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# **Contingent Valuation: A Comparison of Referendum and Voluntary Contribution Mechanisms**

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Contributed paper prepared for presentation at the 58th AARES Annual Conference,  
Port Macquarie, New South Wales, February 4-7, 2014

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**Contingent Valuation: A Comparison of Referendum and Voluntary Contribution Mechanisms**

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**SID: 310248892**

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Number of words: 8698

Number of references: 36

Number of references between 2002 and 2013: 16

Number of figures and tables: 13 (9 figures/4 tables)

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<sup>1</sup>: Journal Style: Australian Journal of Agricultural and Resource Economics

## Abstract

Contingent valuation methods (CVM) are integral in valuating non-market environmental issues. Numerous mechanisms have been proposed and analysed, as well as numerous studies on willingness to pay (WTP) and willingness to accept (WTA) discrepancies. Despite the concentrated and persistent focus on achieving efficient mechanisms, controversies and limitations remain. This paper applies an open-ended approach to the referendum (majority voting) method for contingent valuation as advised by Green *et al.* (1998). This is undertaken via economic experiments with induced values, and by comparison of two novel majority voting mechanisms and one widely accredited voluntary contribution mechanism. The preliminary findings show the majority voting mechanism induce more incentive compatible values and reduce WTP WTA discrepancy compared to the voluntary contribution method. Thus, given promising results, this paper recommends further investigation into the novel open-ended referendum method, termed the undisclosed cost voting mechanism (UCVM).

**Keywords:** Willingness-To-Pay, Willingness-To-Accept, Provision Point Mechanism, Undisclosed Cost Voting Mechanism, Random Price Voting Mechanism

## 1. Introduction

Efficient contingent valuation methods (CVM) have been heavily studied and applied due to its relevance for attaining willingness to pay (WTP) and willingness to accept (WTA) values with respect to non-market environmental issues (Champ *et al.* 2002; Graves 2009). Numerous approaches to CVM have been developed and tested, including research into efficient use and combination of elicitation formats, implementation frame and payment vehicle (Green *et al.* 1998). Despite extensive focus on CVM, numerous controversies and limitations regarding the reliability, accuracy and validity of contingent valuation persist (Carson, Flores and Meade 2001; Champ *et al.* 2002, Carson, Groves and List 2006). As environmental issues become more critical and detrimental, and with growing awareness and understanding of environmental causes and impacts, it is increasingly important to continue progressing to achieve more efficient and reliable contingent valuation mechanisms. This is particularly so given results from contingent valuation mechanisms continue to play an important and primary role in determination of scale of improvement and restoration activities, and mitigation, compensation and sustainability policies (Brown and Gregory 1999).

A common and widely studied shortcoming for contingent valuations includes the discrepancy between WTP and WTA values (Hanemann 1991; Horowitz and McConnell 2002; Brown and Gregory 1999). Two postulations for this discrepancy include incentives for WTP and WTA working in the opposite direction (Brown and Gregory 1999) and the unfamiliarity of WTA questions may lead to confusion on how to respond (Coursey, Hovis and Schulze 1987). There are numerous other potential reasons for the WTP WTA discrepancy, and can be found from a wide range of literature, not all of which are necessarily grounded in economic theory (see Thaler 1980; Brown and Gregory 1999; Graves 2009; Horowitz and McConnell 2002; Boyce *et al.* 1992; Kahneman, Knetsch and Thaler 1990; Plott and Zeiler 2005). This paper will not focus on addressing the discrepancy; however endeavors to contribute to this body of literature by specifically looking at whether participants are able to report their WTP WTA values truthfully given induced values and varying incentives to do so.

Irwin *et al.* (1998) characterises that an ideal bidding mechanism should be incentive compatible, cognitively transparent and should remain neutral by not instructing participants of their optimal bid. An incentive compatible mechanism requires the decision rule for the acceptance of a project to incite

participants to report their 'true' valuation without influence of any strategic behaviour (Plott and Zeiler 2005). Messer *et al.* (2010) also add another requirement for an ideal bidding mechanism must be applicable to a single shot environment. Hoehn and Randall (1987) affirm that referendum contingent valuation, with majority voting and a coercive tax element is incentive compatible. That is, the mechanism is characteristic of the necessary conditions of a decisive implementation frame, where participant responses are consequential to the outcome of the good, and the payment vehicle is 'decoupled', where participant responses only affect the probability of the outcome, not the payment level required if the good is supported (Green *et al.* 1998; Carson and Groves 2007).

Green *et al.* (1998) provides a detailed explanation of the historical development of contingent valuation, particularly in regards to referendum contingent valuation. They clarify how sequential bidding referendum contingent valuation was overlooked due to the view that strategic misrepresentation was not quantitatively significant, sensitive to starting point and because open-ended approach was more affordable and easily conducted via mail survey. Additionally, Poe *et al.* (2002) recognise further limitations posed for referendum CV's include issues such as requirement of coercive power, unanimity or complex iterative group procedures. These mechanisms have also been known to require multiple periods before they resemble aggregate demand revelation, and as such are not conducive to single shot field situations. The requirement of a coercive power to implement payments, essentially a tax, would have to come from an authoritative body. Furthermore, the authoritative power would face limitations in determining which situations would be an appropriate or credible use of a majority voting measure (Champ *et al.* 2002). Other points of concern specific to majority voting includes determination of scale of project, for example who is imposed by this tax, and is this value equal amongst all users and non-users of the issue at hand, and how fairness concerns are taken into account, particularly in regards to tax proportionality and incidence.

Due to some of these unresolved limitations in majority voting mechanisms, voluntary contribution mechanisms remain widely applied and relied upon. One voluntary contribution mechanism that has gained extensive use for its attenuation of free riding and improvement in demand revelation (Bagnoli and McKee 1991; Cadsby and Maynes 1999; Rose *et al.* 2002; Rondeau, Poe and Schulze 2005), and is thus growing in popularity is the provision point mechanism (PPM). For PPM, a public good project only proceeds if the sum of voluntary contributions sufficiently reaches a predetermined threshold or provision point (typically set at the cost of the project). For ease of exposition, this paper will provide an explanation for the WTP case only, however WTA in terms of compensation budget to represent the provision point rather than cost of project intuitively follows. Inclusion of a rebate rule for excess contributions and a money back guarantee if the provision is not met has been shown to increase contributions and provision frequency (Poe *et al.* 2002; Isaac *et al.* 1989; Cadsby and Maynes 1999; Marks and Croson 1998). The PPM is not incentive compatible because participants have an incentive to under report in the case of WTP, or over-report in the case of WTA, and thus free-ride on other contributions if the project proceeds. Nevertheless, this mechanism has been found to induce more accurate revelation than a simple open-ended case, and is accordingly a popular choice when conducting WTP studies (Rondeau, Schulze and Poe 1999; Bagnoli and McKee 1991).

Green *et al.* (1998) further delineate on the development to binomial response single bid referendum format, and its growing prominence, particularly given its recommendation by the NOAA panel. Some reasons for the wide acceptance for the binomial response single referendum format include reduction of non-response and zero response impacts, and notably higher average WTP measures compared to the simple open-ended case. Though, two persisting limitations for this format include informational asymmetry in regards to requirement of large sample size and uncertainty of underlying shape of WTP distribution, and anchoring effects as shown by Green *et al.* (1998). In response to

these limitations, Green *et al.* (1998) recommend an open-ended response to the referendum format. An open-ended approach to referendum format involves asking participants for their maximum WTP, and if the majority of participant's bids are greater than or equal to an undisclosed equal share of project cost, the project proceeds. This incorporates both necessary characteristics for incentive compatibility; a decisive implementation frame and decoupled payment vehicle (Green *et al.* 1998). From here on this paper will refer to this mechanism as the undisclosed cost voting mechanism (UCVM).

A supportive branch of literature to the UCVM is a novel and relatively new approach that has so far been sparsely tested over limited conditions, and moreover shows promising results is the majority voting mechanism, termed the random price voting mechanism (RPVM). This mechanism is theoretically incentive compatible and is considered a public good extension of the private good incentive elicitation Becker De-Groot Marschak (BDM) mechanism (Messer *et al.* 2010). The BDM mechanism involves asking for one participant's maximum WTP value for a private good, and if this value is greater than or equal to a randomly drawn price they must purchase the good at the randomly drawn price (Becker, DeGroot and Marschak 1964). Through experimental economics, Isaac *et al.* (1998) confirm that the BDM mechanism removes incentives for strategic behavior due to its decoupled payment vehicle, at least in an expected utility framework (Messer *et al.* 2010; Horowitz 2006). Similar to the BDM, the RPVM involves providing a public good whenever a majority of participants elicit WTP values greater than or equal to a randomly selected price. Given the majority are in favour at such a selected price, all participants, regardless of their initial WTP bid, must pay this random price (Messer *et al.* 2010; Keiser *et al.* 2013). Current literature on the RPVM and including Messer *et al.* (2010) distinguish that the RPVM is less complex than other incentive compatible mechanisms because it doesn't focus on efficiently providing the collective good. Rather, it focuses on eliciting individual's value for a good in a majority voting context.

