possible to get the number of attributes below ten. It was also important to be able to analyse the data at the level of the individual respondent – and to easily combine respondents to form preference segments.

ACA is generally regarded as a powerful approach to use when the number of attributes is ten or more (Green and Srinivasan, 1990). Studies have also shown that ACA can even outperform full-profile techniques when the number of attributes is as low as five (Huber et al., 1991). However if ACA is used, it is important to put in place a mechanism to test for the existence of the ACA price effect, and to adjust for it if it does manifest (Pinnell, 1994).

Since KBA was relying on CBH rather than ACA for the main findings of the research, managing the ACA price effect was less critical. However it was present, and was removed by calibrating the ACA price utility to ensure that ACA simulations matched choice outcomes.

Details of the calibration technique are provided in the appendices.

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## **A NEW PERSPECTIVE**

The primary purpose of this submission remains to provide the IPART team with important information associated with research undertaken by KBA and its clients that is very relevant to terms of reference for its current review. However we felt it appropriate to offer KBA's perspective on different approaches that IPART could chose to adopt in relation to the issue of customer value creation in general and undergrounding of electricity cables in particular.

If IPART were to embrace the approach which KBA advocates, then it would herald a shift from a focus on the pursuit of economic efficiency to one that ensured energy distributors provided services that were in the long-term interest of individual customers, the wider community and the environment – as well as enabling distribution companies to create wealth for their shareholders on an ongoing basis. While few would argue that these alternative objectives are anything but entirely appropriate, most would not appreciate that the pursuit of economic efficiency alone can never deliver such outcomes.

To demonstrate this point, we will firstly look at the issue of shareholder wealth creation – a fundamental obligation of all publicly listed participants in the industry and an entirely legitimate objective for government owned commercial entities. We will then look at the relationship between customer value creation and shareholder wealth creation and demonstrate the importance of the former in generating the latter on an ongoing basis. Finally, we will use this understanding to re-examine the issue of undergrounding electricity cables and the issues related to customer value creation and shareholder wealth creation that surround it.

#### Shareholder Wealth Creation

The senior management team of any listed entity has a fundamental obligation to enhance the value of the capital with which they have been entrusted by shareholders.

Creating shareholder wealth means a management team must deliver performance in excess of expectations, or convince the capital markets that they have a strategy in place that will enable them to do so. This because the nature of the capital markets is such that shareholders must pay for all of the future financial performance that a company is expected to deliver at the time that they invest. So unless performance exceeds expectations, the value of the company will not rise and the value of the shareholders' investment will not increase. Over time, unless the return shareholders receive from both dividends and share price appreciation exceeds their opportunity cost of capital, then their wealth will actually be diminished.

Conserving the wealth of shareholders in a business requires that the Total Shareholder Return or TSR must equal the shareholders' cost of equity capital. Contrary to popular belief, a Return on Equity (ROE) greater than the Cost of Equity (Ke), a Return on Investment (ROI) greater than the Weighted Average Cost of Capital (WACC), or the delivery of an Economic Profit (EP), do not mean that wealth has been created. They simply mean that, if such performance can be sustained, the market value of the business will be greater than its book value. This is usually of little consequence to an investor who has paid market price.

The situation is illustrated in Figure 5 below. In this example, wealth is only created if management is able to increase the \$300m market value of the business



FIGURE 5. Understanding Economic Profitability

But if it succeeds in doing so and the share price rises, someone had to pay the new and higher price. Their principal concern will be whether or not they are able to get a return on the market value of their new investment. Will it increase in value, remain the same or reduce in value.

The main insight arising from this thinking is that, if management is to create wealth for shareholders on an ongoing basis, then it is faced with the somewhat daunting challenge of having to continually exceed financial performance expectations that are themselves continually increasing. This challenge is portrayed in Figure 6.

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#### FIGURE 6. The Challenge for Management

The only way to respond to this challenge is to continually seek to identify higher value strategies that, when implemented successfully, will deliver greater long-term cash flow than the current strategy.

#### Linking Customer Value and Shareholder Wealth

Succeeding in the ongoing pursuit of higher value strategies depends on unlocking and harnessing the creative potential of an organisation. It also requires an understanding of the relationship that exists between customer value creation and shareholder wealth creation and their acceptance as joint and mutually re-enforcing goals.

In seeking to develop higher value strategies, it is important to remember that all businesses operate in two markets: the market for their products and services and the market for shareholder capital. Winning in the product market means creating more value for customers than the competition. This success should be reflected in increased revenues resulting from higher prices, greater market share or perhaps both. Winning in the capital markets means creating more wealth for shareholders than the competition. A company's ability to do this on an ongoing basis is closely linked to its ability to firstly create additional value for customers and then recapture a reasonable proportion of that value in the form of increased revenues through an appropriate pricing policy. How much of this incremental revenue stream is converted into incremental cash flow for shareholders depends upon the efficiency of the organisation. Real commercial success means winning in both markets, but the wealth creation cycle begins with customer value creation. Because of this, the cycle operates at the level of a properly defined customer segment.

Within each and every individual customer segment, there is a fundamental relationship between the creation of customer value and the creation of shareholder wealth. As illustrated in Figure 7, these two goals are linked by the efficiency with which incremental revenues arising from customer value creation are translated into incremental cash flow and ultimately shareholder wealth creation.





## Implications for Undergrounding Cables

The thinking presented above poses a problem for a regulatory regime focused on encouraging economic efficiency and ensuring that a significant proportion of any economic benefits are passed on to consumers through lower prices. Implicit in the current regulatory frameworks appears to be a belief that perhaps the best way to create value or benefit for consumers is to reduce the price that they pay for a particular product or service – or even to offer them additional value at the same price. Our experience is that are many other and better ways to create value for customers and in so doing create other community benefits. As we have seen from the research in this case, there is no doubt that consumers would appreciate lower prices. But they also value higher reliability, greater safety and enhanced aesthetic amenity – and many are prepared to pay for this.

By focusing mainly on price controls as a way to pass on benefits to consumers, the regulatory framework will encourage "commoditisation" in the same way as has already occurred in many competitive markets. One of the main drivers of commoditisation is companies making the mistake of adding customer value and then trying to force their competitors (rather than their customers) to pay for it by recapturing their investment through a market share gain. In the process, prices are held down and valuable but non-essential features are "engineered out" in an effort to reduce costs and prices. Long-term investment in infrastructure will also tend to be minimised.

What is required is a mechanism that permits value-pricing, or pricing on the basis of benefits received. If an electricity distributor is able to create value for customers by delivering higher reliability (or any other incremental benefit) at an incremental cost that is lower than the incremental price that its customers are prepared to pay, then it will be possible to enhance cash flow and create wealth for shareholders. But if the regulatory regime effectively prevents the distributors from recapturing any additional value created for customers in the form of incremental price rises, then there is little if any incentive to create that value.

