

Urban water restrictions: what drives compliance behaviour?

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Abstract

An extended and severe drought in southern Australia accompanied by policy failures in the allocation of water resources has created a difficult environment for urban water managers. Mandated restrictions over the use of water are now common place and substantial attention is focussed on the efficacy of different approaches to deal with water shortages (see, for example, ABC News 2009). It has become common for proponents of restrictions to claim that the public supports water restrictions in general and, by implication, the punitive measures that attend them. However, media reports regarding numerous instances of social conflict arising directly from water restrictions appear to be at odds with these views (see, for example, Wells 2007). It is against this background that the interest in compliance, the structure of compliance regimes, and the attitudes of the citizenry in this field is investigated in this study.

Theoretically at least, closer alignment of enforcement with individual preferences implies an increase in social welfare, or at least a fall in the costs of gaining compliance. In this paper, choice modelling has enabled the development of empirical models of individual preferences for modifying the attributes of a compliance regime. The study is conducted in southern Australia and embodies data from water rich and water poor communities and metropolitan and regional settings. The results suggest that segments of the community have very diverse, strong and often diametrically opposed preferences for compliance measures, making the adoption of a one-size-fits-all approach fraught with political risk.

1.0 Introduction

Behavioural constraint over the use of water is now applied in almost every major urban centre in Australia, regardless of their merits, and often in the absence of any debate about the compliance regimes that accompany them. Water restrictions are claimed to be a means of changing behaviour, a vehicle for encouraging greater awareness of water use or even a mechanism for promoting greater environmental consciousness generally (see, for example, Water Corporation 2010; Goulburn Valley Water 2010) but such propositions are seldom tested or challenged. The apparent enthusiasm for mandatory urban water restrictions in some spheres raises important questions about how water consumers view the attenuation of their rights to use water. It also raises broader concerns about the mechanisms for gaining compliance with regimes that *prima facie* impinge on individual liberties.

The literature points to a need to understand and integrate two areas if we are to facilitate optimal compliance. Firstly, understanding compliance behaviour requires knowledge of social norms, moral and ethical values, as well as perceptions of fairness and appropriateness surrounding the regulation itself (see, for example, Frey 1997; Sutinen and Kuperan 1999; Tyler 1990). Secondly, understanding the decision-making process of consumers and the impact of incentives and penalties is an important component of optimal compliance (see, for instance, Levitt and Dubner 2005; Sagdahl 1992).

A way forward would involve exploring these components empirically. However, some understanding of the psychology of choice behaviour is required to facilitate this approach. This paper focuses on policy reform in the urban water sector. It seeks to contribute to our understanding of the most effective and efficient instruments for achieving compliance with mandatory urban water restrictions.

This paper is comprised of six main parts. A brief review of New Institutional Economics (NIE) is provided in part two to create the context for reviewing enforcement and compliance behaviour. In part three, the literature from the disciplines of psychology, sociology and economics is drawn from to investigate the theoretical underpinnings of

compliance behaviour before presenting a framework that contributes to the enforcement and compliance literature. In section four, we briefly consider the theoretical groundings of the stated preference technique choice modelling, while section five presents the design employed for this study. The results of the choice experiment are reported in section five. More specifically, we report the significance of various attributes of a compliance regime. The final section discusses the core findings before offering some brief concluding remarks.

2.0 NIE

The focus on comparing real-world alternatives where the choice is not exclusively between ‘the market’ and ‘the government’ is one of the central characteristics within the emerging literature examining institutional organisation and change (Pagan 2009). While acknowledging the challenge in accurately defining the new institutional paradigm, several common themes are apparent (see, for example, Alston, Eggertsson and North (1996, p.1).

2.1 Institutions in NIE

One of the core concepts of NIE is the notion of institutions itself. In common parlance the term ‘institution’ implies some organisation, body or group with authority or standing. However, defining institution with precision in the NIE sense can often prove more problematic (Saleth and Dinar 2004, p. 23). North (1990; 1995) treats organisations as agents of institutional change rather than institutions *per se*. Alternatively, institutions are regarded as “the rules of the game in society or, more formally are the humanly devised constraints that shape human interaction” (North 1990, p.3) and it is this definition that is adopted in this case.