Messer *et al.* (2010) conducted a RPVM experiment using induced values, with focus on social preferences to determine whether participants under or over bid given knowledge of other participant's position. They achieved this by comparing a BDM treatment (with one participant, reduced to a private good case), to a public goods case with three participants with homogeneous and heterogeneous distribution of induced values across participants. Keisner *et al.* (2013) conducted an RPVM with group size of three and using a real commodity; "contaminated" water by a sterilized cockroach. Both Messer *et al.* (2010) and Keisner *et al.* (2013) revealed presence of pure altruism, where some participants with high induced values underbid because they were concerned that they may be imposing losses on others and some participants with low induced values overbid to gain positive utility from the gains of others. Their results show that the RPVM elicits preferences that are consistent with dichotomous choice formats, and remains demand revealing despite attention on social preferences.

This paper extends current applications of the RPVM mechanism to further test its efficiency. Extensions of RPVM include increasing group size from one and three participants to five participants in a group, and taking the focus off social preferences by providing participants with only their own induced value rather than knowing every group member's value.

Given the above introduction, the objective of this paper is to apply three public good contingent valuation mechanisms, the PPM, UCVM and RPVM, to allow for a clear comparison of the advantages and disadvantages of each mechanism. Economic experiments with induced values under a generic public good context are conducted to make basic comparisons between the three mechanisms. Both the PPM and RPVM are separately compared to UCVM to test whether UCVM

overcomes any of the shortcomings of PPM, and whether the UCVM maintains the effective and promising results of the RPVM given it is more credible and compatible in a single shot environment. This paper hypothesises that 1) RPVM and UCVM will both provide greater aggregate demand revealing properties compared to PPM, 2) The WTP WTA discrepancy will be significantly different between PPM and the majority voting mechanisms, RPVM and UCVM 3) UCVM will maintain incentive compatibility of RPVM, even with its enhancement in credibility.

This paper will be presented in the following manner: Section 2 will address previous literature supportive for the relevant mechanisms used in this paper. Section 3 will provide an overview of the experimental design applied in the economic experiments, followed by a results and discussion section. Finally, Section 5 will provide a conclusion of the findings in this paper.

## **2. Theoretical framework**

### **2.1 Provision Point Mechanism**

There is an extensive range of WTP studies conducted for the PPM. (Bagnoli and McKee 1991; Cadsby and Maynes 1999; Rose *et al.* 2002; Rondeau, Poe and Schulze 2005) have all conducted PPM with respect to WTP, and each ascertain that the PPM is not incentive compatible, however praises it for its ability to curtail free riding compared to purely open-ended mechanisms. Each source explains that participants have no theoretical incentive to over-bid, and should feel constrained to not under-bid excessively to ensure the project proceeds. (Isaac *et al.* 1989; Andreoni 1988) reveals that as multiple periods' progress, the extent of free-riding increases as participants familiarize the allowable extent of free-riding they are able to get away with.

Yet, there is limited information for applied WTA study using PPM. Among these limited studies, Bush *et al.* (2012) applied a PPM to estimate costs of conservation through restricting access to protected areas for rural households in Uganda, Africa. The findings demonstrate that the PPM is significantly effective in reducing 'excessive' over-stated WTA values. Bush *et al.* (2012) indicates the theoretical rationale behind this is participants in this study would not under-report their compensation value since they would not be willing to support a program until they receive satisfactory compensation. Similarly, they should not over-report (excessively) as this may lead to the project being abandoned, and participants would not receive the compensation they felt was acceptable. Bush *et al.* (2012) acknowledge the potential for one candidate to have the power to protest the entire project by bidding greater than total compensation budget; however they also suggest the PPM may allow for easier recognition of protest bids by comparing bids across payment scenarios.

### **2.2 Random Price Voting Mechanism**

Messer *et al.* (2010) show that when there is a homogeneous distribution of induced values across multiple players, the strategic bid is to input a bid equal to induced value. Theoretically, participants maximum WTP (or minimum WTA) is their dominant strategy because participants would only be required to pay the randomly determined cost if their bid is equal to or greater than this cost. Over-reporting a bid will increase the probability of the program occurring at a cost exceeding its value, and could result in net losses to participants. Similarly, if the randomly selected payment level falls below a participants induced value, under-reporting a bid with respect to induced value reduces the

probability of the bid counting as a ‘YES’ vote, resulting in potential loss of surplus (Vossler and McKee 2006; Messer *et al.* 2010).

However, when there is heterogeneous distribution of induced values, and participants are aware of other participants induced value, there are considerations of social altruism when determining the theoretical bidding strategy. In this case, Messer *et al.* (2010) provides a formula for utility, expressed as:

$$U = u(Y + \pi_t - C + \sum_{j \neq i} (a_j \cdot (\pi_t - C)))$$

Where  $a$  is the intensity with which individual  $i$  is affected by the gains and losses of others ( $j$ ) (a person is purely self-interested when  $a=0$ , and utility is reduced to the homogeneous case). It is assumed  $a$  is symmetrical, where gains and losses are treated equally, and individuals receive equal weight in individual’s utility function.  $Y$  represents an individual’s endowment,  $\pi_t$  is the induced value,  $C$  is per person cost drawn from a uniform distribution (0, max).  $C$  is a stochastic variable, the game is one of incomplete information and the relevant framework of analysis will be expected utility with a Bayesian equilibrium concept (Messer *et al.* 2010).

As mentioned above, this paper considered RPVM with heterogeneous distribution of induced values across participants and participants are only provided with their own induced values, and are unaware of other participant values. The information given to participants is that induced values are generated across an undisclosed range and varies across participants, and may also vary each period. Keisner *et al.* (2013) suggests that given less information of other participants’ values relative to their own, there is less responsibility in taking their position into account. It is expected that given lack of knowledge of distribution of bids, participants will not take other participant’s positions in to account when reporting their contributions or compensation offers for WTP and WTA respectively. In this case, optimal utility function for this reduces to the case of BDM with one participant and homogeneous distribution of induced values with multiple participants, expressed as:

$$U = u(Y + \pi_t - C).$$

### 2.3 Undisclosed Cost Voting Mechanism

In both the single shot environment and multiple periods of an experiment, the theoretical optimal bidding strategy for UCVM is identical to RPVM. This is because the only difference lies in the decision making rule for how the project proceeds. That is, via a random price or an undisclosed price for RPVM and UCVM respectively. However, there are potential distractions that could deter or influence participants from the optimal strategy. In this respect, UCVM allows for a different optimal bidding strategy to develop compared to RPVM.

In a single shot environment, the UCVM would comprise of more efficient communication characteristics, with a more reasonable or rational reason behind the decision rule than the RPVM. It is thus expected the UCVM will induced more demand revelation compared to RPVM in a single shot environment. A potential explanation of undisclosed cost could be given in the following way (similar framing can be consulted in Green *et al.* 1998):

“While engineers and analysts are conducting a cost assessment for the project in question, please provide your maximum WTP for the project. If your individual WTP value is greater than or equal to the cost per capita, you will be counted as a YES vote in favour of the project occurring. If your WTP value is less than the cost per capita, you will be counted as a NO



vote rejecting the project. The project will proceed if the majority of WTP bids are greater than or equal to the cost per capita, and each participant will be charged this cost per capita regardless of their initial bid.”

And, given there are multiple periods in experiments conducted, there is potential for participants to develop an estimate of the undisclosed total cost of project or total compensation budget for WTP and WTA respectively. In this light, participants may become distracted by this knowledge, and rather than sticking to optimal theoretical bid equal to value, participants may vote a maximal or minimal value to ensure their vote strictly counts in favour or against the project. Though, it should be noted in a real world setting in a single shot environment, this would not be an issue, and the UCVM reduces to essentially the same optimal bidding strategy to the RPVM, but with better communicative characteristics. In a multiple period experiment, because participants are not provided with enough information in RPVM to develop any strategic behaviour, the RPVM may have higher demand revelation compared to UCVM in subsequent periods of an experiment

### **3. Experimental design**

All 40 participants were recruited from the University of Sydney ORSEE Recruitment System. Students from every faculty and tertiary background were included in this experiment to reflect a real world environment. Each person had no prior experience with this particular experiment. Though, participants who had previously attended a different public good experiment were also included in the recruitment process. The experiment took less than an hour, and participants received an average payoff of \$26.

Each experiment consisted of two sessions, one session involved UCVM mechanism with respect to either WTP or WTA, and the other session applied either PPM or RPVM with the alternative, WTA or WTP. Each participant partook in two sessions due to the limited scope of the paper, and in interest of reducing funding needed. Ordering effects were a concern because participants were subjected to two sessions that are not completely independent from each other, where learning from the first session may influence understanding in the second session. This was taken into account by conducting two sessions with the same treatments but in reverse orders. Additionally, learning effects were curtailed by providing limited information of results at the end of each period, including only whether the project was accepted or not, individual returns for the specific period and for the case of RPVM, the randomly generated number that was used.