With virtually no access to incremental revenues through value-pricing, it is impossible for distributors to establish a wealth creation cycle within their customer segments. This leaves their management in a very difficult position. The only option they have to improve financial performance is to reduce costs or pursue capital efficiency gains. But as is demonstrated in Figure 8, cost reduction alone will never enable them to meet (let alone exceed) shareholder expectations on an ongoing basis. At the same time, the continual pursuit of cost reduction opportunities makes it virtually impossible for them to build mutually beneficial relationships with their customer base over time.

The fact is that no company can save its way to prosperity. Many have tried but none have succeeded. Figure 8 presents the reason why.

The top half of the diagram illustrates a value trajectory for two businesses: one that is conserving the wealth of its shareholders by delivering a TSR equal to Ke (the full line); and one that is creating wealth by delivering a TSR greater than Ke and is on track for a doubling duration of 5 years. If revenues are held constant in real terms, then the only way to conserve wealth and deliver a TSR equal to Ke is to halve the costs of the business every five years – something that few businesses can sustain. To create wealth costs must be halved more quickly than this. A five-year doubling duration requires costs to be halved every 3 years.

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#### FIGURE 8. Why No Company Can Save Its Way to Prosperity

Cost reductions and capital efficiency gains can create wealth – but only for a short period of time. They are not sustainable in the longer term. As is suggested in Figure 9, after one or two years, the focus must switch to growth through disciplined innovation.





In the case of the electricity distribution industry, a continued focus purely on cost reduction and capital efficiency gains in an effort to deliver lower prices will eventually lead to a reduction in investment by the network operators. This is because it will not be able to conserve the value of its shareholders' investment – let alone create wealth for them. Almost certainly, this will ultimately lead to a reduction in customer and community value through lower levels of reliability, safety and aesthetic amenity. The result would be the absolute antithesis of the wealth creation cycle so necessary for the ongoing creation of both customer value and shareholder wealth – and to enable distributors to strike an appropriate balance between the achievement of both economic and social objectives.

KBA holds the view that being in business is an opportunity to serve a group of customers (and in this case the wider community) rather than to exploit them. While industry regulators have a responsibility to prevent exploitation, they must also facilitate the delivery of what customers and the wider community actually want. In a fully informed and efficient market, prices are set on the basis of benefits received. There is no constraint on the delivery of additional benefits to customers (or the wider community), so long as the customer believes that the value that they receive is greater than the price that they are being asked to pay.

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## **CONCLUDING REMARKS**

Undergrounding electricity cables is an issue of some magnitude for the state of NSW. While the information presented in this submission does not provide all the answers, we trust that it will assist IPART in better understanding some of the questions.

In the face of the information summarised in the first two parts of this submission and the thinking outlined in the third, in many respects it is difficult to argue against the idea of undergrounding electricity cables.

- Many consumers want it to occur and are prepared to pay a price commensurate with the cost of implementation.
- More would accept it if the price fell through either improved installation technology or by sharing the conduit with the rollout of telecommunication or other cable infrastructure<sup>3</sup>.
- There are clear community benefits and the positive impact on the environment is obvious.

There is also the potential benefit of significant job creation – funded at least in part by the increase in wealth that has occurred through the improvement in property values in recent years in those parts of NSW most likely to be affected.

Many issues remain to be addressed, such as whether such an initiative would be rolled out on a street-by-street, block-by-block or feeder-by feeder-basis. It is also unclear whether the work would be best managed and the costs best recovered by electricity distributors, retailers or local councils. When working on the studies we have referred to in this submission, it was clear that the consensus amongst all those involved in the work was that local councils would need to be active and willing participants in the process and that it may even have been appropriate for them to orchestrate the roll-out and to recover the associated costs from residents.

As with most endeavours of this type, Network Engineering many staff within each of the electricity distributors have excellent ideas as to how to overcome the innumerable small issues that would undoubtedly arise if a decision were taken to move forward with an undergrounding initiative. One such idea was to permit fixed income residents of streets being undergrounded to defer payment and allow a charge to be made against their property – with the liability being extinguished on transfer of the property.

<sup>&</sup>lt;sup>3</sup> At current prices, these people would choose Aerial Bundled Conductor

KBA had little or no knowledge related to electricity supply infrastructure before the commencement of our work in the industry in 1997. We certainly had no *a priori* views on the subject. But by the time we had completed the four studies discussed in this submission, and helped a number of distributors prepare submissions to their respective regulators, we were very much persuaded that undergrounding power was likely to be in the long-term interest of the residents of cities in both NSW and Victoria.

We appreciate the opportunity to make this submission and would be more than happy to consider providing additional information if requested by IPART.

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КВА

## **APPENDIX 1 – DETAILS OF KBA METHODOLOGY**

This paper, entitled:

#### **Calibrating Price in ACA**

The ACA Price Effect and How to Measure It

was written by Denis Kilroy and Peter Williams of KBA in February 2000. It was presented by Peter Williams at the annual Sawtooth Software Conference which in 2000 was held at Hilton Head Island, South Carolina.

(See Appendix 1.pdf)

# CALIBRATING PRICE IN ACA: THE ACA PRICE EFFECT AND HOW TO MANAGE IT

**Peter Williams and Denis Kilroy** The KBA Consulting Group Pty Ltd

## ABSTRACT

The tendency of ACA to underestimate the importance of price has been widely recognised over the last few years. Dual conjoint methodologies have been developed to address this issue. This paper proposes an alternative to dual conjoint. This new technique overcomes the "ACA price effect" by integrating ACA utility scores with the output of a series of explicit holdout choices.

Preference segments are developed from explicit choices made by respondents. A weighting factor for price utility is calculated for each segment. This is achieved by adjusting price utility so that ACA simulations closely align with holdout results.

Unadjusted ACA utilities match holdout responses very well for price insensitive respondents. However, significant adjustments are required for more price sensitive preference segments.

### INTRODUCTION

#### **Objectives**

This paper has three objectives:

- To provide a brief description of the pricing problems that occur in ACA and to discuss potential methodologies for countering them
- To introduce a new method of adjusting ACA utility data to compensate for any inaccurate price signals that may exist
- To provide a starting point for further work and discussion

## THE ACA PRICE EFFECT

Conjoint analysis has been utilized for a wide range of market research purposes over the last twenty years. One of its main applications has been to predict the potential demand for new products or services, and to establish the price that customers are willing to pay for them (Wittink et al, 1994).