Having settled on a definition of institutions and established their prominence in guiding the behaviour of individuals and ultimately determining well-being, a question arises around the constituent parts of ‘good’ institutions. Pagan (2009) identifies a range of heuristics and characteristics that help distinguish superior institutions. In a comprehensive review of the institutional literature pertaining to water resources he

identified five generic design features that define good institutions: Clear objectives; appropriateness of scale; adaptiveness; interconnection with other formal and informal institutions, and; compliance capacity. Notwithstanding the inherent contradiction embodied in some of these features, the latter two characteristics have particular bearing on the present research.

Interconnection between formal and informal institutions

Superior institutions can be distinguished by the extent to which the informal ‘rules of the game’, say in the form of social norms and mores, are consistent with the formal rules established to govern behaviour (Challen 2000; North 1990). The congruity between formal and informal rules has been accredited with explaining the superior performance of markets in the United States, where the underlying institutions that enforce individualism reinforce the market mechanism itself (North 1990). Similarly, Keefer and Shirley (2000) found that the differences in the growth in foreign investment in China and Ghana could be explained by the relative complementarity of formal and informal institutions. This is not to say that the informal institutions can substitute for formal institutions in all cases (Dovers 2001). Rather, the proposition is that greater alignment of formal institutions with the underlying rules of social networks and the like will give rise to lower costs, and thus superior institutions generally (Dovers 2001).

This observation has particular relevance in the current context. Very little is known about the preferences of water users and the formal restrictions currently in place. In essence, restriction regimes targeting specific outdoor water uses have arisen from historical engineering notions about water security. Arguably, attempts have subsequently been made to convince urban water users that these constitute the preferred and socially desirable behaviour (i.e. the informal institutions). The extent to which this is actually the case requires empirical data on the preferences of water users and their preferred means of limiting water consumption during times of scarcity.

An alternative interpretation of these theoretical insights in the context of the current problem is that political players have adjudged that using market rules to ration urban

water is too far removed from existing informal institutions and would thus give rise to severe costs, ultimately felt at the ballot box. This also has implications for the cost of any policy adjustment in this sphere.

Compliance capacity

Enforcement and the ability to bring compliance to rules has been identified as one of the core features of good institutions generally (North 2000) and for institutions dealing with water allocation and sharing in particular (Ostrom 1993). Pagan (2009, p. 33) argues that compliance and enforcement are important because the making of contracts is expensive so they are invariably incomplete. This leaves scope and incentive for individuals to expend resources to capture the benefits left unspecified in the contract.

There are two basic genres of compliance mechanisms – self-enforced and third-party enforced. At the heart of each of these enforcement techniques is the capacity to punish by either reducing the stream of benefits from a long term relationship or by imposing harm (Barzel 2000). In the context of third-party enforcement, Pagan (2009, p. 33) contends that the state enjoys a comparative advantage, inasmuch as it has the capacity to immediately impose large costs or penalties. By way of contrast, self-enforcement “works well when there is a positive value for all parties associated with maintaining the contract” (p. 33). Poignantly, there are significant differences in the costs that attend different compliance regimes.

Regardless of these important differences, very little is understood about the cost of securing compliance with urban water restrictions. This stands in stark contrast to the hefty public investment in crafting water legislation (formal institutions) and efforts to persuade the public about the preferred socially responsibly water-using behaviour (informal rules). More specifically, there is no empirical evidence attesting to the preferred compliance regimes that would best suit water users. This is important for at least two reasons. First, it seems likely that formal institutions (including those pertaining strictly to compliance) that better match the underlying motivations of individual behaviour will achieve more success and cost less. Second, the extent to

which self-enforcement can occur has ramifications for the public purse. Put simply, if consumers self-enforce water restrictions then state-owned water utilities stand to make savings on the cost of securing compliance. It is against this theoretical background that this work is being undertaken.

3.0 Theoretical underpinnings of compliance

Enforcement is a key aspect of regulatory policy design (Cohen 1998) and institutional design generally (Pagan 2009). Gaining more and improved enforcement services is not an inexpensive task. For instance, enforcement is often identified as the most expensive aspect of natural resource management programs (Sutinen and Kuperan 1999). Given this, there are two questions of relevance. Firstly, what are the approaches that would increase the cost-effectiveness of traditional enforcement? Secondly, what are the other non-traditional approaches to securing compliance which could avoid extreme dependence on costly enforcement?