The experiment was conducted with the software program Zurich Toolbox for Ready-made Economics Experiments (otherwise known as zTree) (Fischbacher 2007). There were ten people present during each experiment session. The ten participants were randomly assigned to two groups of five in each session. The purpose of randomly assigning participants to groups was to ensure participants wouldn't feel a sense of connection, or consider establishing communication to those sitting next to them. The composition of each group remained constant throughout subsequent periods. Firstly, participants were randomly allocated to a computer. The instructions were then handed out to participants, and each participant had an opportunity to read through the instructions individually. Despite careful attention to provide clear and non-technical language in the instructions, a multiple choice quiz with numerical examples and relevant and important concepts was also provided to extend participants understanding. A copy of the instructions for two sessions WTP-PPM/ WTA-UCVM and WTP-UCVM/ WTA-RPVM are given in Appendix A and B respectively. There

was an opportunity to ask any questions regarding the instructions and the quiz. The reason why the instructions could not be read aloud was because there were two sessions from different perspectives, both a WTP and WTA session, running at the same time. A post experiment survey was also given to each participant after each session to gather information on participant's thoughts of optimal bidding strategy, their thoughts on various aspects of the experiment and how much information they extracted from the information given to them about determining total project cost and total compensation budget.

Participants were provided with background of a generic public goods project, where the project would only proceed if bids or offers reported by participants revealed it was worth proceeding. The project was kept in a generic context to remove emotional connection that may be associated to any specific environmental issue. Monetary units were used to provide induced values of benefits and costs to participants. And with use of monetary units, endowment effects were removed or at least minimized. The generic context and use of monetary units effectively engages a controlled condition, and allows for direct comparison of mechanisms (Kahneman, Knetsch and Thaler 1990).

Participants were given an endowment of 100 cents each period. Participants had 60 seconds to make their decision each period, and also were given 60 seconds to look at the results each period. There were seven periods in each session, though the number of periods remained undisclosed to participants to prevent potential end-period effects (Irwin *et al.* 1998). There were no practice periods given to see how well these mechanisms could hold up in a one-shot environment, given no prior experience to the situation at hand, as is the case in field conditions (Rondeau, Poe and Schulze 1996). Subsequent periods would start earlier if every participant indicated they were ready.

For WTP cases, participants were provided with a personal payoff amount each period; this individual benefit is the amount the participant would receive if the project proceeds. Participants were informed that the payoff amount was randomly generated over an undisclosed range, and may vary amongst other group members in each group. This format is consistent with real field settings, where individuals are only aware of their own value for a public good (Rondeau, Poe and Schulze 2005). Participants were asked to report the highest amount they would be willing to pay to contribute to a project, given their endowment and the benefit they would receive. Similarly, for WTA, participants were provided with a personal loss amount, and as was the case for personal payoff amounts, the personal loss amounts were randomly generated across an undisclosed range, and could vary amongst participants in their group. Participants were asked to report the lowest amount they would be willing to accept as compensation to remain in favour of the project occurring, given the costs they would incur. The personal payoff and loss amounts were randomly generated to prevent allowing the optimal bidding strategy to carry through to each subsequent period. For example, some payout ranges were mostly high but contained one low value in some periods, so for certain periods you could get a high value and the project would still fail, or alternatively, you could receive a low induced value, and it would likely proceed.

For WTP-PPM participants were informed a public goods project would proceed if the sum of voluntary contributions made by participants was greater than or equal to an undisclosed cost of project threshold. If sum of contributions are less than the provision point, contributions are returned to participants, and if sum of contributions are greater than the provision point, excess contributions are returned proportionately as personal dividends to participants. Similarly, for WTA-PPM, participants were required to report a level of compensation claim given personal loss amounts they would incur if the project proceeded, and if the sum of compensation claims was less than or equal to the compensation budget the project would proceed and receive their individual compensation claims.

WTP-UCVM involved requiring a majority of participants to contribute greater than or equal to an undisclosed equal share of project cost for a project to proceed. Conversely, for WTA-UCVM the project would only proceed if the majority of participants claim compensation payment less than or equal to an undisclosed equal share of the available compensation budget. For WTP-RPVM, the project proceeded if the majority of participants contribute greater than or equal to a randomly generated share of project cost. For WTA-RPVM the project proceeds if the majority of participants claim compensation less than or equal to a randomly generated compensation budget share. The randomly generated cost share/compensation budget share for WTP and WTA respectively, was randomly generated by the computer program ztree, between 0 and 100. All treatments were essentially the same, except for changes in explanation of mechanism design. Table 1 provides a clear format to understand the decision rules for each mechanism and the corresponding payouts participants were aware they would receive.

**Table 1** Summary of each mechanism’s decision rule for project to proceed and corresponding pay-outs

<b>Mechanism</b>	<b>Decision Rule</b>	<b>Pay-outs</b>
WTP with PPM	$\sum WTP \Rightarrow Cost \rightarrow Project \checkmark$	100 + Your Payout - Your WTP
	$\sum WTP < Cost \rightarrow Project X$	100
WTP with UCVM	Majority WTP $\Rightarrow Cost/n \rightarrow Project \checkmark$	100 + Your Payout – Cost/n
	Majority WTP $< Cost/n \rightarrow Project X$	100
WTP with RPVM	Majority WTP $\Rightarrow$ Randomly Selected Price $\rightarrow Project \checkmark$	100 + Your Payout – Randomly Selected Price
	Majority WTP $<$ Randomly Selected Price $\rightarrow Project X$	100
WTA with PPM	$\sum WTA \Leftarrow Budget \rightarrow Project \checkmark$	100 - Your Damage + Your WTA
	$\sum WTA > Budget \rightarrow Project X$	100
WTA with UCVM	Majority WTA $\Leftarrow Budget/n \rightarrow Project \checkmark$	100 - Your Damage + Budget/n
	Majority WTA $> Budget /n \rightarrow Project X$	100
WTA with RPVM	Majority WTA $\Leftarrow$ Randomly Selected Price $\rightarrow Project \checkmark$	100 - Your Damage + Randomly Selected Compensation Payment
	Majority WTA $>$ Randomly Selected Price $\rightarrow Project X$	100

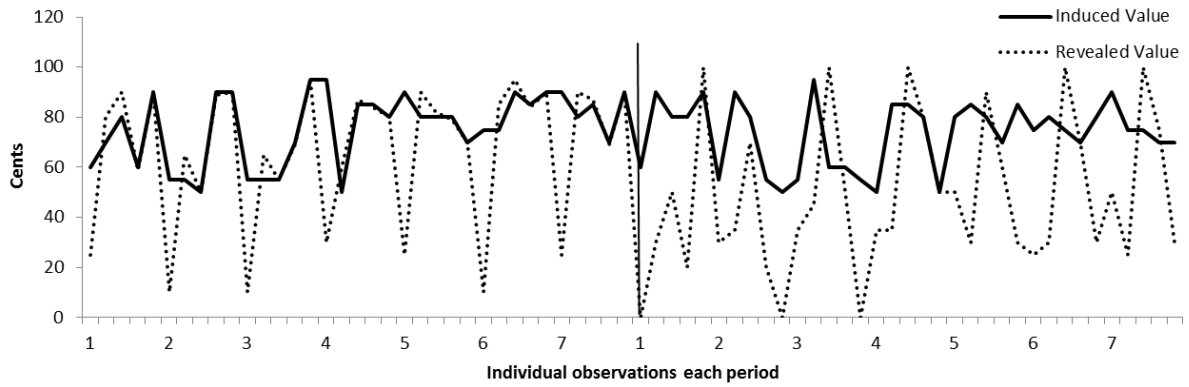
#### 4. Results and discussion

The results section will firstly provide an overview of the experimental data, and then make comparisons between mechanisms with respect to various factors such as demand revelation, failure rate, learning effects and variance between WTP and WTA.

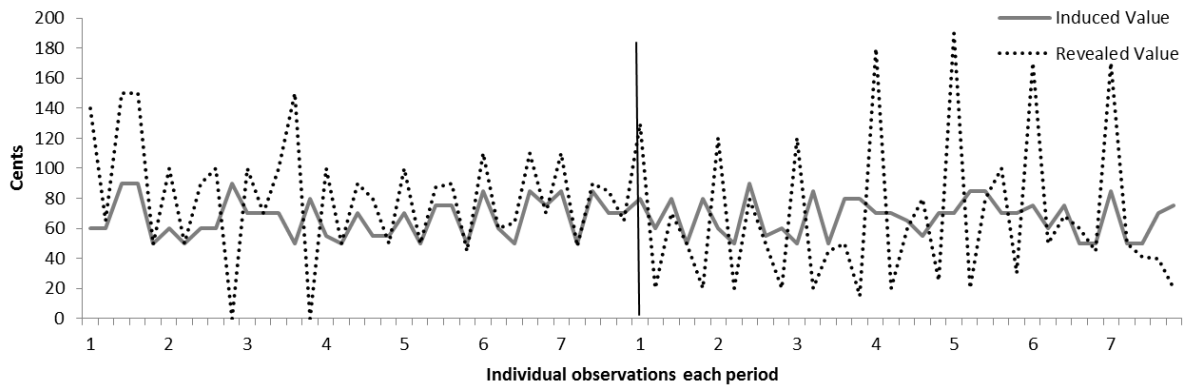
##### 4.1 Overview of experimental data

Figures 1 to 6 present the results for each mechanism with respect to WTP and WTA. Each graph displays results by sequential order of periods to discern learning effects, and vertical lines are used to

