Towards an Understanding of Static Transaction Costs in the NSW Permanent Water Market: An Application of Choice Modelling

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Paper presented at the 45th Annual Conference of the Australian Agricultural and Resource Economics Society, January 23 to 25, 2001, Adelaide, South Australia.

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Abstract

The theoretical foundation of water market reforms presumes that such institutions will allow water to be traded from relatively low-value to higher-value uses and simultaneously accomplish many of the economic and environmental objectives ascribed to water resource managers. Numerous ex ante analyses have been conducted to model the impacts of entitlement markets, allocations for the environment and other recent legislative changes pertaining to water (see, for instance, Hall, Poulter and Curtotti 1993; Crean et al. 1998). In general, these analyses support the market framework as a technique for allocating water as it becomes increasingly scarce. However, a relative dearth of information exists about the impact of legislative change itself on the citizenry who are required to assimilate and conform to the changing rules within a market setting. This paper explores the impact of the resulting attenuation of property rights on the behaviour of potential buyers and sellers of water in the market for permanent water transfers in NSW. The paper uses a Choice Modelling approach to enumerate the value of a more stable set of property rights.

1.0 Introduction

Water markets have become an integral component of the reformed institutions that govern the allocation of water resources in the mature water economy (see, for example, Rosegrant 1999; Bauer 1997; Thobani 1997). In Australia, the Council of Australian Governments [CoAG] water reform process strengthens the role of water markets by requiring, amongst others, that the nexus between land and water titles be

broken and arrangements for the trading of water entitlements be established. The theoretical foundation of these reforms resides in the presumption that water will be traded from relatively low-value to higher-value uses, thereby encouraging irrigators to retire degraded lands and promote the use of water-saving technologies (National Competition Council [NCC] 1998; Rigden 1998; Crase *et al* 2000). Accordingly, the efficiency of these markets is an important determinant of the overall efficacy of water policy.

Water markets are neither recent nor uniquely Australian institutional arrangements. Researchers investigating water markets have thus had ample opportunity to explore their operation from an empirical perspective. Notwithstanding this opportunity, Howitt and Vaux (1990, p. 107) have observed that "...empirical models of water trades are uncommon, probably due to the absence of empirical data on regional supplies and demands, and the difficulties of solving these models". More recently, Montginoul and Stosser (1998, p. 20) have contended that "...empirical studies analysing the impact of water markets are rare and not sufficient to recommend their implementation in other contexts, apart from a theoretical point of view". Nevertheless, a growing empirical literature is emerging which deals with the economic performance of water markets.

Two broad groups of studies can be identified. Firstly, a strand of empirircal research has emerged that employs observations from related input and output markets to infer behaviour under some idealised water trading scenario. Studies within this group might therefore be described as 'quasi-empirical' in so far as they explore the welfare implications attendant on different institutional frameworks for managing water resources and draw comparisons with hypothetically efficient water markets. Within this category, two distinct genre of research can be identified; work dealing with issues arising from bulk water pricing (Guise and Flinn 1970; Bari 1998; Kanazawa 1993; Varela-Ortega *et al.* 1998; Moore and Dinar 1995; Samaranayaka *et al.* 1997; Howitt and Vaux 1990; Eigenraam and Stoneham 1998) and broader analyses of the effects of trade (Giannias 1997; Lekakis 1998; Fishelson 1994; Zeitouni 1994; Vaux and Howitt 1984; Chang and Griffith 1992; Taylor and Young 1995; Turner and Perry 1997; Shah and Zilberman 1992; Zilberman *et al.* 1993; Howe *et al.* 1990; Saleth *et al.* 1991). In an Australian context studies in this latter category include the use of

spatial equilibrium models (Crean *et al.* 1998; Barker *et al.* 1997) and optimisation and linear programming models (Hall *et al.* 1993; Beare and Bell 1998; Topp and McClintock 1998). However, it can be argued that many of these studies run the risk of manifesting the 'nirvana fallacy' (Demsetz 1969), since an idealised water market frequently employs assumptions of rationality and homogeneity which are not always apparent in the real world.