Individual compliance with regulations is the ultimate objective of enforcement procedures (Cohen 1998). Notably, there has been a tendency for regulatory scholars to shift their focus from analysing the enforcement procedures of regulatory bodies to the motivations underpinning individual compliance with regulations (see, for example, Cohen 1998; d'Astous, Colbert and Montpetit 2005). Notwithstanding the research interest in this field, much remains to be done. It appears that the fundamental question associated with the development of regulatory policy is 'Why do individuals comply with the law?' The existing research on compliance motivations fails to provide a consensus answer. Inconsistency in these findings may be attributed to a range of factors, including differences in regulatory regimes, the different methodologies employed for analysis, and/or the variability in the nature of the entities being regulated (Wenzel 2005).

3.1 Calculative motivations

An expanded understanding of compliance behaviour can assist policy makers in stipulating compliance policy and institutional design of enforcement regimes. The most prominent theory regarding regulatory compliance stems from calculated motivations for

compliance. The seminal work by Becker (1968) proposes that the regulated will comply with a particular regulation when they perceive the benefits of compliance, including avoidance of fines and penalties, surpass the associated costs (see also Ehrlich 1972; Stigler 1970). Although the approach to this calculation may vary, depending on how an individual evaluates benefits and costs of compliance, the process of selecting between complying and not complying is based on the expected utility in terms of net return (Becker 1968).

A succession of studies on the economics of crime stem from Becker's model (1968) (see, for example, Anderson and Lee 1986; Heineke 1978; Milliman 1986; Pyle 1983; Sutinen and Andersen 1985). These studies employ the basic deterrence framework in which the threat of sanctions is the single policy lever offered to increase compliance with regulations.

This 'self-interest' standpoint has been criticised as being too limited (Wenzel 2005). More specifically, recognition of the relatively small degree of audit and lenient penalties within society indicates that deterrence alone cannot explain the generally large extent of compliance across the population (see, for instance, Alm, McClelland and Schulze 1992). It has been suggested that social motivations, such as social norms and ethical concerns, perceptions of legitimacy and fairness, as opposed to mere selfishness, substantially influence individuals' behaviour in this sphere (James, Hasseldine, Hite and Toumi 2001; Tyler 1990). Thus, individuals may not be motivated only by extrinsic incentives (see, for instance, Carroll 1987).

3.2 Intrinsic Motivation and Morality: Incorporating Intrinsic Motivation into the Basic Deterrent Model

A sense of moral obligation is a common reason why many in society comply, even though illegal gains are greater than the anticipated penalties (Sutinen and Kuperan 1999). Put differently, the need to 'do the right thing' is perceived as being an important motivation clarifying much of the evidence regarding compliance behaviour (Sutinen and Kuperan 1999).

Regrettably, the paradigm generally employed in economics to describe and anticipate behaviour (particularly the theory adopted for policy analysis) provides limited allowance for personal moral values. Contemporary economics generally either overlooks the impact of moral considerations or may even fail to recognise that moral aspects have an effect on economic behaviour (Hausman and McPherson 1993, 1996).¹ This raises questions as to whether regulatory policy developed by economists is adequately grounded.

3.2.1 Moral development and personal values

Social psychology highlights the value of an individual's own characteristics in influencing compliance behaviour (see, for instance, Kohlberg 1969, 1984). It has been conjectured that there is a positive relationship between the moral development of an individual and their propensity to comply with regulations (Sutinen and Kuperan 1999). Kohlberg (1969, 1984) proposes that there are three apparent levels of moral development: pre-conventional, conventional, and post-conventional.

Each of these levels is based on the association between the individual and their social environment, which is itself sourced from the individual's attitude towards society's regulations (Kohlberg 1984). Pre-conventionals generally base their rationale on fear of punishment as opposed to the potential destructives of their behaviour or the desire for social order (Sutinen and Kuperan 1999). Conventionalists are inclined to reason on the basis of social conformity and stability (Sutinen and Kuperan 1999). Post-conventionalists rationalise on the basis of moral principles that are independent of social order (Sutinen and Kuperan 1999). Kohlberg (1969, 1984) argues that rule violations are likely to diminish at higher levels of moral development and this has been supported by empirical research in a variety of contexts (see, for example, Kuperan and Sutinen 1994).

¹ This dimension of motivation has been given various labels from different authors. For instance, "normative commitment" (Burby and Paterson 1993); "moral or ideological compliance" (Levi 1988, 1997; McGraw and Scholz 1991); commitment based on civic duty (Scholz and Pinney 1995; Scholz and Lubell 1998); an apparent obligation to follow the law which comprises a form of legitimacy (Tyler 1990).