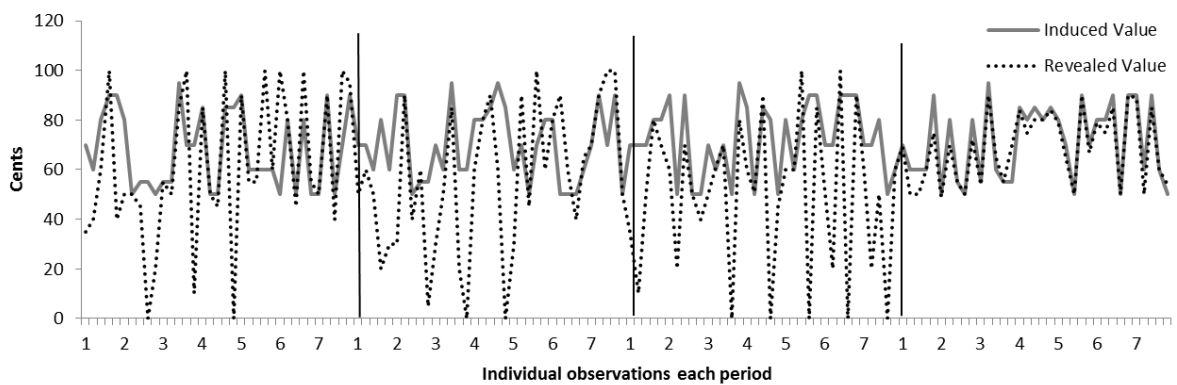
distinguish between different group treatments. Each session ran for 7 periods. There are five observations that remain in constant ordering each period, and this simply corresponds to each of the five group members in each treatment.



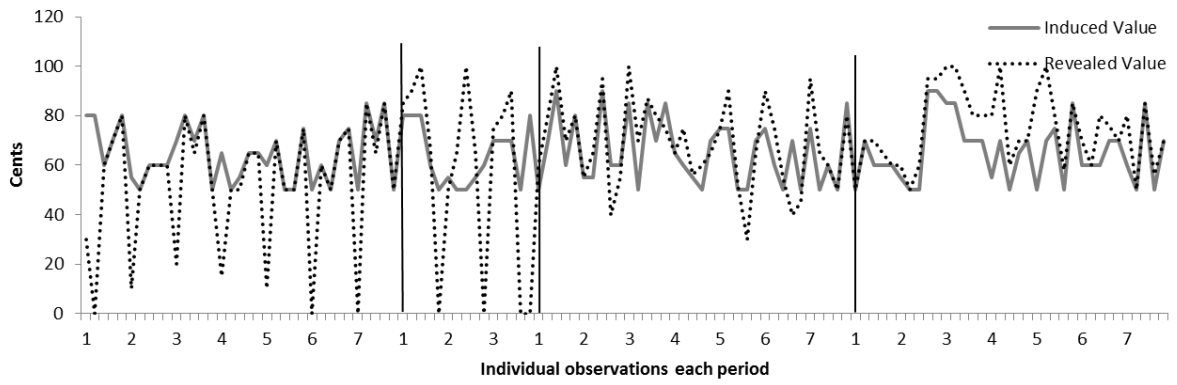
**Figure 1** Induced and revealed values for WTP-PPM.



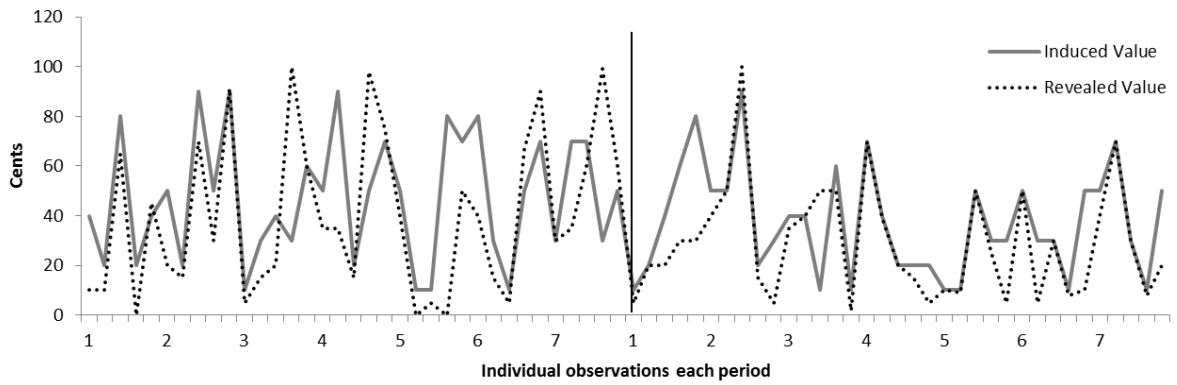
**Figure 2** Induced and revealed values for WTA-PPM.



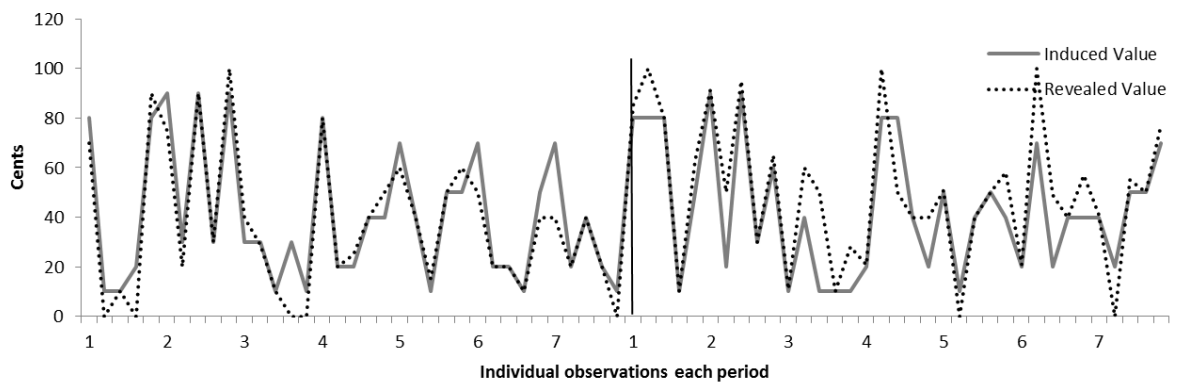
**Figure 3** Induced and revealed values for WTP-UCVM.



**Figure 4** Induced and revealed values for WTA-UCVM.<sup>2</sup>



**Figure 5** Induced and revealed values for WTP-RPVM.



**Figure 6** Induced and revealed values for WTA-RPVM.

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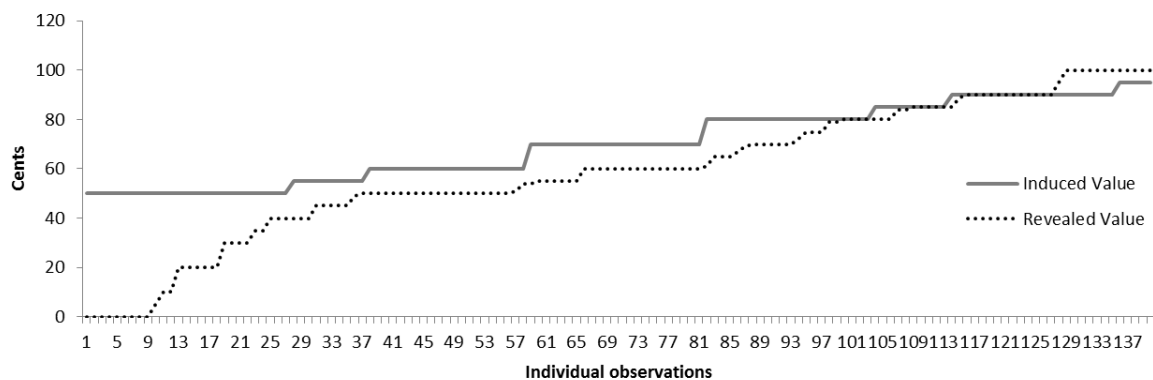
<sup>2</sup> The second session only ran for 3 periods instead of 7 periods due to a programming malfunction.

Overall, it is clear some groups performed more rationally and conformed to theoretical optimal bidding strategies compared to other groups. This was expected, as it is common for participants to make subsequent bids taking into account group performance. This occurred despite UCVM and RPVM not essentially requiring any knowledge of other bids to decide on your own optimal individual contribution/compensation offer.

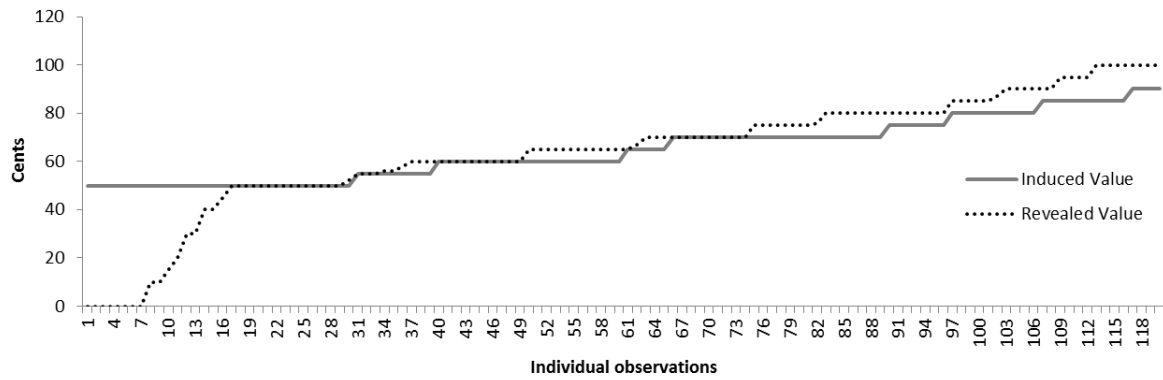
As can be seen from figures 1 to 6, a share of individuals in each mechanism applied a strong free-riding approach with contributions of 0 cents, and others provided bids equal to induced value or even irrationally indicated bids greater than their induced value. An additional mention is the susceptibility of these results to even a single candidate in a group, where for example, in the third group for WTP-UCVM there was one participant who consistently bid 0 between periods 3-7, and the reasoning provided in the post-survey survey was simply to “Try to stop all the projects”. Despite the proficiency of an experiment process or mechanisms used, economic experiments are in general subject to these occurrences (Schwartz 2008).