The second broad category of empirical studies might be regarded as 'pure-empirical' analyses. Although fewer in number, these studies are commonly concerned with enriching our understanding of the behaviour of actual economic agents in existing real-world water markets. International examples include Colby *et al.* (1993), Colby (1990), Howitt (1994), Archibald and Renwick (1998), Hearne (1998), Lovell *et al.* (2000) and Dubash (2000). Australian 'pure empirical' analyses include the use of hedonic pricing techniques to investigate the dimensions of market behaviour (Bjornlund and McKay 1996; 1998; Challen and Petch 1997) and less sophisticated statistical comparisons between different trading groups (Bjornlund and McKay 1995; 1999). An enduring theme of these empirical studies is the significance of transaction costs embodied in the market institution.

Challen *et al.* (1996, p. 122) argued that "...conventional neoclassical models with assumptions of zero transaction costs have been used to demonstrate a theoretical potential for markets in individual property rights to produce perfect resource allocation". However, many 'pure-empirical' analyses reveal divergence from some theoretically ideal state. In addition, the explorations to date have employed a relatively narrow definition of transaction costs, focussing on conventional market failures, third-part effects, infrastructure impediments, policy-induced costs and administratively-induced transaction costs. In most cases analyses have used empirical evidence to acknowledge the existence of transaction costs without quantifying the extent of specific costs. Perhaps this accounts for the claim by Challen *et al.* (1996, p. 120) that "...[a] search of the published literature has revealed no detailed empirical studies of transaction costs in water markets of any sort. Even the limited number of empirical studies have tended to avoid quantitative estimation of transaction costs".

Invariably conclusions from the 'pure-empirical' analyses have argued for policies capable of reducing the effect of transaction costs, but without quantitative measurement this may not be feasible. Thus, the empirical analyses of the operation of water markets is incomplete. In an Australian context a valuable contribution can be made by quantifying specific transaction costs relating to institutional change. This paper seeks to empirically investigate the extent of transaction costs arising from a reduction in the attenuation of property rights in the market for permanent water transfers in NSW.

The paper itself is divided into six main parts. In part two we review the transaction cost framework with specific reference to the seminal contribution of Challen (2000) and Challen and Schilizzi (1999). A choice modelling [CM] technique used to quantify transaction costs and the related experimental design process is described in part three. Part four is given to a description of the results of the choice experiment whilst policy implications are discussed in part five. The paper ends with some brief concluding remarks.

2.0 A Transaction Cost Framework for Analysing Water Institutions.

The origins of the theory of transaction costs can be traced to two influential views expressed about managed coordination and the existence of the firm. More specifically, the seminal work of Frank Knight (1921) and Ronald Coase (1937) are seen as the genesis of transaction costs economics (Demsetz 1997, p.2). The analysis of markets and hierarchies offered by Williamson (1975), subsequently formalised the notion of transaction costs within economic theory. From the original contributions of Knight (1921), Coase (1937) and Williamson (1975) a body of literature has emerged which attempts to explore the role of transaction costs under different institutional regimes. In accepting the broadest definition of transaction costs (see, for instance, Furubotn and Richter 1992, p.8), it is possible to identify a number of categories of transaction costs associated with any institutional change.

Recent contributions by Challen and Schilizzi (1999) and Challen (2000) seek to extend this analysis to a consideration of the dynamic transaction costs of institutional change. More specifically, Challen and Schilizzi (1999) offers a two-fold taxonomy

of dynamic transaction costs, which arise from the process of institutional change, as distinct from static transaction costs, which pertain to the current institutional arrangements. The two-fold typology of dynamic transaction costs comprises transition and inter-temporal opportunity costs. This second category of dynamic transaction costs relates to the capacity to reverse institutional change. In developing this category, Challen and Schilizzi (1999) note the political costs associated with transferring property rights and draws upon the work of Horn (1995). Institutional history suggests that devolution of property rights from the dispersed many to the concentrated few has relatively low costs, since the intense preferences of the few encourage them to mobilise political resources to secure such a redistribution. By way of contrast, it is relatively difficult and therefore costly to reverse property rights from the few to the many. To this extent institutional change must also consider the 'quasi-option' costs of change and the extent to which reversibility may be required under conditions of uncertainty.

This issue is of particular significance in the allocation of water resources in NSW, where the stated aim of the Department of Land and Water Conservation [DLWC] has been to retain an adaptive approach to water management. This approach stems, in part, from uncertainty surrounding the riverine environment (DLWC 1998, p. 11). It can be argued that the reluctance of the state to enhance the property rights of irrigators is the manifestation of the perception that inter-temporal opportunity transaction costs outweigh any static transaction costs attendant on the existing framework. Put simply, a firming of property rights might improve the operation of the water market [and other water-related investments] but the cost of re-purchasing water at some time in the future is assumed to outweigh any current welfare gains.