A very popular conjoint technique is Adaptive Conjoint Analysis (ACA). ACA was introduced by Sawtooth Software in 1987 (Johnson, 1987), and is used extensively by marketing professionals in both the USA and Europe (Wittink et al, 1994).

One of the main advantages of ACA is that it allows the researcher to study more attributes than a respondent can evaluate at one time. This avoids the problem of "information overload" which can occur in full-profile studies when the number of attributes is greater than five or six (Green and Srinivasin, 1990). A typical ACA study uses between eight and fifteen attributes (Orme, 1998).

One of the most important outputs of a conjoint study is related to price. Understanding price utility allows researchers to:

- Forecast the effect of changes in price on customer demand for either a new or an existing product or service
- Quantify in dollar terms the benefits that individual product or service features provide to customers, and compare these with the cost to provide them.

Over the last few years researchers have found that the importance of price is underestimated in many ACA studies (Pinnell, 1994; Orme, 1998). This is obviously of great concern, and a number of methods have been developed to counter this effect (hereafter referred to as the "ACA price effect").

Most pricing studies make use of either traditional full-profile conjoint (for example Sawtooth Software's CVA package) or choice-based conjoint (for example Sawtooth Software's CBC package) techniques. However neither of these techniques is appropriate when the number of attributes to be studied is greater than about five or six. This problem has left researchers with a challenge to find a technique that has the ability to investigate large numbers of attributes, and still obtain accurate information about price utility.

A possible solution to the problem involves the use of dual conjoint methodologies (Pinnell, 1994; Sawtooth Software, 1999). If two conjoint studies are conducted in the one interview, then the first section can use ACA to obtain information about a large number of attributes, and the second section (utilising another conjoint methodology) can be used to obtain information about price and two to three other key attributes.

This paper proposes an alternative form of conjoint that integrates ACA utility scores with the outputs from a series of choice-based holdouts (CBH). The result of this is a set of calibrated utility scores that have had their price utilities adjusted to overcome the ACA price effect.

## **OVERVIEW OF PROPOSED METHODOLOGY**

The study methodology is based on the combination of ACA and CBH. In this paper it is applied to a ten-attribute study of approximately 1000 respondents, which was completed for an electricity distributor. The decision process was highly involved and required respondents to carefully consider the impact that their decisions would have over both the short and long term. Interviews were strictly managed at central locations so that all respondents received a thorough introduction to the concepts and components of the questionnaire. This ensured that respondent carefully considered their options and made meaningful decisions. The prices of some options offered were significantly more than the respondents were currently paying.

ACA is best used when:

- The number of attributes involved in the study is larger than six
- The decision process being investigated is one in which consumers use substantial depth of processing (Huber et al, 1992)
- The number-of-levels effect needs to be minimized (Wittink et al, 1999)
- Individual level analysis is required

The study highlighted in this paper met all of these criteria. However due to the ACA price effect, ACA alone was not sufficient.

CBH (which is a series of explicit holdout choices) was structured so that the ACA price utility could be calibrated. As well as being the measure against which ACA was judged, it was also used to identify preference segments and to display results in a stand-alone manner.

Since the core structure of CBH was for a client-specific purpose, the results presented in this paper are not as open to generalization as would otherwise be the case. However many of the ideas behind the techniques demonstrated are still applicable in other situations, and could be used for calibrating "pure" dual conjoint studies. (This study is not a "pure" dual conjoint study, as utilities cannot be calculated from CBH in isolation.)

## WHAT IS THE ACA PRICE EFFECT?

#### **Recognising the ACA Price Effect**

The clearest evidence of the ACA price effect is a simulation that severely over-predicts share for a feature-rich product (Pinnell, 1994). For a respondent who always tends to select the cheapest product available, the amount of extra utility that they place on a low price over a higher price level must exceed the utility from all the extra features that accompany the higher priced products. If it does not, then a simulation will incorrectly predict that the respondent will select the feature-rich product at a higher price.

As shown below, at the individual level the output of an ACA simulation may indicate that a respondent prefers the expensive feature-rich product to the budget product. However, this is a problem if the respondent actually selected the budget product when presented with an explicit choice. While the price level in the budget product has a significant amount of utility, it is not enough to counter the combined impact of the added features in the expensive product.



Holdout choices are an excellent means of identifying price underestimation. Both internal consistency and the underestimation of price utility by ACA can be examined by comparing ACA predictions with actual holdout choices (Johnson, 1997).

The ACA price effect can be best illustrated through the use of an example. An ACA simulation was compared with results from a holdout choice (consisting of three options) administered after the ACA questions were completed.

#### Example:

The three options consisted of a top-of-the-range feature-rich (expensive) product, a midrange (mid-priced) quality product, and a budget-priced basic product. The results below show that while the simulation predicts that 66% of respondents would select the feature-rich product, only 20% of respondents actually did when presented with that holdout choice.

For this example, it is clear that using the results of ACA in isolation would result in an incorrect conclusion being drawn from the analysis, and ultimately would lead to flawed strategy development.



#### What Causes It?

There are a number of theories as to why the ACA price effect occurs. These include:

- Inadequate framing during importance ratings
- Lack of attribute independence
- Equal focus on all attributes
- Restrictions on unacceptable levels

#### Inadequate Framing During Importance Ratings

Perhaps the most difficult part of an ACA interview for respondents to understand and answer accurately is the section known as "importance ratings". In this section, respondents are asked to indicate the level of importance they place on the difference between the highest and lowest levels of each attribute included in the study. The purpose of doing this is to refine the initial utility estimates before the trade-off section begins.

Assigning importance ratings to attribute levels in this way can be a difficult task – particularly when respondents do not know what other product attributes will be offered.

If an attribute related to the reliability of electricity supply has levels ranging from one blackout per annum to three blackouts per annum, then the respondent may rate the difference between one and three blackouts as being very important. If the next attribute tested is price, with levels ranging from \$0 to \$1,000 per annum, then the difference of \$1,000 would almost certainly be assessed as very important as well.

However, if both attributes are rated as very important, then ACA would initially assign utilities to these attribute levels consistent with the respondent being prepared to pay \$1000 to reduce blackout incidence from three to one per annum. Clearly if the importance of different attributes is to be captured accurately, respondents must be provided with some context so that they can frame their responses correctly.

If the respondent knew in advance that the next question was going to ask them about a large price difference, then they would probably realise that the number of blackouts per annum. is not as important as they might otherwise have thought.

It can also be beneficial to order the importance rating questions so that they are structured in a similar manner to the "calibrating concepts" section. Therefore, the researcher may show what they believe is the most important attribute first and the least important attribute second.

While respondents should not be told this (as everybody may have different opinions), at the very least this ordering will help to better define the boundaries of what "importance" means. This "framing" will also help to ensure that the initial pairwise trade-offs are meaningful.