There are evident higher levels of over bidding in WTA and under bidding in WTP under the PPM case. This is consistent with theory since PPM is not incentive compatible, and participants were perhaps instead incentivized to find the optimal share of their induced value to contribute and still allow the project to proceed.

An explanation for the high volatility of revealed values compared to induced values for UCVM was conveyed in a number of post experiment survey’s, where, if participants had an indication of the undisclosed share of project cost, given low or high induced values, they would bid 0 or 100 respectively to ensure their vote counted as a NO or YES vote. Although this explanation is not consistent with the theoretical optimal strategy to bid equal to your induced value, it nonetheless explains this variability. Figures 7 and 8 provide an alternative medium to look at WTP-UCVM and WTA-UCVM. The induced values and revealed values are both ascending, thus making the values unpaired. The purpose of providing these graphs is to show that despite the high volatility in UCVM, overall results induce more accurate aggregate demand revelation. This will be further discussed shortly.



**Figure 7** WTP-UCVM with unpaired ascending induced and revealed values



**Figure 8** WTA-UCVM with unpaired ascending induced and revealed values

Figures 5 and 6 illustrates the RPVM case as the most efficient mechanism overall. A postulation for this is that the randomness takes away thoughts of strategy, participants may more clearly see they benefit most be reporting their induced values. This result is consistent with the theoretical expectations outlined above.

**Table 2** Summary of statistics

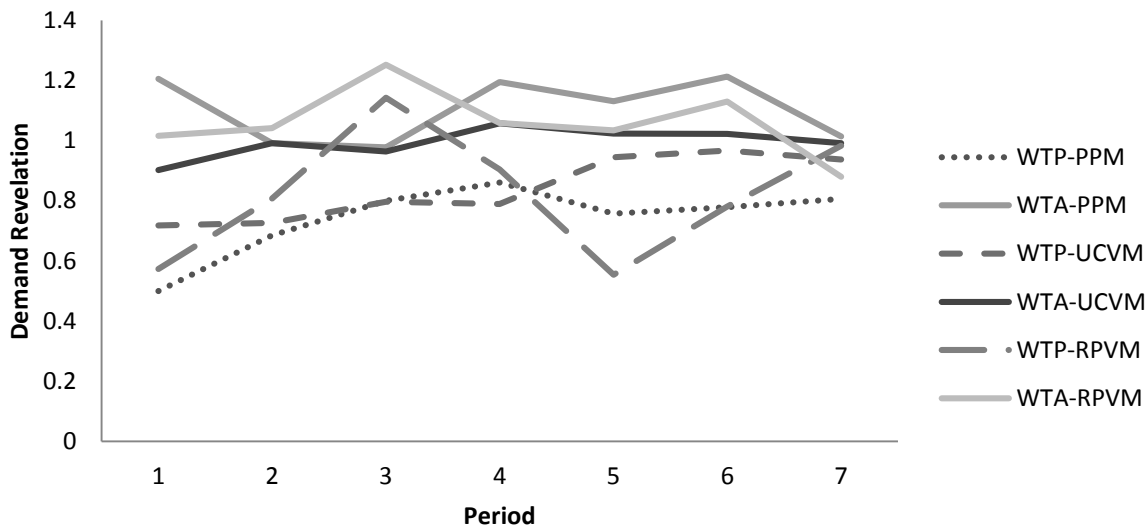
	WTP-PPM	WTA-PPM	WTP-UCVM	WTA-UCVM	WTP-RPVM	WTA-RPVM
n	10	10	20	20	10	10
Mean V	74.57	67.00	70.25	64.96	42.14	41.57
Mean B	57.62	74.24	59.05	64.14	34.59	43.31
Median B	60	66.5	60	65	30	40
Mean B/V	0.77	1.13	0.85	0.99	0.85	1.08
SD B/V	0.39	0.64	0.36	0.35	0.75	0.70
Median B/V	0.99	1	0.94	1	0.8	1
Failure Rate in First Session	85.71%	57.14%	28.58%	14.28%	42.86%	14.28%
Failure Rate in Second Session	14.28%	14.28%	21.43%	21.43%	14.28%	14.28%
Aggregate Demand Revealed	77.28%	110.81%	84.06%	98.74%	82.07%	104.19%
Demand Revealed in 1st Period	50%	120.57%	71.81%	90.22%	57.31%	101.60%
Demand Revealed in 7th Period	80.62%	101.45%	93.79%	99.16%	98.26%	87.95%

<sup>a</sup>. B is each participant's revealed value or bid, and V is each participant's induced value.

#### 4.2 Demand Revelation

Aggregate demand revelation is given by total contribution (or compensation) divided by total induced value. Similarly, demand revelation for each period is simply total contribution (or compensation) in given period divided by total induced value in given period. Care must be taken when using aggregate demand revelation as a measurement in policy analysis as this value doesn't take into account the extent of variation of bids made above or below the induced value. That is, overbidding and underbidding may counter each other so that in aggregate the results may be portrayed as demand revealing, despite poor demand revelation at an individual level (Taylor *et al.* 2000). Though, given this consideration, demand revelation still remains a widely used and informative tool to discern incentive compatibility of mechanisms.

Figure 9 shows demand revelation over the duration of the experiment. The convergence trend toward aggregate demand revelation provides an indication that there was learning occurring as participants gained more experience and exposure to the experiment. The solid lines were used for WTP cases, and dashed lines for WTA to allow for perception of a general under bidding trend for WTP and overbidding for WTA.



**Figure 9** Demand Revelation across periods for each mechanism with respect to WTP and WTA.

Graphically, WTP-RPVM and WTA-RPVM seem to be the most demand revealing, with revealed demand most closely following induced value compared to the UCVM and PPM case. However, from table 2, it is shown UCVM performed consistently well for both first period and last period demand revelation. With the exception of WTA-PPM demand revelation of 101.45% in the last period, PPM exhibited poorer demand revelation in all cases compared to UCVM and RPVM. This result was as expected; given the incentive compatible nature of the majority voting mechanisms. Overall, the majority voting mechanism upholds with respect to its incentive compatibility, and is able to curtail free riding more extensively than PPM. These results support hypothesis 1 and 3, with better demand revelation for majority voting mechanisms compared to PPM, and UCVM has maintained, and even exceeded incentive compatibility compared to RPVM in some respects.

WTA is more demand revealing for all three mechanisms compared to WTP. Additionally, median bid to value ratios for each WTA mechanism was equal to 1, which further supports an overall efficient aggregate demand revelation. This was a surprising result, particularly given current existing literature's reluctance and uncertainty regarding WTA. Given this paper has provided WTA induced values and participants have overall reported revealed values truthfully, a plausible explanation for this is that the complexity associated with WTA is not due to incentive issues. Rather, the lack of familiarity or disorientating nature of WTA, among other issues mentioned above, could be the reason for WTA difficulty. The efficiency of WTA, particularly for the majority voting mechanisms is supportive for the second hypothesis.

### 4.3 Results from the first period

Multiple periods in a controlled laboratory experiment with induced value of monetary units allow for determination of whether participants require time and experience to “learn” that the optimal bidding strategy is equal to demand revelation (Brookshire and Coursey 1987), or whether the strategy



employed in the first period persists regardless of experience (Kahneman, Knetsch and Thaler 1990). This will be measured by comparing demand revelation between the first and last periods,

Table 2 presents results for demand revelation in the first period for each mechanism. WTP-UCVM performed best out of the 3 mechanisms with respect to WTP, at 71.8%, and WTA-RPVM performed most efficiently for WTA at 101.6%. WTA-UCVM also induced high demand revelation in the first period, at 90.22%. As expected, the UCVM performed well in the first period, indicating that it is in fact applicable to a single shot environment. This is a very positive result for UCVM, suggesting it holds efficient communicative characteristics. WTP-PPM and WTP-RPVM performed quite poorly, at 50% and 57.31% respectively. This low demand revelation for WTP-RPVM is quite surprising, and not consistent with existing literature. Over the duration of the experiment, WTP-RPVM became more acceptable, finally reaching demand revelation of 98.26% in the final period.

The demand revelation in the first period is overall less demand revealing than in the last period. Figure 7 shows a wider dispersion of demand revelation in the first period compared to the last period. And this is supported by results from table 2, which clearly show that there was greater demand revelation in the last period compared to the first period with the exception of WTA-UCVM. This confirms that there was learning occurring throughout the duration of the experiment, and participants adapted their strategy given their experience.