3.3 Extrinsic motivation: social motivation

The concept of social motivation has also been identified as an impetus for compliance; that is, “the desire of the regulated to earn the approval and respect of significant people with whom they interact” (Grasmick and Bursik 1990 in Winter and May 2001, p.3).² Possible foundations for these social pressures include external advocacy groups, family, friends, the media and other regulated entities.

Social influence is an important part of daily social exchange, generally adopting the subtle means of ostracism or the withholding of favours (Sutinen and Kuperan 1999). Similar to the role of enforcement authorities, peer groups are able to punish and reward their members (Sutinen and Kuperan 1999). For instance, a peer group may punish a member by changing their signs of respect and group status. Empirical evidence suggests that an individual is more likely to behave in a recalcitrant manner when their peer groups are not complying (Geerken and Gove 1975; Witte and Woodbury 1985).

It has long been established that the value that an individual places on his/her reputation is an important motivation of compliance behaviour (Ajzen and Fishbein 1980; Coleman 1990; Fishbein and Ajzen 1975; Wrong 1980). There is a close association between social influence and morality. It is anticipated that the social influence to conform is likely to be greater the more prevalent a moral obligation (Sutinen and Kuperan 1999).

In sum, both social influence and moral obligation can potentially create high degrees of compliance, even when a weak deterrent effect exists. The extrinsic motivation literature leads to two questions of interest: ‘Will compliance increase as a result of increased formalism in inspection styles?’ and ‘Will compliance increase as a result of increased coercion in inspection styles?’ Again, answers to these questions can only be found by understanding preferences for enforcement regimes, which in turn has implications for overall compliance, *ceteris paribus*.

² This is consistent with the conventionalist perspective as specified by Kohlberg (1969).

3.4 Extrinsic versus intrinsic motivations

Frey (1997) considers potential crowding effects between extrinsic incentives (e.g. monetary compensations, social pressures) and intrinsic motivations (e.g. morals, values). More specifically, a situation where extrinsic incentives surpass some or all intrinsic motivations for a particular action has been termed the crowding-out effect. Alternatively, when intrinsic motivations are reinforced by extrinsic incentives it is termed crowding-in (Frey 1997).

Frey (1997) identifies some valuable applications of the crowding-out. For example, intrinsic motivations can be undermined, which is evident in legal rules (e.g. constitutions and tax laws) when governments are granted high levels of supervisory authority and the individual is given limited liberty to behave according to their own intrinsic motivations. Therefore, concepts such as civic virtues, trust and voluntary behaviour could be undermined by regulations. They could also be undermined by the adoption of punishment (the stick) for non-compliance, compared to the use of rewards (the carrot) for compliance. Notably, environmental morals may be negatively influenced if monetary incentives are employed (Frey 1997). For example, compensating a community for substantially conserving their water may prompt all other communities to request compensation in all other conservation cases thereafter.³

In addition to these three fundamental motivations for compliance (i.e. deterrence, moral and social motivations), some researchers also factor in the ability and capacity of the regulated to comply, the role of the beliefs and attitudes of the regulated regarding regulations and regulatory practices (see, for instance, Winter and May 2001).

3.5 Compliance framework

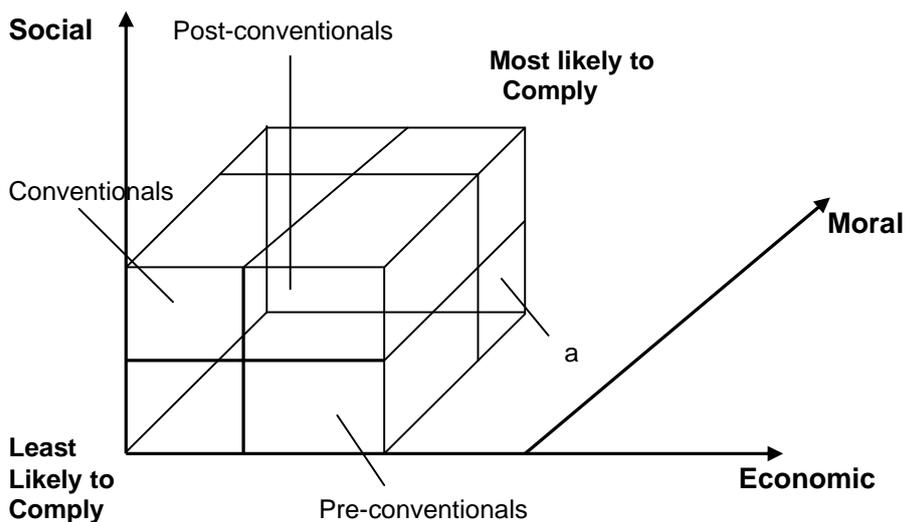
A framework that captures the pertinent concepts of compliance motivations can be used to reduce the complexity of the preceding literature. For instance, Burby and Paterson