#### Lack of Attribute Independence

If an ACA study is conducted on the price, performance and colour of cars, then a respondent who rates the colour "red" highly because they believe that red cars go faster (ie. Superior performance), has contravened the main-effects assumption. When a simulation is run, the effect of performance is double-counted because the respondent has attributed performance-related utility to both the colour and performance attributes.

This error serves to underestimate the importance of price. However, the effect can also work in reverse. If the respondent assigns a low rating to performance because they believed that a high performance car would always come at a high price, then the effect of price is effectively being double-counted, and its importance will be overstated.

Either way, these errors are preventable and should be countered by clear explanations and examples at the beginning of the questionnaire. For a very difficult questionnaire it may be worth including a short dummy conjoint exercise at the start that is not used for utility calculation. The extra time that this takes could well be insignificant compared with the increased efficiency with which the main exercise is completed.

#### Equal Focus on All Attributes

The partial-profile design of ACA forces respondents to consider all attributes. In a fullprofile study, respondents may well focus on only those attributes that are more important to them (and take less notice of those attributes that are less important). Respondents are less likely to be able to employ simplification strategies such as this with ACA. Consequently, the importance of each attribute is likely to be more similar with ACA (Pinnell, 1994) than with fullprofile techniques.

For example, if the price range tested is quite large, then price will naturally be one of the most important attributes. If ACA forces respondents to place more focus on other attributes than they would have in full-profile, then this will serve to underestimate the importance of price.

#### **Restrictions on Unacceptable Levels**

ACA permits the respondent to narrow the focus of a study by indicating which attribute levels are unacceptable. For most studies it is not appropriate for the researcher to allow price levels to be deemed unacceptable. In others it may be important to permit levels to be deemed unacceptable, but there is a risk that in doing this errors will be introduced.

It is difficult to ask respondents to rate a price level as unacceptable or not if they are not fully aware of the benefits of the product they are evaluating. This is particularly true in the case of new products or services. Many respondents may be quite clear about the maximum that they would pay for a new car or personal computer. However, it is much harder for them to put a limit on the price they would pay for products or services that they have never been exposed to, or that they have not been asked to consider before - such as value-added services provided by utility companies.

The problem for the researcher is two-sided. It is clearly undesirable for a respondent to be permitted to rate a large number of attribute levels as unacceptable at the start of the survey - particularly when demand for new or unfamiliar products or services is being studied. Nevertheless if respondents are not given the right to deem a particular price level to be unacceptable, then they may be forced to consider price levels that in reality they would never be prepared to pay.

If a respondent is not allowed to rate a price level as unacceptable, then this level will receive more utility than if it was rated as unacceptable. This will serve to understate the importance of price.

## **OVERCOMING THE ACA PRICE EFFECT**

#### **Quantifying the ACA Price Effect**

The key to overcoming the ACA price effect is to be able to quantify it. Since the price utility calculated by ACA may be suspect, another methodology must be used which accurately assesses the impact of price.

One method for achieving this is through the use of "dual conjoint". Dual conjoint can be described as two consecutive conjoint studies utilising different methodologies to obtain information on the same subject.

The first study may use ACA, with the second study usually focussing on price and two or three other key attributes. The first study enables the researcher to collect detailed information on a variety of attributes (which may or may not include price), while the second study can be used to calculate accurate pricing information.

Full-profile methodologies are often used as the second study in dual-conjoint projects. These methodologies include:

- Traditional full-profile conjoint (eg. CVA)
- Choice-based conjoint (eg. CBC)

The two studies can be either compared, or the results can be combined or calibrated to form one set of utilities. It must be noted that on many occasions researchers undertake dual conjoint studies to compare the different perspectives offered by ratings/rankings-based versus choicebased techniques. As each technique has different strengths and weaknesses, many researchers (if time and money permit) employ both techniques to "cover their bases". However this usage of dual conjoint is not addressed in this paper.

This paper focuses specifically on the use of holdout choices ("Choice Based Holdouts" or CBH) for the second study. While CBH is not actually a conjoint methodology, it is used to calibrate conjoint utility scores from ACA. This differs from standard holdout choices, which are purely used to check the predictive ability of the conjoint model.

At a general level, there are three advantages to selecting CBH as a method for countering the ACA price effect.

- CBH allows full control over the choices presented to respondents. It is undesirable to have restrictions (prohibited pairs) on the attribute levels that can appear when using traditional full-profile or CBC techniques. However restrictions are hard to avoid if certain combinations of attribute levels naturally tend to be associated with one another (eg. higher quality products should appear with higher prices so that the choices make sense to respondents). CBH allows the researcher to present realistic choices that may exist in the marketplace (Johnson, 1997). CBH cannot be used to calculate utilities, but can be used to calibrate those generated by ACA.
- CBH can be used in its own right. If the researcher is able to formulate choices that are realistic and meaningful, then the output from the choice questions can be presented (ie. results such as "when presented with three options, 28% of respondents selected option A"). While some managers may never really come to terms with the somewhat abstract

nature of "utility" derived from ACA, CBH is something that they can view as unambiguous. However such analysis is obviously restricted to the choices shown in the questionnaire, and the flexibility provided by ACA to simulate a variety of potential product offers is not available. If CBH is used as the primary method of research, ACA can be used to help explain why respondents made the choices that they did.

• The nature of CBH means that it is less time-consuming (and therefore cheaper) and less complex than many dual conjoint methodologies. Depending on the nature and purpose of the research, this factor may have a strong influence on the choice of methodology.

## **METHODS FOR CALIBRATING PRICE UTILITY**

#### Introduction

In the absence of an actual purchase decision, most studies use CBH as a proxy for customer behavior. Therefore any conjoint model which produces results significantly different to CBH has a problem. For example, if a CBH question has three options (feature-rich, mid-range, and budget), then an ACA simulation with three products should produce a similar outcome (assuming a "none" option is not appropriate). If the simulation severely over-predicts the share for the feature-rich product (relative to CBH), then the ACA price effect exists.

A number of methodologies for calibrating price utilities can be used:

- Compare the share predicted by ACA and CBH and apply a single weight to all respondents' price utilities so that the ACA simulation and CBH results match at the aggregate level
- Identify utility importance segments using cluster analysis and use the method above to adjust each segment
- Use regression to adjust each respondent's price utility individually to better predict their CBH results

However, there are a number of problems with each of these methodologies.

Comparing overall ACA simulations with CBH aggregate results does not identify any lack of internal consistency within the questionnaire. It is possible for the overall ACA simulation to match CBH results (to a satisfactory degree of accuracy), but at the individual level for the predictive validity to be much lower.