An important observation is the responses provided from participants in the post-experiment survey. Participants were asked to “Please provide an indication of how you decide on the optimal contribution/compensation claim to make”. These responses, along with review of the data, provided an opportunity to review whether participants developed strategic behavior or thoughts on optimal bidding dependent on whether they had a low or high induced value. There was no evidence that participant’s knew enough to know when a project was purposefully a failed project. Rather, a vast amount of responses commented that failed projects were due to the irrationality or greed of other participants. Additionally, despite learning was evident with respect to demand revelation, as indicated in the post-experiment survey, only 3 participants out of a total of 40 participants worked out the threshold level. Given there was enough information for participants to work out the overall project cost and compensation budget in the UCVM case, it was surprising only a small proportion of participants worked this out.

With respect to learning, survey responses revealed that participant’s incentive to report thoughtfully in the first period was generally undermined. This was because participants felt they had multiple periods to determine the optimal bidding strategy. If a real world field settings case were to be conducted, it would be recommendable to include more explanation and guidance to participants in regards to their optimal bidding strategy. This would hopefully improve individual and aggregate demand revelation further

### **4.3 Failure Rate**

For the purposes of this paper, the failure rate used is with respect to the failure of each mechanism. This includes when a project passed when it should have failed (overall costs exceeded benefits), and when a project failed when should have passed (when benefits exceeded costs). A mechanism failure means that participants lost out on potential surplus earnings overall when it incorrectly failed, or participants lost earnings compared to their initial position when projects unfittingly proceeded. The benefit cost ratio (BCR) for each period and each mechanism varied because of the varied nature of induced values. This result may perhaps influence the results, where lower BCR’s may be more

susceptible to higher failure rates because there are fewer leniencies to free ride. This consideration is supported in Rondeau, Poe and Schulze (2005), where they indicate the PPM is more susceptible to higher failure rates when the BCR of a good or service is quite low, for example, between the range of 1 and 1.4. However, given this paper is purely considering when the project failed or passed unfittingly, the results are not adjusted for BCR values.

Table 2 shows failure rates for each mechanism and distinguishes the ordering of sessions, to understand the effects of WTP or WTA being conducted first. An F test comparing variance of ratio's was conducted to show the variance between the failure rate in the first and second session is significantly different across all mechanisms ( $F= 56.5000$ ,  $p\text{-value}= 0.0004$ ). It was expected PPM would have high failure rates, and this occurred, with WTP-PPM failing 85.71% and WTA-PPM failing 57.14% out of the 7 periods in the first session. Both WTP-PPM and WTA-PPM exhibited lower failure rates of 14.28% in the second session, a potential explanation for this is ordering effects, where participants freshly aware of the alternative perspective. The difference between WTP and WTA failure rates were not significantly different ( $F= 2.5260$ ,  $p\text{-value}= 0.3321$ ), indicating there was no overall superior perspective between WTP and WTA.

Both the RPVM and UCVM was less subject to failure compared to the PPM in the first session. This was as expected, given the free-riding prospect in PPM. Table 3 shows that the higher failure rate for PPM compared to UCVM is significantly different at the 2% level. UCVM and RPVM variance of failure rates were not significantly different, and this was also expected, considering their very similar incentive structure. The overall low failure rate indicates the efficiency of the UCVM and RPVM as a demand revealing mechanism. The majority voting mechanism's efficiency in terms of failure rate of mechanisms compared to PPM is further supportive of hypothesis 1.

**Table 3** Variance Ratio Test for failure rates between mechanisms

	F	p-value
PPM-UCVM	36.0000	0.0150
PPM-RPVM	6.0000	0.1753
UCVM-RPVM	0.1667	0.1753

A consideration to note in regards to comparing mechanisms is that unfamiliarity of mechanisms to participants, even if the task may appear straightforward may nonetheless result in participants to default to a more familiar strategy, for example free riding (Plott and Zeiler 2005). This rationale may have attributed to initially low WTP demand revelation for the novel majority voting mechanisms. More importantly, a distinguishing feature for one mechanism may be so similar to other mechanisms that participants feel familiar with, and this leads to the important or noted difference to be overlooked despite having experimental controls in place (Plott and Zeiler 2005).

Another cause for reservation when studying and making comparisons of the failure rate, and other factors including demand revelation, is the small group size used in the experiments conducted. In the majority voting mechanisms, a group size of 5 thus required at least 3 persons to be in favour of the project to proceed. This meant that if at least one person was attempting to free-ride or bid lower than their induced value it would dramatically reduce the likelihood of the project proceeding. Larger group sizes would correct for this limitation, as each participant's actions would hold less weighting to the overall outcome of the project.

#### 4.4 WTP WTA Discrepancy

With use of an F test comparing equality of two samples variance, the variance between WTP and WTA for PPM, UCVM and RPVM are all significantly different at a 2% level of significance (see Table 4). There is evident under bidding for WTP, and overbidding in WTA. Thus, given each mechanism demonstrates statistical difference between WTP and WTA in statistical terms over a small range (p-value= 0.0178 for UCVM to p-value=0.0000 for RPVM), hypothesis 2 has been unverified statistically. This isn't necessarily a detrimental outcome, considering the high incentive compatibility shown via demand revelation for UCVM and RPVM and through graphical terms via figures 1-6 it can be seen PPM exhibits a higher overbidding in WTA and underbidding in WTP trend compared to UCVM and RPVM.

**Table 4** Summary of F test comparing equality of two samples variance between WTP WTA, and between mechanisms

		F	p-value
WTP-WTA	PPM	1.7779	0.0059
	UCVM	1.5281	0.0178
	RPVM	3.1966	0.0000
WTP	PPM to UCVM	1.1632	0.4511
	PPM to RPVM	1.5933	0.0550
	UCVM to RPVM	1.3697	0.1458
WTA	PPM to UCVM	3.1413	0.0000
	PPM to RPVM	9.0007	0.0000
	UCVM to RPVM	2.8653	0.0000

As Table 4 shows, WTP between each mechanism were not significantly different between any of the mechanisms. And interestingly, each WTA for all three mechanisms were statistically different from each other at the 1% level. This result suggests that there was less variability in WTA results, and thus allowing for statistical significant variances between mechanisms to show.

### 5. Concluding Remarks

This paper proposes the undisclosed cost voting mechanism as an efficient majority voting mechanism. With use of laboratory economic experiments with induced values and a generic context, a direct comparison between PPM, UCVM and RPVM allowed for the merits and shortcomings for each mechanism to be clearly observed. As mentioned above, referendum contingent valuation formats are incentive compatible (Hoehn and Randall 1987) due to its decoupled payment vehicle and decisive implementation frame (Green *et al.* 1998), and this paper presents results in adherence to this statement. Overall this paper has shown some interesting results, particularly in regards to efficient WTA results, and this paper thus infers that the complexity of WTA is not due to incentive issues. This paper also lends further promise to the majority voting mechanism as a credible and reliable contingent valuation mechanism. Furthermore, the results shown for RPVM and PPM are consistent with existing literature. Where, high demand revelation shown in RPVM is consistent with findings found in Messer *et al.* (2010) and Keisner *et al.* (2013). Similarly, results for PPM, where there was general, however not excessive, underbidding for WTP and overbidding for WTA and this is also

agreeable with a wide range of current PPM studies (Bush *et al.* 2012; Rondeau, Poe and Schulze 1999).

The results provided indicate that majority voting mechanisms are more efficient than the widely applied PPM in terms of demand revelation, failure rate and WTP WTA discrepancies. This successfully met the first hypothesis. The second hypothesis that there would be a significant difference between PPM and majority voting mechanisms, RPVM and UCVM was not statistically satisfied. However, it was met graphically, where there was a notable improvement in WTP WTA discrepancy for majority voting mechanisms used compared to PPM. The third hypothesis, that the UCVM maintained the promising results of RPVM in terms of incentive compatibility, despite its enhancement in credibility of decision rule was also successful. Furthermore, it has been shown that the UCVM was superior compared to PPM and RPVM in the first period, in terms of inducing more accurate demand revelation and lower initial failure rates.

### **5.1 Recommendations**

There has been limited focus on open-ended referendum formats; to my knowledge this paper is one of the first paper's to clearly conduct this format in an economic experiment, and with comparison to existing CVMs. Given the scope of this paper, and the preliminary nature of the RPVM and UCVM literature, only contingent valuation mechanisms in a generic context with monetary units in an economic experiment laboratory have been applied. And particularly, due to the promising results shown, this paper highly recommends applying this mechanism to a real world field setting. This is essential in determining if the UCVM can play a more prominent role in contingent valuation studies, particularly in relation to government projects where there is an authoritative means to apply a coercive tax when deemed worthy of proceeding. This paper recommends further replications to be conducted, and possibly with variation to group sizes to improve the reliability of the results, and ensure the majority voting mechanism holds up with greater group sizes. Another area of interest could be to compare the impact of information given to participants for the UCVM and RPVM, particularly because this paper is the first paper, to my knowledge that addresses RPVM without focus on social preferences.