³ As an aside, it is worth noting the difficulties experienced in the irrigation sector, due to the uncoordinated sequencing of 'rewards' between jurisdictions. More specifically, the decision by the Federal government to fund the Northern Foodbowl Modernisation Project in Victoria after NSW irrigators had independently funded their own 'upgrades' was roundly criticized by NSW irrigators. Consequently, CoAG undertook to fund a range of other projects in jurisdictions outside Victoria (CoAG 2008).

(1993) present a typology of compliance motivations, which comprises: calculated motivations; moral motivations; and social motivations. Kohlberg's (1969, 1984) threefold typology is also worth building into a framework. Essentially, this typology enables individuals to be classified according to the type of motivations that drive them to comply with regulations.⁴ These categories include pre-conventionals, conventionals and post-conventionals.

A framework, which attempts to capture the compliance literature is presented visually in Figure 1.

Figure 1 Compliance cube



This 'compliance cube' is used to capture the three key motivational dimensions of compliance - economic, social and moral. This framework facilitates the segmentation of individuals according to the motivations that drive them to comply. For instance, individuals that are solely driven by; economic motivations fall into the pre-conventionals segment; social motivations are classified as the conventionals segment;

⁴ Refer to section 3.2.1 for a review of this typology.

and moral motivations fall into the post-conventionals segment. Individuals who are driven by more than one dimension fall between these extremes. For instance, segment 'a' would include those individuals that are driven by both moral and economic motivations.

Drawing from the moral development literature discussed earlier in the paper, the framework can be employed to identify which segments of the citizenry are least likely to comply and which are most likely to comply. This framework should prove useful for contemplating the challenge of designing effective compliance strategies. For instance, a policy maker that segments a regulated market according to motivations to comply might be able to develop enforcement mechanisms that are more closely aligned with individual motivations. Therefore, a potentially more cost effective approach to achieve compliance can be developed.

Discussion has enhanced and synthesised understanding of factors that influence consumer choice in relation to their willingness to comply with regulations. Subsequently, this information will be the basis for identifying consumer preferences regarding what constitutes an optimum compliance regime for water restrictions. The rationale is that the effectiveness of at least some components of an enforcement regime will be a function of the perceived acceptability of the regime itself.

4.0 Choice modelling (CM)

In order to increase understanding on the preferences for a water restriction compliance regime we turn to the methodology of CM. This is a type of multivariate technique which is used to investigate the way in which respondents form preferences for the attributes of products, services, or ideas (Hair *et al.* 1998). CM is employed in various applications including transportation, health, marketing, and environmental economics (see, for example, Scarpa and Rose 2008; Rolfe and Windle 2008; James and Burton 2003; Louviere *et al.* 2000). The mixed logit model (ML) is one of the newer models proposed in the literature and provide improved behavioural specifications (see, for instance, Train 1999; Brownstone and Train 1999; Herriges and Phaneuf 2002).

An advanced random utility model underpins the ML model, where the assumption that the coefficients are the same for all individuals is relaxed. This approach also relaxes the independence from irrelevant alternatives (IIA) assumption (see, for instance, Louviere et al. 2000) making it a less restrictive model specification than the MNL. Hensher et al. (2005) have suggested that as discrete choice models become less restrictive in their behavioural assumptions, the likelihood of the model revealing sources of preference heterogeneity associated with the mean and variance of systematic and random components increases. Therefore, this extended framework is able to capture a superior level of true behavioural variability in choice making (Hensher et al. 2005) and is entirely consistent with the notion of ‘segments’ described in the preceding section.

The following outlines the ML framework employed in this analysis, which is based on Hensher, Rose and Black (2007).