A reduction in static transaction costs derives from the notion that successful water markets are predicated on the premise that "...buyers must feel confident that they will receive and be able to use the right purchased ...[and]... well-defined and enforced mechanisms and criteria must be in place to assure that users are adequately compensated when their rights are confiscated or transferred to higher societal preferences" (Simpson and Ringskog 1997, pp. 6-7). By way of contrast, the *Water Management Bill* would appear to do little to allay the concerns of irrigators about the strength of their property rights in water. For example, Clause 38 of the Bill asserts

that "[t]he Minister may, by order published in the Gazette, vary the bulk access regime established by a management plan if satisfied that it is in the public interest to do so." Irrigators who are adversely affected by such amendments are entitled to seek compensation, although Clause 78 significantly constrains the extent of compensation thus:

"The Minister, with the concurrence of the Treasurer, may determine whether or not compensation should be paid and, if so, the amount of any such compensation and the manner and timing of any payments. No appeal lies against any decision of the Minister or the Treasurer under this section, and any such decision is not to be called into question in any legal proceedings".

We contend that the attenuation of property rights in this form constrains the capacity of the market to generate surplus by limiting the incentives to undertake trade. Alternatively, in the parlance of transaction costs, the attenuation of property rights implies a divergences from some 'efficient' allocation of resources. However, Williamson (1979) argues that "...if transaction costs are negligible, the organisation of economic activity is irrelevant, since any advantages that one mode of organisation appears to hold over another will simply be eliminated in costless transacting". All institutional structures achieve an efficient resource allocation where transaction costs are zero and, in the 'real world' of new institutional economics, the institutional arrangements that minimise transaction costs should be pursued.

All of this implies that the transaction costs attendant on different institutions can be measured. In the context of water resource allocation in NSW, measuring the static transaction costs in the NSW permanent market would provide a starting point for objective analysis of different water institutions. This could also provide the foundation for investigating the extent to which static transaction costs might fall short of the inter-temporal opportunity transaction costs of re-purchasing water for the environment. Accordingly, such an analysis would enhance water policy formulation. The remainder of this paper is devoted to describing an attempt to measure the static

transaction costs that arise in the market for permanent water transfers in the Murray and Murrumbidgee irrigation districts of NSW[1].

3.0 Using Choice Modelling to Measure Static Transaction Costs in the NSW Water Market

Crase *et al.* (2000) identified in this Journal a relative paucity of permanent trade in NSW water markets. Drawing on the international literature, it was hypothesised that the relative dearth of trade was the manifestation of various market impediments. In the case of NSW these included unclear or poorly defined property rights to access the resource, infrastructure impediments, excessive transaction and transfer costs, hoarding behaviour and speculation, and cultural or sociological attributes that limit market participation. Accordingly, in the current context a methodology is required which can measure the influence of a single attribute [the attenuation of property rights] on the decision of potential market participants. CM was considered an appropriate analytical tool for accomplishing this task.

CM can be traced back to the seminal work of Louviere and Henscher (1982) and Louviere and Woodworth (1983). However, Carroll and Green (1995) contend that CM itself represents an extension of conjoint analysis, which stems largely from the theoretical contributions of Luce and Tukey (1964), Kruskal (1965), Roskam (1968), Carroll (1969; 1973) and Young (1972). Conjoint analysis is the term given to describe a multivariate technique which explores the mechanisms by which respondents develop preferences for products or services or ideas with multiple attributes. It differs from other multivariate techniques in its decompositional nature, its capacity to estimate utilities at the individual level, and its flexibility in terms of relationships between dependent and independent variables. Conjoint analysis assumes that consumers evaluate sets of objects or concepts as bundles of attributes. More specifically, the technique seeks to ascribe utility to the various attributes, under the assumption that consumers are able to allocate utility to the various levels of an attribute and then formulate a total utility for the particular product/service/idea. Products/services/ideas can be real or hypothetical. The aim of the conjoint research

[1] It should be emphasised that this represents the lower bounds of static transaction costs since other water-related investments are also likely to be deterred by excessive attenuation of property rights.

is to statistically unbundle the part-worth utilities assigned to various attributes. In this case, varying the attributes of water entitlements, particularly the level of certainty pertaining to property rights, provides a policy relevant context to examine the behaviour of potential buyers and sellers in the water market. This could then be used as the foundation for measuring static transaction costs.