For example, in a study of 140 respondents, both ACA and CBH may predict that 100 respondents prefer product A, and 40 respondents prefer product B. A problem exists if the two methodologies do not agree on which respondents would select each product. If ACA and CBH only overlap in their prediction of preference for product A by 80 respondents, then the two methodologies only match for 80% of choices for product A, and for only 50% of choices for product B (the model performs no better than a simple coin toss).

Identifying segments that are influenced differently by the ACA price effect using utility importance is a difficult task. Not only do different respondents have different sensitivities to price, they may also be influenced differently by the ACA price effect. This makes identifying a homogenous segment very difficult.

Calibrating price at the individual level is theoretically the best way to align ACA and CBH. However the presence of any reversals (such as when a respondent appears to prefer a higher price level to a lower one) in the data makes calibration difficult.

If a weighting factor is applied to price utilities that are in the wrong order, then the magnitude of the reversal will increase. When these respondents are combined with other "clean" respondents, then aggregate utilities will appear more distorted than before the calibration took place. While the reversals could be artificially removed before calibration, this approach has implications that are beyond the scope of this paper.

#### Using CBH Segments

A potential segmentation methodology involves the use of CBH data. Examining the pattern of CBH responses can identify the importance of price to respondents.

A respondent who consistently chooses high-priced feature-rich products in CBH is unlikely to have the importance of price underestimated by ACA. Quite simply, price isn't particularly important to them. However, a respondent who makes all their choices based upon the cheapest price available is a strong candidate for the ACA price effect. Unless the lower price levels have extremely high utility, then simulations may predict that the respondent would choose a more expensive option if it contained enough features. If the mid-priced option is one price level more expensive than the cheap option, then the difference in utility between these two price levels must exceed the total difference in utility for each attribute that is enhanced in the mid-priced option.

A simple criterion for identifying price sensitivity segments is to count the number of times that the respondent chooses an option at a certain price (assuming that multiple CBH questions are asked on similar products). If each choice contains a high-priced (H), mid-priced (M) and low-priced (L) option, then a respondent may be considered relatively price insensitive if they choose the high priced option the majority of times. This allows the H segment to be identified. Similarly, respondents who choose the other two options the majority of times may be characterized as belonging to either the M or L segments.

Once segments have been identified, an extremely important cheek is to calculate the average utility importance for each one. If there is no obvious difference in utility importance between segments, then the study has very little internal consistency between ACA and CBH, and is of questionable value.

The main focus is to examine the ability of ACA to predict CBH results for each of the three price segments. When evaluating ACAS's predictive ability, the most important factor to monitor is the percentage of respondents for whom ACA correctly predicts the CBH response. If the hit rate is high, it automatically follows that the predicted market shares will be similar. However, if the predicted shares are similar, it does not necessarily follow that the hit rate (ie. the internal consistency) is high.

The predictive ability of ACA for each of the segments is likely to be quite different. The H segment is not price sensitive, and will probably require little or no adjustment to the ACA utilities. Some adjustment will need to be made to the M segment, and it is likely that substantial adjustment will need to be made to the L segment. For the L segment, the utility for low price

levels will have to be high enough so that it outweighs all the extra utility available from more expensive options.

The above methodology is best illustrated through the use of a simple example.

#### Example:

Segments were identified by analysing the overall pattern of respondent preference to nine of the holdout choices presented. Of the ten attributes in the study, each of the nine key holdout choices presented comprised only five of these attributes. The remaining attributes were set to be equal (and were examined in separate holdouts not detailed in this paper). The utility importance determined using ACA for each of the three segments is shown below (using Points scaling).

The number of respondents in each segment was 231 in H, 592 in M, and 146 in L.

The utility importance of each of these five attributes is "pointing in the right direction".

- The price attribute shows that the L segment places the most importance on price
- The importance of attribute 1 is flat across all segments, as attribute 1 was a fundamental attribute that wasn't seen as a luxury
- The importance of attributes 2, 3 and 4 indicates that the H segment values them more than the M segment, which values them more than the L segment. These three attributes are all luxuries, so this trend in the level of importance is to be expected.

	Segment			
Attribute	Н	М	L	
Price	59	67	77	Price trend as expected
Attribute 1	45	45	45	
Attribute 2	64	58	40	Similar importance
Attribute 3	28	24	21	due to
Attribute 4	59	35	29	attribute levels

Additionally, of the three options presented in each choice, some of the attribute levels were common. This allowed ACAS's predictive ability to be scrutinized further.

For example, of the five attributes in each option, attribute 2 always appeared in the high priced and mid priced options at the best level, while attribute 4 always appeared in the mid priced and low priced options at the worst level.

• As attribute 2 is always set at the best level in the options used to identify the H and M segments, then it would be expected that it is one of the reasons why they chose those options. Respondents who fitted into the L segment would be expected to do so partly because they didn't really value the best level of attribute 2. As can be seen by the similar

utility importance for attribute 2 in the H and M segments, ACA supports the preference segments identified.

• A further example of this is provided by attribute 4. Respondents who fitted into the H segment did so because they really valued the top level, while those who chose M or L didn't place as much value on that level. The ACA importance for the M and L segments demonstrates their relative indifference to attribute 4.

The price sensitive respondents (segment L) place more importance on the price attribute and less on the other attributes available. However when a simulation is run which combines price with these attributes, the magnitude of the price importance is not high enough to cancel out the utility available from the other four attributes. The importance of the price attribute reported by ACA is "too flat".

To adjust the utility levels so that the results from a simulation are similar to CBH results, the price utilities must be enhanced by a scaling factor. The factors found to maximize the predictive ability of ACA were:

- H: no adjustment needed
- M: scaling factor of 2
- L: scaling factor of 4 (or greater)

These factors were determined by looking at the hit rate of ACA when applied to the nine key CBH questions. The scale factors were adjusted until ACA best predicted (at an individual level) the CBH results for each segment. This process ensured that the integrity of each individual interview was maintained. After the three segments were analyzed and calibrated, they were brought together.

The average utility function for one of the simulated CBH questions is shown below – before and after calibration. The average importance of the calibrated price attribute is about two times greater than before calibration. This is obviously significant - especially when calculations based on the dollar value of utility differences are performed.

When checking the validity of ACA simulations with CBH results, it is important to note that some options in CBH will have similar utility when simulated using ACA. If the utility of two options at the individual level is very close, then it is unreasonable to expect ACA to correctly predict the option that each respondent chose. A sensitivity allowance must be built into the calibration model to account for this effect.



#### Internal Consistency

A useful cheek of internal consistency is to repeat at least one of the CBH questions (Johnson, 1997). ACA results will not be able to predict CBH results if the CBH results themselves are inconsistent. However much care should be taken when repeating CBH questions. Respondents may detect that questions are doubled up, and therefore become suspicious about the motives of the questionnaire.