### **Acknowledgements**

First and foremost, I would like to express my gratitude to my supervisor, Alan Randall, for his steadfast guidance throughout the duration of this paper. I would also like to thank Elizabeth Bernold, Todd Sanderson and Tim Capon for their assistance in running processes of an economic experiment and using the ztree program. Finally, I would like to express thanks to the Faculty of Agriculture and Environment for providing the resources to fund this experiment.

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## Appendix A

Provided below is a copy of two sets of instructions as seen by participants. These two sets of instructions offer an example for how each mechanism; the PPM, UCVM and RPVM were explained to participants. They were firstly provided with session 1 instructions, and after session 1 ended they were given the session 2 of instructions. The remaining sets of instructions, quizzes and surveys are available from the author upon request.

### Instructions for WTP-PPM and WTA-UCVM:

#### Instructions for Session 1

This is an experiment on the economics of decision making. The instructions are straight-forward, and if you follow them and make good decisions you may earn a considerable amount of money. This will be paid to you in cash at the end of the experiment. From this point onwards, if you have any questions please raise your hand and an attendant will assist you. If you do not follow these instructions you will be asked to leave the experiment and will not receive a payment.

#### Background

In this experiment, there is a proposed public good project that will benefit society, and will benefit each individual person if the project proceeds.

You will be asked to indicate the highest amount of money you would be willing to contribute in favour of this project proceeding. The project will proceed if the sum of the group contributions to the project exceeds or equals an **undisclosed** cost of the project. If the sum of group contributions does not exceed the cost of the project, it will not go ahead.

#### Procedure

There are two sessions in this experiment. This instructions sheet is for the first session only.

There will be an undisclosed number of rounds occurring in this experiment. You will not know which round is the last round you are playing until it has finished. Participants are randomly divided into **groups of five** before the first round commences. The composition of the group will stay the same for all rounds.

At the beginning of each round, each participant will be given an initial **endowment of 100 cents**. An endowment simply means an income given to you.

You will also be provided with a personal payoff amount (i.e. your individual benefit). Your personal payoff amount is the benefit you will receive if the project proceeds. Personal payoffs are randomly generated across an undisclosed range. Your payoff may be different each round, and personal payoffs may also vary among participants within your group.

You will be asked to report the highest amount you are willing to contribute to a group project. You may contribute any amount between 0 to 100 cents. Once you have input a contribution and clicked OK, you may not change your decision for that particular round.



A screen shot of the beginning of each round for this session is provided:

Period 1 Remaining time [sec]: 58

Your endowment: 100  
Your personal payoff: 90  
Your contribution to the project:

OK

HELP  
Please enter your individual contribution to the project.

At the top of the screen the round number appears. You will have 60 seconds each round. Your decision must be made within the time limit.

Whether or not the project proceeds is influenced by your contribution, the contribution of others in your group and the total cost of the project. The total cost of project will remain undisclosed to you throughout the duration of the session.

THE PROJECT PROCEEDS IF: the sums of your group's contributions equals or exceeds the undisclosed cost of the project. If the sum of group contributions exceeds the undisclosed cost of the project, group members will receive the surplus funds as personal dividends in proportion to the amount each has claimed. Your earnings for the round will be your personal payoff (your individual benefit) plus what you keep for yourself ( $100 - \text{Your Contribution}$ ), plus a potential dividend if total contributions exceeds project cost.

**Return=  $100 - \text{Your Contribution} + \text{Your Personal Payoff} + \text{Your personal dividend from any surplus contributions}$**

The income from each group member is calculated the same way. However your earnings will differ depending on the contribution you provide and the personal payoff you are given.

THE PROJECT FAILS IF: the sum of your group's contributions is less than the cost of the project. In this case, your contribution is returned to you and you will simply keep your initial endowment for that specific round.

**Return= 100**

The results screen will provide you with the outcome of the project for the specific round, and your earnings for the round. Once you click continue, the next round will prepare to commence, and this process will continue until the final round is announced.

Please attempt the quiz on the desktop in the top right hand corner of your computer screen (It is an excel file labeled QUIZ). Once you have answered all the questions, a message at the bottom of the quiz will appear saying “All your answers are correct” or “At least one of your answers is incorrect”. Please continue the quiz until you can see the message “All your answers are correct”. Only attempt the quiz on the first sheet of the excel file labeled Session 1.

If you have any questions regarding the answers to the question or for the instructions in general please raise your hand and an attendant will assist you.

Once you have finished the quiz, please minimize the quiz excel file and open the **zleaf icon** on the desktop in the top right hand corner of your computer screen. You will then be informed when the experiment will commence.

## **Instructions for Session 2**

### **Background**

In this experiment, there is a proposed public good project that will benefit society, but you and the other players in your group will be inconvenienced if this project proceeds. The project authority is willing to pay compensation claims to damaged parties, to the extent that its budget allows.

You will be asked to indicate the smallest amount of money you would be willing to accept as compensation and still vote in favor of a public good project proceeding. The amount of compensation you request acts as a vote in favor or against a project, depending on the amount you request. In this way you will as a group collectively determine whether a project proceeds or not.

### **Procedure**

Similar to the previous session, there will be an undisclosed number of rounds occurring in this experiment. You will not know which round is the last round you are playing until it has finished. Once again, participants are randomly divided into **groups of five** before the first round commences. The composition of the group will stay the same for all rounds.

Also, as before, at the beginning of each round, each participant will be given an initial **endowment of 100 cents**.

This time you will also be provided with a personal loss amount (i.e. your individual cost of damage). This personal loss amount will be deducted from your endowment if the project proceeds. Personal loss amounts are randomly generated across an undisclosed range. Your loss amounts may be different each round, and loss amounts may also vary among participants within your group.

You will be asked the lowest amount of compensation you wish to claim while still remaining in favor of this project proceeding given the personal cost of damage you will incur. You may claim any

number equal to or greater than 0. Once you have reported your claim for compensation and clicked OK, you may not change your decision for that particular round.

A screen shot of the beginning of each round for this session is provided:

Period 1 Remaining time [sec]: 28

Your endowment: 100  
Your cost of individual damage: 95  
Your claim for compensation: 1

OK

You will have 60 seconds each round. Your decision must be made within the time limit.

Whether or not the project proceeds is influenced by the size of the compensation you claim, the compensation claims offered by other players, and your share of the compensation budget. Your share of the compensation budget is simply the undisclosed total compensation budget divided by the number of participants, in this case, five.

- If your individual claim for compensation is **less than or equal** to the undisclosed compensation budget share, then your compensation claim will count as a YES vote in favour of the project proceeding.
- If your individual claim for compensation is **greater than** your undisclosed compensation budget share, then your compensation claim will count as a NO vote, in favour of rejecting the project.

**THE PROJECT WILL PROCEED IF:** the majority of participants (i.e. 3 or more participants) report claims for compensation that are less than or equal to the compensation budget share. In this case each participant will receive this equal compensation share, but will also have to pay their personal loss amount. This means that even if your vote counted as a NO vote in favour of rejecting the project, you will still pay your personal loss amount and receive an equal share of the available compensation budget.

Each participant's earnings for the round would be:

$$\text{Return} = 100 - \text{Your Personal Loss Amount} + \text{Your Share of the Compensation Budget}$$

The income from each group member is calculated the same way, however your earnings will differ depending on the personal loss amount you are given. Please note, you receive an equal share of the compensation budget, not the individual compensation claim you report.

THE PROJECT WILL FAIL IF: the majority of participants (i.e. 3 or more participants) claim compensation greater than the compensation share. In this case, the project will be rejected, and you will simply receive your initial endowment of 100 cents for the round.

<b>Return = 100</b>
---------------------

The results screen will provide you with the outcome of the project for the specific round, and your earnings for the round. Once you click continue, the next round will prepare to commence, and this process will continue until the final round is announced.

At the end of the experiment you will be paid privately and anonymously. You will receive the earnings you make in the two sessions you participate in plus a \$10 show-up fee.

Please attempt the quiz on the second tab of the excel file. If you have any questions regarding the answers to the question or for the instructions in general please raise your hand and an attendant will assist you.

## Appendix B

### Instructions for WTP-UCVM and WTA-RPVM:

#### Instructions Session 1

This is an experiment on the economics of decision making. The instructions are straight-forward, and if you follow them and make good decisions you may earn a considerable amount of money. This will be paid to you in cash at the end of the experiment. From this point onwards, if you have any questions please raise your hand and an attendant will assist you. If you do not follow these instructions you will be asked to leave the experiment and will not receive a payment.

#### Background

In this experiment, there is a proposed public good project that will benefit society, and will benefit each individual person if the project proceeds.

You will be asked to indicate the highest amount of money you would be willing to contribute and still vote in favour of the project. The amount you indicate will act as a vote in favour or against the project, and determine whether or not the project is funded and proceeds. In this way you will as a group collectively determine whether a project proceeds or not.

#### Procedure

There are two sessions in this experiment. This instructions sheet is for the first session only.

There will be an undisclosed number of rounds occurring in this experiment. You will not know which round is the last round you are playing until it has finished. Participants are randomly divided into **groups of five** before the first round commences. The composition of the group will stay the same for all rounds.

At the beginning of each round, each participant will be given an **initial endowment of 100 cents**. An endowment simply means an income given to you.