The basic MNL model forms the basis of the initial analysis, with alternative specific constants α_{ji} and attributes x_{ji} , for individuals $i=1, \dots, N$ in choice setting t :

$$\text{Prob}(y_{it} = j_t) = \frac{\exp(\alpha_{ji} + \beta_i' x_{jit})}{\sum_{q=1}^{j_i} \exp(\alpha_{qi} + \beta_i' x_{qit})} \quad [1]$$

The random parameter model transpires as the form of the individual specific parameter vector, β_i is developed. The simplest form of the model specifies:

$$\beta_{ki} = \beta_k + \sigma_k v_{ik},$$

And [2]

$$\alpha_{ji} = \alpha_j + \sigma_j v_{ji},$$

where β_k is the population mean for the k^{th} attribute ($k=1,\dots,K$), σ_k is the standard deviation of the distribution of β_{ik} 's around β_k , and v_{ik} is the individual specific heterogeneity, with mean zero and standard deviation one. The choice specific constants, α_{ji} and the elements of β_i are distributed randomly across individuals with fixed means.

The v_{ij} 's are individual and choice specific, unobserved random disturbances (the source of the heterogeneity). For the full vector of K random coefficients in the model, the full set of random parameters is written as:

$$\rho_i = \rho + \Gamma v_i, \quad [3]$$

where Γ is a diagonal matrix which contains σ_k on its diagonal and ρ is a vector of mean effects.

4.1 Experimental Design

This research generally followed the experimental design process established by Hensher et al. (2005), involving focus interviews, focus groups, survey pre-testing and development of an efficient design. It was anticipated that this process would reveal the attributes of the 'product'; i.e. an urban water restrictions compliance regime and relevant attribute levels. Six cities were selected to draw the sample comprising Sydney, Goulburn, Albury, Wodonga, Bendigo and Melbourne. These cities provided scope for analysis on several dimensions: comparisons between different state jurisdictions (NSW and Victoria); regional and metropolitan settings, and; urban communities with historically differing levels of water scarcity (refer to Table 1 for the descriptive statistics of these Australian cities).

Table 1 Characteristics of study locations

City	State	Rural or Metropolitan Centre	Population	Average annual residential water supplied for the period 2006-2008 (kL/property)^â
Melbourne	Victoria	Metropolitan	3.9 million [†]	161
Wodonga	Victoria	Rural	34 504 [*]	235.5
Bendigo	Victoria	Rural	96 741 [*]	158.5
Goulburn	NSW	Rural	27 277 [*]	146.5
Albury	NSW	Rural	48 629 [*]	234.5
Sydney	NSW	Metropolitan	4.4 million [†]	190.5

[†]Source: ABS (2009)

^{*}Source: ABS (2008a-d)

^âThis indicator is derived from dividing the total volume of residential water supplied with the number of connected residential water properties (Source: NWC 2008).

Initially, thirteen in-depth interviews were conducted with water industry experts, such as compliance team leaders, environmental consultants, water restrictions operation's managers and water patrol officers, from each of the water authorities across the six cities. In addition to the in-depth interviews with water industry experts, group discussions were held with residents from the sample cities. The attributes chosen for pre-testing were those that respondents raised and understood, that policy makers could influence and that could be measured and improved upon.

Concurrent with a move within the literature toward the use of efficient designs (see, for instance, Sandor and Wedel 2001), this study employed a D-efficient design with a Bayesian information structure, which generated 24 choice situations (see, Sandor and Wedel 2001 for a review of Bayesian efficient designs).⁵

Each respondent evaluated 12 stated choice sets, where each choice set comprised three alternatives and the third alternative was always the status quo. Whilst the specified

⁵ The efficiency of a D-efficient design with a Bayesian information structure is less sensitive to misspecification of the priors, and is therefore considered to be more robust (Rose and Bliemer 2005).

attributes were common across all options, the levels differed from one option to another (except for the status quo, of course).

In this case, the product was identified as a ‘compliance regime’ for urban water restrictions⁶, which was comprised of the following four generic attributes: the cost respondents were willing to pay per annum to have the compliance regime invoked in their city, where the payment vehicle would be an additional charge on their water bill; the number of water inspectors per household to patrol householders’ outdoor water usage; an attribute to act as a proxy for the value individuals place on exposure to information in the media was included in the form of ‘frequency of exposure’ to informative media advertisements regarding water restrictions; the ability to report neighbours non-compliance via a hotline to a team who would process the complaint.