While in many cases it is desirable to repeat holdouts before and after the main conjoint task, this is not suitable for the ACA/ISBH approach. As ACA relies on respondents making maineffects assumptions, any CBH questions shown before ACA will only serve to confuse them. CBH questions are designed to reflect reality, so they will contain options that have lots of features and high prices, versus others with minimal features and low prices. It is undesirable for respondents to make any associations between levels (such as that a high price implies more features) before undertaking ACA, as this violates main-effects assumptions.

Another extremely important factor to consider is the order of CBH questions. If a respondent who prefers the feature-rich option is shown a choice which has this option at a high price, and then another choice which has the option at a low price, they will probably pick the feature-rich option both times. However, if they are then shown another choice with the feature-rich option at a high price once again, they may not select it, as they know that it is potentially available for the cheaper price. The respondent has had their preference 'framed'' by the range of prices previously shown.

## **O**THER ISSUES

Four other issues that must be addressed when designing an ACA/CBH survey are:

- Presenting meaningful choices
- The "number of attributes effect"
- The range of CB11 questions shown
- Accuracy of utility estimates for non-price attributes

#### **Presenting Meaningful Choices**

CBH relies on presenting respondents with meaningful choices. It is obviously easier to construct realistic choices after a study is complete. For this reason, it may be worth running a pilot ACA study that can be used to help formulate choices. When the main ACA research program takes place, the researcher can be sure that the choices that they are presenting are appropriate and will provide meaningful information. Alternatively, the researcher may already have a strong idea of the particular product configurations that they are hoping to test.

#### Number of Attributes Effect

If the choices used in CBH are not full profile (ie. only contain a subset of the attributes used in the study), then the weighting factor to be applied to the price utilities may be influenced by the number of attributes present in the choice. The weighting factors used in the previous example were based on holdout choices that contained five attributes of varying levels, and five attributes set at a constant level (according to main-effects assumptions). However, the weighting factor would probably be different if only two attributes varied, and eight were kept constant. It is therefore important that CBH is structured to reflect reality as closely as possible.

#### **Range of CBH Questions**

The range of CBH questions asked must be sufficient so that all price levels are covered. The calibration process effectively turns price utilities into a "plug" which adjusts a simulation so that it matches CBH results. If only one CBH question is asked, then it is possible to apply a weighting factor that implies that the respondent has a really strong preference for a particular option. While ACA is correctly predicting the option that the respondent chose, the calibration process has overwhelmed the fact that the respondent may have only just preferred this option. It is difficult to assess which option the respondent would have chosen if the pricing levels used

were slightly different, as a single CBH question gives no sense of how close the respondent was to choosing a different option.

However if multiple CBH questions are asked at different price points, then it is possible to assess the "strength of preference" that they possess for a particular pricing level. If ACA price utilities are calibrated so that simulations accurately predict a variety of CBH questions at different price points, then the researcher can be confident that the price utilities are quite robust.

#### Accuracy of Utility Estimates for Non-Price Attributes

Many of the problems with ACA that impact on the price utility estimation can also apply to other attributes. However the impact of these problems is likely to be different (and not as damaging) for non-price attributes. Price is a unique component of an ACA study, as in many cases it can be viewed as the only means of "taking utility away" from the respondent.



The product and delivery system attributes may be formulated based on 10-12 features which all add to the utility that the customer derives from a value proposition. If these attributes are enhanced, the net customer value will also increase unless other attributes are made less attractive. In most cases it costs company money to provide extra product features. The price must be increased to cover this cost. This means that price is usually the only attribute that is used to subtract utility from an enhanced product offer (as switching costs are often too intangible to include).

The price attribute also comes to the fore when performing calculations such as the dollar value of attribute enhancements. The utility of price is the critical factor when converting the utility values of other attributes into more tangible units such as dollars.

While price may not be the only attribute which needs adjustment in an ACA study, it is often the attribute which most needs to be accurate. The effect of incorrectly estimating utility for other attributes is in many cases not likely to significantly impact on the findings of the study (although this of course is dependent on the purpose of the study). It is the unique role of price that makes it such an issue.

## CONCLUSION

While there is much written about the merits of a dual conjoint approach, there is little documentation available on the mechanics of performing this technique. This is unfortunate, as

many researchers simply cannot condense the number of attributes to be tested down into a form that can be used exclusively by choice-based or traditional conjoint, and still meet their research aims.

The techniques used in this paper can be summarized as follows:

- In the absence of an actual purchase decision, CBH choices provide a strong basis for predicting respondent choices. By asking the respondent to choose between a range of options, real-world purchase decisions can be simulated. The pricing signals evident from these choices can be used to calibrate pricing signals emerging from the ACA study.
- The dual ACA/CBH approach is useful as it allows the researcher to present managers with the responses from CBH. ACA utility data can then be used to illustrate the drivers of these choices. If ACA is calibrated so that it accurately predicts CBH, ACA can be more confidently used to present results from hypothetical choice simulations that the respondent did not directly evaluate.

The dual ACA/CBH approach was developed to meet a specific aim for a particular project. In many ways it is a "fix", and it may not be suitable for all projects. However as ACA will undoubtedly continue to be used to address projects with large numbers of attributes, it is important that researchers are able to achieve correct pricing signals. The dual ACA/CBH approach enables ACA to be used to develop robust strategies involving many attributes. Until other methodologies are further developed, this approach provides a sound basis for researchers and managers.

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## **APPENDIX 2 – REVIEW OF KBA METHODOLOGY**

This review was completed by Dick McCullough, President of Macro Consulting – a market research consultancy based in Palo Alto.

(See Appendix 2.pdf)

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# **COMMENT ON WILLIAMS AND KILROY**

Dick McCullough MACRO Consulting, Inc.

## Introduction

This paper, to my mind, epitomizes the Sawtooth Software Conference: it has real-world applicability, it is thorough and rigorous in its analysis and it is presented in such a straightforward and clear manner that it is accessible to almost any reader. It is a useful and interesting paper that raises many important issues.

The paper discusses two main topics:

- Sources of the ACA price effect
- A proposed adjustment to eliminate the ACA price effects.

I will make a few comments on both these topics.

## Sources of the ACA Price Effect

It would be desirable to minimize, or ideally eliminate, the ACA price effect by removing as much of the source of the effect as possible before making any post hoc adjustments.

One source of the effect identified by Kilroy and Williams is attribute additivity. Due to the large number of attributes that may be included in an ACA study, it is possible for a number of attributes, each with fairly low utility, to, in sum, overwhelm a price attribute that has a fairly large utility. For example, a product with nine attributes each with level utility of .2 (and a price level utility of .2) will have greater total utility than a product with a price utility of 1.5 (and nine attributes with level utilities of 0).