Any conjoint experiment requires that the product/service/idea be appropriately described, in terms of its relevant attributes and levels, and that respondents are subsequently provided with suitable stimuli (Hair *et al.* 1998, pp. 387-393). Generally, stimuli are developed using an iterative experimental design process. In this instance, a group of *a priori* attributes and levels were developed from in-depth interviews with selected individuals who were directly involved in the debate surrounding water rights in NSW. This group comprised managers within DLWC, executives from irrigation companies and executive officers from the horticulture, rice and dairy organisations in the Murray and Murrumbidgee Valleys. Advice on the practical application of potential attributes was also sought from researchers familiar with the choice-based conjoint methodology. Subsequently focus groups were organised on an enterprise basis across the study region of the Murray and Murrumbidgee valleys. Grower organisations provided membership for the focus groups. Lockwood and Carberry (1998) and Morrison *et al.* (1997) observed that this is a pragmatic approach to soliciting focus group members, which minimises the expense and difficulty of recruitment. The industry groups comprised rice growers and dairy farmers, located in both valleys, and horticulturalists, predominantly located in the Murrumbidgee valley.

The primary aim of the focus groups was to facilitate the development of the choice sets by identifying common attributes and feasible levels of attributes. Clearly, there exists a trade-off between the cognitive demands imposed on respondents and the number of attributes and levels included in the choice experiment. A judgement is therefore required which restricts the experiment to those attributes most important to the research question, maintains the realism of the experiment, and avoids excessive burdens on survey respondents which may manifest themselves in response bias. Three attributes were expected to fulfil these criteria, namely, the price of permanent

water transfers, the level of legislative uncertainty pertaining to entitlements and the price of nearby agricultural land which included a water entitlement.

The price attribute was the least difficult to communicate in the choice task. However, specification of this attribute needed to account for the different security of entitlement holders in the survey. The survey specified that the price represented general security entitlements and a high security price was about double that in the choice sets. Identifying appropriate levels for this attribute was problematic. Hair *et al.* (1998, p. 408) observes that [ideally] the range of attribute levels should be set just outside existing values whilst retaining plausibility. Notwithstanding the information on current prices for permanent water [circa $450-$550 per ML], evidence from the focus groups suggested that such levels were unlikely to invoke changes in the behaviour of many respondents. Accordingly, the repeated selection of the *status quo* from the choice sets would yield little information to quantify the relative importance of stable property rights. The focus groups had provided some anecdotal evidence on the price levels that might potentially encourage significant sales of water entitlements on a permanent basis, with mention of $1,500 per ML and $2,000 per ML by horticulturalists and rice growers respectively. Thus, $350 per ML was taken as the lower bound and $2,000 as the upper bound, even though this might be viewed by conservative respondents as implausible.

Specifying and communicating the extent of certainty about property rights and legislative change offered a number of options. Firstly, the extent to which a water entitlement can be changed can be described in proportionate terms. That is, a percentage of entitlement that is 'secure' versus a percentage which can be autonomously changed by government. Secondly, certainty [or uncertainty] can be described in a chronological context where the extent of certainty is encapsulated in the time frame of the right. Thirdly, as suggested by one of the horticultural focus groups, certainty [or uncertainty] can be conceptualised by some combination of a proportional and chronological scale. Notwithstanding the realism of the latter approach, it adds significant complexity to the choice task for the respondent. In effect, this requires the creation of a "super-attribute" which must then be compared against the other attributes in the choice sets. Moreover, the release of the *White Paper* had focussed many irrigators attention on the time-specific nature of

entitlements, with the time-frame indicated in the document attracting significant attention. In light of this, and the requirement that the choice task be communicable, a chronological specification was adopted. Again four levels were used to maintain reasonable balance across attributes and minimise potential biases from this source (see, for example, Wittink *et al.* 1990).

The third attribute, the price of land with accompanying water entitlements, could also be specified in a variety of forms. 'Dollars per Ha' could be used but variations in land values between valleys and districts would need to be specified. Also the combination of this attribute with the water price attribute would inevitable generate unrealistic choice options with higher water price [$2,000 per ML, for example] being paired with lower real property prices which included the water entitlement. An alternative, adopted in the present case, was to specify the value of land with a water entitlement as a premium on the value of the water. This reduces multicollinearity between attributes and maintains the realism of the experiment. Likely premiums were originally established by contact with real estate agents in the study areas. However, a review of the transcripts of the focus sessions suggested that the current low premium for land might dominate the choice decision, making it difficult to discern the influence of other attributes. Accordingly, three levels were set slightly above the existing land premiums reported by estate agents.