You will also be provided with a **personal payoff amount** (i.e. your individual benefit). Your personal payoff amount is the benefit you will receive if the project proceeds. Personal payoffs are randomly generated across an undisclosed range. Your payoff may be different each round, and personal payoffs may also vary amongst participant within your group.

You will be asked to report the highest amount you are willing to contribute to a group project. You may contribute any amount between 0 to 100 cents. Once you have input a contribution and clicked OK, you may not change your decision for that particular round.

A screen shot of the beginning of each round for this session is provided:

The screenshot shows a game interface with a yellow border. At the top left, it says "Period" followed by "1". At the top right, it says "Remaining time [sec]: 28". In the center, there is text: "Your endowment: 100", "Your individual payout: 80", and "Your contribution to the project" followed by a blue rectangular input field. In the bottom right corner, there is a red button labeled "OK".

At the top of the screen the round number appears. You will have 60 seconds each round. Your decision must be made within the time limit.

Whether or not the program proceeds is influenced by the size of the contribution you offer, the contributions offered by other players, and the cost of the project. The total cost of the project will remain undisclosed to you throughout the duration of the session. Your share of the project cost is the total cost of the project divided by the number of participants, in this case, five.

- If your individual contribution **is greater or equal to** the undisclosed share of project cost, then your contribution will count as a YES vote in favour of the project.
- If your individual contribution is **less than** the undisclosed share of project cost, then your contribution will count as a NO vote, in favour of rejecting the project.

THE PROJECT WILL PROCEED IF: the majority of participants (i.e. 3 or more participants) report contributions that are greater than or equal to the share of project cost. In this case, each person will receive their personal payoff amount, but will also have to pay the undisclosed share of project cost. This means that even if your vote counted as a NO vote in favour of rejecting the project, you will still receive your personal payoff amount and be charged for the project.

Each participant's earnings for the round would be:

**Return= 100 – Equal Share of the Project Cost + Your Personal Payoff Amount**

The income from each group member is calculated the same way, however your earnings will differ depending on the personal payoff amount you are given. Please note, you pay an equal share of the project cost, not the individual contribution you report.

THE PROJECT WILL FAIL IF: the majority of participants (i.e. 3 or more participants) contribute less than the share of project cost. In this case, the project will be rejected, and you simply receive your initial endowment of 100 cents for the round.

<b>Return = 100</b>
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The results screen will provide you with the outcome of the project for the specific round, and your earnings for the round. Once you click continue, the next round will prepare to commence, and this process will continue until the final round is announced.

Please attempt the quiz on the desktop in the top right hand corner of your computer screen (It is an excel file labeled QUIZ). Once you have answered all the questions, a message at the bottom of the quiz will appear saying “All your answers are correct” or “At least one of your answers is incorrect”. Please continue the quiz until you can see the message “All your answers are correct”. Only attempt the quiz on the first sheet of the excel file labeled Session 1.

If you have any questions regarding the answers to the question or for the instructions in general please raise your hand and an attendant will assist you.

Once you have finished the quiz, please minimize the quiz excel file and open the **zleaf icon** on the desktop in the top right hand corner of your computer screen. You will then be informed when the experiment will commence.

## Instructions Session 2

### Background

In this experiment, there is a proposed public good project that will benefit society, but you and the other players in your group will be inconvenienced if this project proceeds. The project authority is willing to pay compensation claims to damaged parties, given there is sufficient compensation levels available.

You will be asked to indicate the lowest amount of money you would be willing to accept as compensation and still vote in favor of a public good project proceeding. The amount you provide acts as a vote in favor or against a project, depending on the amount you offer. And in this way you will as a group collectively determine whether a project proceeds or not.

### Procedure

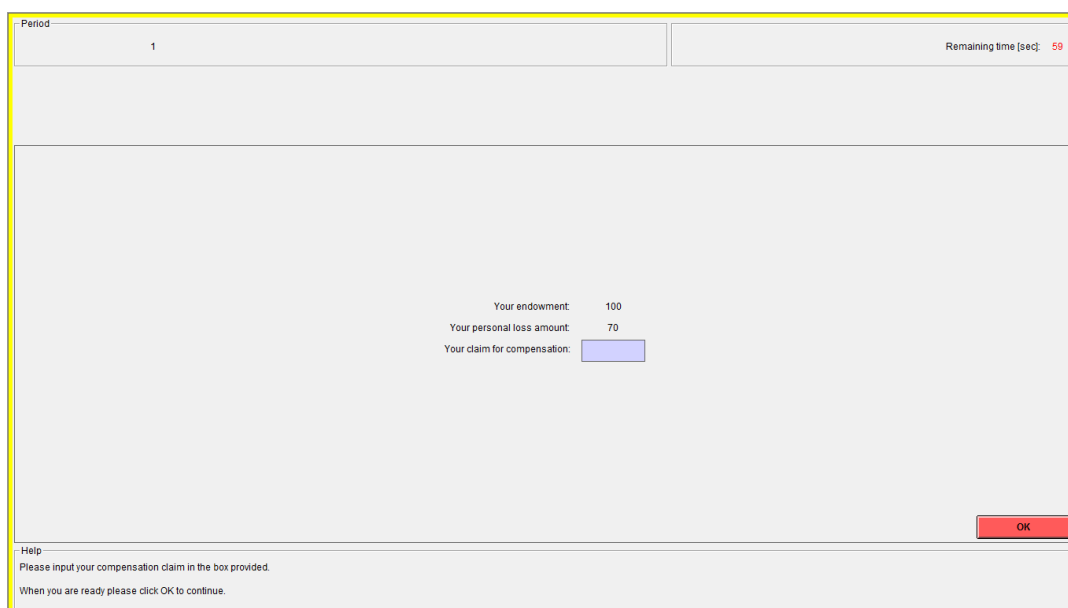
Similar to the previous session, there will be an unknown number of rounds occurring in this experiment. You will not know which round is the last round you are playing until it has finished. Once again, participants are randomly divided into **groups of five** before the first round commences. The composition of the group will stay the same for all rounds.

Also, as before at the beginning of each round, each participant will be given an initial **endowment of 100 cents**. An endowment simply means an income given to you.

This time you will be provided with a **personal loss amount** (i.e. your individual cost). This personal loss amount will be deducted from your endowment if the project proceeds. Loss amounts are randomly generated across an undisclosed range. Your loss amount may be different each round, and it may be different from the loss amount for other group members.

You will be asked the lowest amount of compensation you wish to claim to still remain in favor of this project occurring given the cost you will incur. You may claim any number equal to or greater than 0. Once you have input your claim for compensation and clicked OK, you may not change your decision for that particular round.

A screen shot of the beginning of each round for this session is provided:



Period 1 Remaining time [sec]: 59

Your endowment: 100  
Your personal loss amount: 70  
Your claim for compensation:

OK

Help  
Please input your compensation claim in the box provided.  
When you are ready please click OK to continue.

You will have 60 seconds each round. Your decision must be made within the time limit.

The compensation budget share (simply, the total compensation budget divided by the number of participants, in this case, five) will be randomly generated by the computer program you will be using today. The computer program will randomly generate any number between 0 to 100, as such any compensation payment between 0 and 100 cents is equally likely. The compensation budget share will be equal amongst all group members in each round, however will randomly generated in subsequent rounds. The compensation budget share will be displayed to you after you have submitted your compensation claim.

Whether or not the project proceeds is influenced by the size of your compensation claim, the compensation claims made by other group members and the randomly generate compensation budget share.

- If your individual claim for compensation is **less than or equal** to the compensation budget share, then your compensation claim will count as a YES vote in favour of the project occurring.



- If your individual claim for compensation is **greater than** the compensation budget share, then your compensation claim will count as a NO vote, in favour of rejecting the project.

THE PROJECT WILL PROCEED IF: the majority of participants (i.e. 3 or more participants) claims for compensation are less than or equal to the compensation budget share. In this case all participants will receive this equal compensation budget share, but each will also have to pay their personal loss (i.e. cost of damage) amount. This means that even if your vote counted as a NO vote in favour of rejecting the project, you will still pay your personal loss amount and receive an equal share of the compensation payment.

Each participant's earnings for the round would be:

$$\text{Return} = 100 - \text{Your Personal Loss Amount} + \text{the Equal Compensation Budget Share}$$

The income from each group member is calculated the same way, however your earnings will differ depending on the personal loss amount you are given. Please note, you receive an equal share of the compensation budget, not the individual claim you report.

THE PROJECT WILL FAIL IF: the majority of participants (i.e. 3 or more participants) claim compensation greater than the compensation budget share. In this case, the project will not go ahead, and you simply receive your initial endowment of 100 cents for the round.

$$\text{Return} = 100$$

The screen will provide you with the outcome of the project for the specific round, and your earnings for the round. Once you click continue, the next round will prepare to commence, and this process will continue until the final round is announced.

At the end of the experiment you will be paid privately and anonymously. You will receive the earnings you make in the two sessions you participate in plus a \$10 show-up fee.

Please attempt the quiz on the second tab of the excel file, labeled Session 2. If you have any questions regarding the answers to the question or for the instructions in general please raise your hand and an attendant will assist you.

Once you have completed the quiz, please re-open the **zleaf icon** at the bottom of your computer screen task bar. Once again, you will be informed when the experiment will commence.