Attribute additivity can be a serious problem that will affect any trade-off method that attempts to accommodate a large number of attributes. One approach to counteract this effect is to limit the number of attributes included in the calculation of total utility (in the model simulation stage) for each individual to that individual's top six most important attributes. That is, if three products are being modeled simultaneously in a market share model and 10 attributes are included in product specification, for each product and each individual, include only those top six (out of the total 10) attributes in the calculation of total utility for that individual.

The rationale would be similar to that of limiting the number of attributes in a full-profile exercise to six: respondents cannot consider more than six attributes at a time when making a purchase decision. By limiting the number of attributes to six in the simulator, the attribute additivity problem would be diminished and the purchase decision process may be more accurately modeled.

Another source of the ACA price effect identified by Kilroy and Williams is attribute independence. Some attributes may interact with others, violating the main effects assumption of ACA. For example, in the importance ratings section of ACA, a respondent may be asked how

important the color red is versus the color blue in the context of new cars. Their true opinions, however, may depend on what type of car the color is applied to. They may prefer red on a high-priced car (such as a sports car) and blue on a lower priced car (such as a family are).

This is an extremely serious problem for all trade-off methodologies that involve some form of direct questioning or self-explicated scaling, not just ACA. The larger question that should be raised is whether self-explicated scaling is appropriate for all types of attributes. Kilroy and Williams have identified a problem with attributes that are dependent on other attributes, i.e., interact with other attributes. But can we determine if there are other types of attributes that are also inappropriate for self-explicated scaling? Are there other, operationally convenient ways to characterize inappropriate attributes? This issue deserves additional attention in the literature and I am very happy that Kilroy and Williams have raised it here.

Kilroy and Williams also cite attribute framing as a potential source of the ACA price effect. Without knowing what attributes are coming next, a respondent might give the strongest importance rating to the one presented first. For example, if the price attribute follows any other attribute, i.e., is not the first attribute to be rated in the importance section, then it may be rated as only equally important to another attribute that the respondent, in reality, does not feel is as important as price.

A simple antidote to this problem would be to review all attributes with the respondent prior to conducting the importance rating exercise. I believe that in most commercial applications that this would be feasible with the possible exception of telephone surveys.

## **PROPOSED ADJUSTMENT TO ELIMINATE THE ACA PRICE EFFECT**

Given an ACA price effect, the authors have developed a surprisingly straightforward method for recalibrating the price utility to more accurately reflect the magnitude of respondent price sensitivity.

Their approach is to adjust each respondent's price utility so that predicted choice optimally matches a set of choice-based holdouts. They segment the sample population into three groups: those that need no price adjustment (that is, those whose predicted choices closely match their holdout choices), those that need some adjustment and those that need a lot of adjustment. They chose not to recalibrate price utility at the individual level due to the high incidence of reversals commonly found in conjoint data.

Reversals in conjoint data are commonplace, often involving up to 40% of the total sample. Like attribute independence, this issue is not unique to ACA. If there are reversals in the data set, it appears to me that they can be caused by one of only four factors:

- The data accurately reflect the respondent's values (and we simply are unwilling to understand or accept the possibility)
- Within attribute level variance is large due to the respondent being confused or fatigued when answering the survey, causing unstable level utility estimates
- Within attribute level variance is large due to limited sample size or experimental design issues, causing unstable level utility estimates
- There is an anomaly in the utility estimation algorithm

Whatever the cause of the reversals, recalibrating at the segment level does not avoid the problem, it just ignores it. The reversal respondents are included in the three segments and receive the same adjustment as the other respondents. I have no simple solution to this significant problem. I suspect that a good percentage of what we typically call reversals is simply accurate reflections of human behavior. Humans are clearly and frequently irrational in their buying behavior (and in every other aspect of their lives as well). Rather than attempt to force respondents to be rational just so that our models perform better, I suggest we look for ways to better model their sometimes irrational behavior. I also suspect that much of reversal data is due to confused or tired respondents. Making the interview as simple and brief as possible may help minimize reversals. I would like to see more research into the cause of reversals and possible ways to handle reversals in conjoint data sets without constraining respondent answers to conform to our assumptions.

The choice-based holdouts on which the price utility recalibration is based varied five of the 10 attributes and held five constant. The authors correctly point out that the recalibration scalars may be affected by the number of attributes included in the holdouts. For example, if only two attributes are included in the holdouts, the price recalibration scalar will most likely be smaller than if eight attributes are included because the attribute additivity problem will be greater with eight attributes than with two.

This appears to me to be a very serious problem with their proposed approach because the ACA simulator is designed to include all 10 attributes. Thus, one could recalibrate price to optimally predict holdouts and still underestimate price in the simulator. One possible solution would be to include all attributes in the holdout exercise but more often than not there would be too many attributes in the study to make this approach practical.

The suggestion made earlier for addressing the attribute additivity problem appears to me to also be a potential solution to the number of attribute holdouts problem as well. If the number of attributes included in the holdout exercise is six and if the simulator selects the top six attributes per person to calculate total utility, the recalibration scalar will be near the appropriate magnitude as long as the net relative importance of the six attributes in the holdout exercise is relatively similar in magnitude to the net relative importance of the six attributes selected in the simulator.

The authors make a very strong case for selecting price as the most important attribute to recalibrate. I would, in general, strongly agree. However, I suspect that there may be other attributes that would also be excellent candidates for recalibration, depending on the issues at hand. Although brand was not included in the Kilroy and Williams study, it is commonly included in conjoint studies and would be a strong candidate for recalibration because of the obvious lack of attribute independence coupled with its typically high degree of importance. It would be interesting to explore possible ways to simultaneously recalibrate two or more attributes, using the Kilroy and Williams approach.

It would also be interesting if guidelines could be developed to assist the practitioner in determining:

- The ideal number of holdout tasks needed for recalibration
- Which product configurations to include in holdout tasks
- How many products to include in the holdout tasks

## SUMMARY

The choice-based holdout tasks have appeal for numerous reasons:

- Fills client need for realistic alternatives
- Increases model credibility in client's eyes
- Powerful presentation/communications tool to unsophisticated audience
- Cheaper and simpler than dual conjoint

The Kilroy and Williams method for removing the ACA price effect is:

- A useful technique
- A sound approach
- Easy to understand
- Relatively easy to apply

Overall, I found this paper very useful and interesting. The authors raise many important issues and provide a practical solution to a significant shortcoming in many ACA models.