If the level of unobserved attributes is fixed in the minds of respondents, there is increased confidence that the choices and differences in ratings are due only to differences in the manipulated attributes (Elrod *et al.*, 1992; Johnson 1987; Johnson and Levin 1985). Accordingly, the survey specified that commodity prices and other cogent influences were fixed at the same level as the time of the survey[2]. All attributes and related levels originally employed in the choice experiment are detailed in Table 1.

[2]The survey was conducted over July/August 2000. It is presumed that there were no significant movements in other attributes over the course of this month which generated different choice responses.

Table 1: Attributes and Levels within the Pilot Choice Experiment

Attribute	Levels
Price of permanent water	$350, $500, $1,000, $2,000
Time without state changing the rules	5 years, 15 years, 30, years, 99 years
Premium on purchasing unimproved land with existing entitlement in your district	5%, 25%, 50%

A main effects fractional factorial design was generated using *SPSS Conjoint* which resulted in 16 choice options. A foldover design was then used to generate alternative choice options which were paired to provide the choice sets. Foldover designs generally maximise the number of tradeoffs between options but "...[t]he high efficiency in terms of maximising tradeoffs comes at the cost of high cognitive burdens on participants - there are no easy choices" (Lockwood and Carberry 1998, p. 14). Since each respondent was unlikely to be able to cope with all 16 choices the survey was randomly split into two sets of eight choices. In addition, the survey was further subdivided into two parts, one asking respondents to consider the choice options only as buyers and the other asking respondents to consider themselves only as potential sellers. Socio-economic data were also collected, including the size of water entitlement, the age of the respondent and whether they had previously engaged in either the temporary or permanent market. An additional variable, which was considered to be of significance, was the participant's attitude to risk. In order to control for this influence, survey respondent were asked a series of questions relating to the types of insurance they held[3].

A mail survey employing Dillman's (1978) Total Design Method was used to collect choice data. This comprised an original survey with return post and a series of follow-up correspondence. Two weeks after the distribution of the initial survey a reminder letter was mailed to all respondents. After four weeks had elapsed a complete survey package was mailed to those who had not yet returned the survey. The survey population comprised shareholders in Murrumbidgee Irrigation [MI] and Murray Irrigation [MIL] districts. The sample frame was stratified on the basis of

[3] It must be conceded that this is not an ideal mechanism to account for risk. For example, the premium itself combined with budgetary constraints may cause otherwise risk averse respondents to avoid purchase. However, more sophisticated techniques for assessing risk were likely to confound attempts to minimise the burdens on respondents.

shareholder type in the case of the former and enterprise type in the case of the latter. A survey pre-test and toll-free support line indicated that respondents struggled to incorporate the third attribute [the price of land which included a water entitlement] into the choice decision. In the interests of minimising response bias, this final attribute was deleted from the final choice experiment. The levels of the remaining attributes were unchanged.

4.0 Results

Eight weeks after the distribution of 932 surveys 482 had been returned, representing an overall response rate of about 52%. A small number were excluded because of incomplete socio-economic information about the respondent. All choices for which the respondent had matching socio-economic data were included in the analysis. A summary of the socio-economic characteristics of respondents is provided in Table 2.

Table 2: Socio-Economic Characteristics of Respondents

Variable	Buy Survey	Sell Survey	Both Surveys	MIL+MI
Mean Water Entitlement (ML)	1390	1167	1281	793[#]
Mean Farm Area (Ha)	603	512	558	323[#]
Used Temporary Water Market in the Past (%)	74%	80%	77%	45%[+]
Used Permanent Water Market in the Past (%)	15%	8%	11.6%	3%[+]
Age*	2.96	3.07	3.01	51.5 years[a]
Purchased Personal Accident and Illness Insurance (%)	64%	59%	62%	_

Notes: [#] Combined average provided by MIL and Murrumbidgee Irrigation.