The four attributes and their levels developed for the main survey are presented in Table 2 and an example of the choice sets used in the choice experiment is illustrated in Table 3.

⁶ In an attempt to address the potential challenge of adverse behaviour, that is, respondents who breach water restrictions deliberately selecting compliance regime alternatives that will minimize the likelihood that they will get caught, a series of statements were included before the choice experiment. These statements highlighted the possible and generally undesirable outcomes of people not complying with water restrictions (e.g. reduced water reliability in the immediate term, more severe water restrictions in the future, an increase in the need to source alternative water supplies).

Table 2 Attribute levels used in the choice sets

ATTRIBUTES	DESCRIPTOR	STATUS QUO	LEVELS
Number of Inspectors	ratio: inspector per household	1: 10 000	1: 1000; 1: 2000; 1: 5000; 1:8000; 1: 50 000; 1: 200 000
Information	Frequency of household exposure (days)	Every 90 days	Everyday; Every 7 days; Every 14 days; Every 31 days
Increase in Water Bill (WTP)	\$ Per annum	\$0 per annum	\$2; \$5; \$10; \$20; \$50; \$100
Able to report your neighbour	Yes; No	No	Yes; No

Table 3 Example choice set used in the choice experiment

Which enforcement & education package would you choose?	Price of the Enforcement Package	Number of Inspectors	Information	Able to report your neighbour
				
Package 1	\$5 per year	1 per 8 000 households	Every 14 days	Yes
Package 2	\$50 per year	1 per 5 000 households	Every 7 days	No
Neither	\$0 per year	1 per 10 000 households	Every 90 days	No

4.2 Data collection

The main survey was distributed by an on-line survey company via email to a sample of residents from the pre-defined study locations⁷. Data was collected during April 2008, with a response rate of 59%. Complete and valid data were gathered from 512 respondents (Wodonga: 54; Albury: 94; Melbourne: 106; Sydney: 102; Goulburn: 51;

⁷ See Fleming and Cook (2007) for a review of the advantages and disadvantages of collecting data on-line.

Bendigo: 105)⁸. Sampling was completed during April 2008. The characteristics of the sample are presented in Table 4.

Table 4 Socio-demographics of the survey respondents⁹

Metropolitan (Sydney, Melbourne)	40%
Rural or Regional Centres (Albury, Wodonga, Goulburn, Bendigo)	60%
New South Wales	48%
Victoria	52%
Average age	42 yrs
Average household income before tax	\$978 per week
Own their home	30%
Male	40%

5.0 Results: ML Choice Model

In the first instance, a basic MNL model was estimated using Equation [1]. Econometric software, NLOGIT 4.0, was used to conduct the analysis. The indirect utility functions specified for the MNL models were as follows, with V_3 representing the status quo utility:

$$V_1 = ASC_1 + \beta_1 COST + \beta_2 INSPECTORS + \beta_3 INFORMING + \beta_4 REPORT$$

$$V_2 = ASC_1 + \beta_1 COST + \beta_2 INSPECTORS + \beta_3 INFORMING + \beta_4 REPORT$$

$$V_3 = \beta_1 COST + \beta_2 INSPECTORS + \beta_3 INFORMING + \beta_4 REPORT \quad [4]$$

⁸ This is considered adequate given the experimental design of this CM.

⁹ The sample differed slightly from the general population in terms of age and household income.

A t-test of the two ASCs in the basic model revealed no significant differences at the 5% level. Accordingly, the ASCs were constrained to be equal across V_1 and V_2 , rendering the constants as representing generic taste parameters in this unlabelled experiment. In essence, this indicates the propensity of respondents to enter the market for a water restrictions compliance regime, independent of attribute levels.

The MNL model rests heavily on the assumption of IIA (see, Louviere et al. 2000, p.161). Moreover, violations of the IIA property should be tested in this type of analysis. The Hausman and McFadden test (1984) revealed significant violations of the IIA even at the 10% level. The inability to confirm that the IIA assumption held within the model indicated that the ML model, where the assumption is relaxed may improve the data analysis (see section 4.0). As already noted, the ML offers a more flexible structure than other choice models, in particular it has the capacity of recognising correlated alternatives and taste variations expressed through random parameters (Munizaga and Alvarez-Daziano 2001).