This peer review is available for download at:

www.macroinc.com/html/art/s\_kil.html

## **APPENDIX 3 – OUTLINE OF KBA METHODOLOGY**

This document is a copy of an internal KBA presentation that describes the methodology detailed in Appendix 1. It is in bullet point form and provides an overview of the technique. The numbers used in this presentation relate to the 1,000 respondent study undertaken for a NSW distributor.

(See Appendix 3.pdf)

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# **CALIBRATING PRICE IN ACA**

# The ACA Price Effect and How to Manage it

# **Denis Kilroy and Peter Williams**

# KBA

# **CALIBRATING PRICE IN ACA**

- The tendency of ACA to underestimate the importance of price is now well recognised
- Nevertheless it remains a popular research methodology particularly when the number of attributes is greater than six
- Dual Conjoint methods have been developed to address the problem with price utility
- In this presentation, we propose an alternative to Dual Conjoint which involves integrating ACA utility scores with outcomes from a series of explicit holdout choices



# **CALIBRATING PRICE IN ACA**

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In describing this new technique, we will seek to answer two questions

- What is the ACA Price Effect?
- □ How can we overcome it?

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# WHAT IS THE ACA PRICE EFFECT?

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- ACA offers the research community a means with which to study customer decisions involving more attributes than a respondent can evaluate at one time
- However it has been observed that ACA can often underestimate the importance of price

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# WHAT IS THE ACA PRICE EFFECT? Recognising the Effect

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# The clearest evidence of the ACA Price Effect is in a simulation that severely over-predicts share for a feature rich product





# WHAT IS THE ACA PRICE EFFECT? Example

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In this case, ACA predicted that 66 percent of respondents would select the Feature-Rich product. But when presented with an explicit holdout choice, only 20 percent





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# WHAT IS THE ACA PRICE EFFECT? Potential Causes

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The potential causes of the ACA Price Effect include:

- Inadequate framing during Importance Ratings
- Lack of attribute independence
- Equal focus on all attributes
- Restrictions on Unacceptable levels

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# **CALIBRATING PRICE IN ACA**

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In describing this new technique, we will seek to answer two questions

- □ What is the ACA Price Effect?
- How can we overcome it?

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# **OVERCOMING THE ACA PRICE EFFECT**

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- To overcome the effect, we must first quantify it
- Since ACA price utility may be suspect, another methodology is required
- One approach is to use dual conjoint, and employ either full profile conjoint (CVA) or choice-based conjoint (CBC) along with ACA in the same study



# **OVERCOMING THE ACA PRICE EFFECT** An Alternative to Dual Conjoint

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- An alternative to Dual Conjoint involves the use of Choice-Based Holdouts (CBH)
- CBHs are already used by many practitioners to check the predictive validity of conjoint simulations
- In this alternative methodology, CBHs become a source of data which is used to adjust or calibrate the utility data derived from ACA

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# OVERCOMING THE ACA PRICE EFFECT Advantages of the CBH Approach

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There are three main advantages associated with the use of CBHs as a method for countering the ACA Price Effect

- CBHs allow full control over the choices presented to respondents
- CBHs can be used as a stand-alone source of information
- CBHs offer a less complex, less time-consuming and cheaper alternative to Dual Conjoint

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OVERCOMING THE ACA PRICE EFFECT Methods of Calibrating Price Utility

A number of potential methodologies exist

- Adjust price utilities so that ACA and CBH share predictions match at an aggregate level
- Use cluster analysis to identify "utility importance" segments and adjust price utilities on a segment by segment basis
- Use regression to adjust each respondent's price utility

There are problems with each of these techniques



# OVERCOMING THE ACA PRICE EFFECT Calibrating Using CBH Preference Segments

A simpler approach involves calibrating on the basis of preference segments identified using CBH outcomes

- CBH response patterns can enable preference segments to be identified based on price sensitivity
- This can be done simply by counting the number of times that a respondent chooses a higher priced alternative. (This requires multiple CBHs to be asked on similar products)
- Segment integrity can be checked using average utility importance derived from ACA data

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# OVERCOMING THE ACA PRICE EFFECT Calibrating Using CBH Preference Segments

The predictive ability of ACA will be different for each preference segment

- It is important to monitor the percentage of respondents for whom ACA correctly predicts the CBH outcome
- If the "hit rate" is high, then predicted market shares will also be similar between ACA and CBH

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# OVERCOMING THE ACA PRICE EFFECT Example of Preference Segment Calibration

- Study related to electricity supply infrastructure and reliability
- 10 attributes in ACA section

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- CBHs each included 5 of the 10 ACA attributes
- 969 respondents. CBH preference outcome showed that 231 preferred a high quality, high-priced offer. 592 preferred a midrange offer. 146 preferred a low-priced, basic offer
- These groups of respondents were treated as separate preference segments

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# OVERCOMING THE ACA PRICE EFFECT Example of Preference Segment Calibration

It can be seen that for this segmentation scheme, the utility importance determined from ACA is "pointing in the right direction"

Attribute	Underground	Overhead Insulated	Overhead Bare	
Price	59	67	77 🗲	Price trend as expected
Reliability	45	45	45	
Insulation	64	58	40	Similar
Tree Trim	28	24	21	due to common
Cable Location	59	35	29	attribute levels

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# OVERCOMING THE ACA PRICE EFFECT Adjusting ACA Utility Scores

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- Price utility was adjusted within each segment so that ACA best predicted CBH outcomes at the individual level
- No adjustment was necessary for the segment comprising respondents who preferred the high-priced, high-quality offer
- A scaling factor of 2 was required for the mid-price segment
- A scaling factor of slightly more than 4 was required for the price sensitive preference segment

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# OVERCOMING THE ACA PRICE EFFECT Adjusting ACA Utility Scores

# These adjustments alter the utility functions quite significantly

• KBA





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# **OVERCOMING THE ACA PRICE EFFECT** Interview Integrity

There are three important factors to consider in maintaining interview integrity

Internal consistency

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- Positioning of ACA and CBHs within questionnaire
- Order of CBH questions

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OVERCOMING THE ACA PRICE EFFECT Other Survey Design Considerations

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- Presenting meaningful choices
- The "number of attributes effect"
- The range of CBH questions shown
- Accuracy of utility estimates for non-price attributes

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# CALIBRATING PRICE IN ACA Conclusion

- The approach presented provides a clear alternative to using Dual Conjoint
- It allows the researcher to determine the outcomes from explicit holdout choices. Adjusted ACA utility data can then be used to illustrate the drivers of these choices
- If ACA is calibrated so that it accurately predicts CBH outcomes, adjusted utility data can be used to predict more confidently the outcomes from hypothetical choices (ACA simulations) that the respondent did not evaluate directly

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