[+] Derived from trading and entitlement data (Source: Justine Harris, Water Analysis and Audit Unit, DLWC, 1999, e-mail, 30 June and Paul Simpson, Water Analysis and Audit Unit, DLWC, 1999 and 2000, e-mail 21 August)

[a] Reported from ABARE data collection (Source: Colin Mues, Land Use and Environment Unit, ABARE, 2000, e-mail, 1 September)

*Age was assessed using a 4-stage Likert scale ranging from 18 to 55 plus. The averages recorded here indicates that the mean respondent lies in the 45 to 55 age bracket.

Unfortunately, comprehensive data relating to the population of the study area are not readily available for all variables examined in this part of the survey. However, information gained from the irrigation companies, ABARE surveys of NSW irrigators in 1996-97, and aggregate water trading and entitlement data from DLWC provided some foundation for comparison. The comparison data from other sources has some definitional inconsistencies with the sample. For example, MIL data are available on the basis of farm businesses which excludes 'hobby farms', although similar information is not available from Murrumbidgee Irrigation[4]. Notwithstanding these limitations, the survey data would appear to contain a disproportionate number of larger businesses that have been more actively involved in trade than the norm. *A priori* we expected risk averse respondents to be predisposed to purchasing more insurance than risk neutral or risk seeking farmers. The purchase of "personal accident and illness" insurance was selected as the proxy for risk, having been purchased by about 60% of survey respondents.

Since random utility theory underpins CM it must be conceded that there is an unobservable component of utility. Moreover, assumptions need to be made about the distribution of this random component. Most commonly, an independently and identically distributed error term is assumed, implying that a multinomial logit model can be employed to analyse the observable component of utility. Following Morrison *et al.* (1996, pp. 9-10), a typical multinomial logit model with probability of choosing a given option, *i*, is given by:

$$P_i = \exp(\lambda V_i) / \exp(\lambda V_j) \qquad [1]$$

[4]In MIL, for example, the average farm business comprises 1.5 farms as defined by entitlement numbers (Murrumbidgee Consultancy Services 1998, p. 1).

where V represents the observable and systematic component of utility for a particular alternative, and j takes values from one to n. The scale parameter, λ, is inversely related to the variance and is arbitrarily equated to unity in most cases.

In the first instance, basic multinomial logit models were computed using equation [1]. A specialised computer program, *LIMDEP*, designed to analyse models employing limited dependent variables, was used to conduct the analysis. The indirect utility function specified for basic buy and sell models were as follows:

$$U_1 = C_1 + \beta_1 \text{ Price} + \beta_2 \text{ Years}$$
$$U_2 = C_1 + \beta_1 \text{ Price} + \beta_2 \text{ Years}$$
$$U3 = \beta_1 \text{ Price} + \beta_2 \text{ Years} \qquad [2]$$

Separate buy and sell models were generated constraining the alternative specific constant [ASC] to be equal across U_1 and U_2. The resulting models are referred to as Buy Model 1 and Sell Model 1 and they appear in Table 3.

All coefficients in Buy Model 1 were significant at the 1% level or better. In addition, increasing the price attribute reduce the probability of a potential buyer choosing an alternative and extending the time frame before the government can alter the rules improves the chances that a respondent will select an alternative. The model provides an adequate explanation of the variation of the data reporting a Rho-squared value of 0.19. Values of between 0.2 and 0.4 are usually regarded as a good fit of the data in choice analysis (see, for example, Henscher and Johnson 1981).

Since the multinomial logit model rests heavily on the assumption of independence applied to irrelevant alternatives [IIA], violations of the IIA property should be tested. One alternative is to employ a mother logit test to assess the presence of IIA violations. The mother logit test requires the inclusion in each utility function of attributes from the other alternatives. Likelihood tests are then conducted with significant improvement pointing to IIA violations[5]. An alternative approach,

[5]For an example of the application of the mother logit test and approaches to deal with IIA violations see Blamey *et al.* (2000).

employed in this instance, is the Hausman and Mc Fadden (1984) test. Comparisons are conducted between a full multinomial model and a model with an alternative removed. If the parameter estimates do not vary significantly across the two models the IIA assumption holds. The Hausman and McFadden test revealed no significant violations of IIA at the 5% level in Buy Model 1.

The basic multinomial model generated from the sell survey explained about 32% of the variation in the choice data. However, the significance of the different explanatory variables is of particular interest in the present context. The PRICE variable met *a priori* expectations with increments in price raising the probability that a respondent would select a sell alternative. Moreover, this variable remained significant at the 1% level. However, the YEARS variable was not significant at the 10% level in this model. Again, the Hausman and McFadden test revealed no significant violations of IIA at the 5% level.

Although IIA violations were not significant in either of the basic multinomial models numerous alternative specifications were investigated. This was partly justified in the context of the present research since improving the significance of the YEARS variable in the sell model would assist in formulating policy recommendations. Additional models were generated using socio-economic data collected as part of the first section of the survey. The process of including socio-economic variables in choice models differs from that of conventional regression techniques, since socio-economic variables do not differ across the choice sets, and therefore cannot be used to predict the option chosen (Blamey *et al.* 1999, p. 350). There are two main ways of including socio-economic variables in the analysis. Firstly, they can be interacted with attributes in the choice sets. Secondly, they can be included through interactions with the ASC. In this instance, all combinations of interactions were trialed with socio-economic variables being interacted with both the ASC and choice attributes. Generally, attempts to include additional variables were confounded by significant reductions in the overall performance of the models. Moreover, all socio-economic interactions proved insignificant at the 10% level. However, on the basis of our *a priori* expectations that an individual's attitudes to risk would influence the choice decision, the results of an alternative buy and sell model are reported in Table 3. The inclusion of the risk variable had only minor impact on the overall performance of

both models. However, the interaction of the RISK with YEARS variables did not prove statistically significant at the 10% level in either case and failed to enhance the significance of the YEARS attribute in the sell model. IIA violation were not evident at the 5% level in either Buy Model 2 or Sell Model 2.

Table 3: Multinomial Logit Models of Potential Buyers and Sellers of Permanent Water

	Buy Model 1	Buy Model 2	Sell Model 1	Sell Model 2
C1	-0.2570[#] (0.85E-01)	-0.93E-01 (0.1073)	-2.9156[#] (0.1269)	-2.8170[#] (0.1440)
PRICE	-0.14E-02[#] (0.93E-04)	-0.14E-02[#] (0.93E-04)	0.11E-02[#] (0.74E-04)	0.11E-02[#] (0.75E-04)
YEARS	0.14E-01[#] (0.11E-02)	0.14E-01[#] (0.11E-02)	0.1687 (0.13E-02)	0.1756 (0.13E-02)
INSURE*YEARS		-0.2627 (0.1058)		-0.131 (0.1131)
Log-Likelihood	-1433.0101	-1429.9218	-1209.3518	-1167.5254
Adjusted rho2	0.19	0.19	0.32	0.32
Observations	1604	1604	1626	1626
Skipped	0	0	0	64
IIA (p)	0.39*	0.25*	0.17*	0.25*

Note:[#] Denotes significant at the 5% level or better.

* Indicates that IIA violations were not evident at the 5% level

5.0 Policy Implications

The primary objective of this paper was to quantify the transaction costs attendant on the current institutional arrangements in the permanent water market. We have argued that uncertainty surrounding the property rights to water reduces the willingness of buyers and sellers to participate in the market, thereby restricting the capacity of the water market to generate welfare. It is possible to estimate welfare change in the form of compensating surplus directly from CM data by considering

some hypothetical policy alternatives (see, for example, Blamey 1999, p. 342). However, in this instance we employ implicit prices as the basis for our discussion[6].

Implicit prices are derived by examining the marginal rate of substitution between the price attribute and the other attribute under consideration. In the current context this has been simplified by the inclusion of only two attributes in the choice sets, YEARS and PRICE. Accordingly, the marginal rate of substitution between these variables defines the buyers and sellers willingness to pay [WTP] to strengthen the property rights of their water entitlements. Estimates of the implicit price of enhanced property rights are provided by employing the basic multinomial models. This negates the need to define the 'average respondent' and acknowledges the statistical limitations embedded in the alternative models. Confidence intervals for welfare change [implicit prices in this case] can be calculated using a technique attributed to Krinsky and Robb[7] (1986). This is particularly useful when choosing between alternative model specifications. However, given the nature of the derived models, we follow Blamey *et al.* (1999, pp. 342-343) for simplicity and estimate the mean implicit price of a one year increment in the certainty of property rights from a buyer's perspective to be $10.001 per ML. Put differently, each additional year of certainty in property rights adds about $10 per ML welfare to potential buyers.

The calculation of the implicit price of improved property rights for sellers is more vexatious. This difficulty stems from the apparently insignificant nature of the YEARS variable in the sell models. Put differently, sellers do not appear to be concerned with the strength of the property rights pertaining to their water entitlements and appear to be solely and strongly motivated by price. Whilst this behaviour might appear plausible, there are important implications which can be drawn from this finding. Amongst the purported benefits of water markets is the perception that extractive users, confronted with the opportunity to market water, will economise on water use to release part of their water right for sale. Moreover, this issue was emphasised in the sell surveys by asking respondents to consider the

[6] Since there are only two attributes and a simple before and after scenario, the calculation of compensating surplus reduces to an examination of implicit prices.
[7] This procedure employs a large number of random draws from a multivariate normal distribution relating to the estimated parameters.

possibility of selling some of their entitlement if the remaining portion was more secure with respect to legislative change. However, the statistical insignificance of the YEARS variable in the sell models suggests that respondents are unlikely to choose this strategy. Moreover, these results support other empirical studies that concluded the selling of water is usually viewed in the context of complete exit from agricultural production (see, for example, Lovell *et al.* 2000; Bjornlund and McKay 1995). From a policy perspective this might also suggest that attempts to break the nexus between land and water titles have been found wanting, since exit implies simultaneous sale of both water and land assets. These results might also provide grounds for questioning whether water markets alone can encourage irrigation farmers to retire degraded lands.

An alternative interpretation is that the enhanced property rights structure lacked credibility. In some respects the sell surveys contained an implied willingness to accept [WTA] principle. Entitlement holders are presumed to given up some of their entitlement in return for monetary gain and enhanced property rights over the remaining portion of their entitlement. The WTA structure of the sell surveys could either manifest itself in a lack of credibility in the experiment or compound an over-riding lack of trust in governments to adhere to policy commitments[8]. Anecdotal evidence from numerous survey respondents indicated that they would be unwilling to sell part of their entitlement on the basis of a policy 'promise' that the remaining entitlement was more secure from legislative change.

6.0 Concluding Remarks

CM has successfully uncovered the relationship between price and firmer property rights from a buyers perspective in the market for permanent water in NSW. However, property rights proved largely insignificant for sellers. More specifically, on the basis of the data collected sellers appear to be motivated primarily by price increments. Accordingly, this has constrained the extent to which we can assign implicit prices to enhanced property rights for all sectors of the market, thereby

[8]Divergence between WTP and WTA measures of welfare have long proven a troublesome issue for economists (see, for example, Sinden 1988).

limiting conventional estimation of compensating surplus as a proxy for static transaction costs.

Notwithstanding this limitation, important policy revelations stem from these results. Potential buyers of water entitlements have a defined and positive WTP for firmer property rights. Moreover, our analysis of the choice models reveals that buyers are WTP about $10 per ML for each one year extension of the security of the property right. To the extent that increased demand might raise prices above the reservation prices of sellers, we can expect that significant and credible reductions in the attenuation of property rights will increase trade in the market for permanent water entitlements in NSW.

However, caution must also be applied in the interpretation of these results. A firming of property rights *per se* does not ensure greater market activity. Since sellers are motivated by price, or other factors outside the scope of the choice experiment, there is no way of guaranteeing that actual trades will occur. The fact that buyers are willing to offer more does not mean that sellers will be willing to sell! In addition, price increases capable of stimulating supply by definition must also reduce the welfare gains attendant on buyers.

A number of policy-relevant explanations emerge that might enlighten the behaviour of sellers and the apparent insignificance of the property right attribute. Firstly, sellers of water might consider this strategy only in the context of their complete exit from irrigated agriculture. Accordingly, claims that water markets will singularly and innately stimulate water efficiency investments may be flawed. In addition, claims that farmers will retire degraded lands as a result of the water market may be misplaced. Secondly, questions arise about the extent to which a bifurcation between water and land titles has been achieved by the present water reform process. Both the sell models and qualitative responses provided by survey participants suggest that breaking the nexus between land and water has not been successfully achieved by the reforms to date. Thirdly, another explanation of the insignificance of the property right attribute for sellers is that the attribute itself was not credible. Whilst this could be a function of the experimental design process, it is also possible that sellers lack trust in the ability of governments and public agencies to adhere to legislation or

policy, particularly when they are 'giving up' an existing entitlement. Moreover, conducting the choice experiment to coincide with the *White Paper* and the release of the *Water Management Bill* may have done little to enhance the credibility of the attribute in the experiment.

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