5.1 ML model: A less restrictive model

With the ML model, individual heterogeneity is introduced into the utility function through the marginal utilities of attributes, β_k , which are assumed to vary across the population, and are drawn from some distribution: $\beta_k \sim F(b, \Omega)$. Estimation involves identifying the most appropriate distribution parameters for the assumed functional form as β_k can take on different distributional forms such as normal, log-normal, uniform and triangular. Hence, the unobserved parameters can be considered to have two elements: the mean of the distribution and the stochastic distribution around the mean (Greene, Hensher and Rose 2005).

A normal distribution was initially trialled for all of the non-cost attributes, resulting in a log-likelihood of -4297.63. Other distributions resulted in minimal differences in the goodness of fit measured by the log-likelihood. Accordingly, the results of the model estimation with a normal distribution for each of the random parameters are reported

(INSPECTORS, INFORMING and REPORT). In this case, the COST attribute was included as a nonrandom parameter.¹⁰

Thus, the indirect utility functions specified for the preferred ML models were as follows, with V_3 representing the status quo utility:

$$\begin{aligned}
 V_1 &= ASC_1 + \beta_1 COST + (\beta_2 INSPECTORS + \delta_2 INSPECTORS * N) + \\
 &(\beta_3 INFORMING + \delta_3 INFORMING * N) + (\beta_4 REPORT + \delta_4 REPORT * N) \\
 V_2 &= ASC_1 + \beta_1 COST + (\beta_2 INSPECTORS + \delta_2 INSPECTORS * N) + \\
 &(\beta_3 INFORMING + \delta_3 INFORMING * N) + (\beta_4 REPORT + \delta_4 REPORT * N) \\
 V_3 &= \beta_1 COST + (\beta_2 INSPECTORS + \delta_2 INSPECTORS * N) + (\beta_3 INFORMING + \\
 &\delta_3 INFORMING * N) + (\beta_4 REPORT + \delta_4 REPORT * N)
 \end{aligned}
 \tag{5}$$

Here, N reflects a normal distribution. However, these functions may be reduced to:

$$V_i = ASC_i + \beta_1 COST + \sum (\beta'_j X_j)$$

$$\text{Where } \beta'_j \sim N(\beta_j, \sigma_j) \tag{6}$$

The random parameters assigned over the sampled population are obtained from repeated simulated draws. The estimates presented are a result of 500 random draws made using the Halton sequence draw method, which secured a stable set of parameter estimates. The results of the ML model are summarised in Table 5.

¹⁰ Train (1999) observed several reasons for keeping the price coefficient fixed: (1) ML models have a tendency to be unstable when all coefficients are allowed to vary. Fixing the price coefficient resolves this instability; (2) the choice of distribution to use for a price coefficient is problematic given that the price coefficient is necessarily negative; (3) if the price coefficient is allowed to vary, the distribution of WTP is the ratio of two distributions, which is often problematic. With a fixed price coefficient, WTP for an attribute is distributed the same as the coefficient of the attribute.

Table 5 ML model: Attributes only

Model 1: ML	
Random parameters	
INSPECTORS	-0.1131 E-04*** (-22.126)
INFORMING	0.0101*** (2.978)
REPORT	0.9350*** (13.777)
Nonrandom parameters	
ASC ₁	1.5784*** (08.896)
COST	-0.0361*** (-31.694)
Derived standard deviations	
INSPECTORS	0.6405 E-05*** (8.864)
INFORMING	0.0412*** (24.845)
REPORT	1.2936*** (14.128)
Model statistics	
Log likelihood	-4297.636
Pseudo Rho 2 (ρ^2)	0.363
AIC	1.401
BIC	1.410
Observations	6144
Chi-square	4904.476

Wald-statistics in parentheses

*** indicates significance at the 1 percent level

Model 1 has a Rho 2 value of 0.36, which implies that it can be used to explain approximately 36 percent of the variation in the data. A Rho 2 values between 0.2 and 0.4 are usually regarded as a good fit of the data in choice analysis (see, for example, Hensher and Johnson 1981; Hensher et al. 2005; Whitten and Bennett 2001; Mazzanti 2003). In this case, the chi-square statistic exceeds the critical value of 20.090,¹¹ thus the null hypotheses that the model is insignificant is rejected.

¹¹ The critical value used here was χ^2 $\alpha=0.01$. The degrees of freedom is equal to the number of restrictions in the model, in this case 8.

The COST and INSPECTORS parameters are negative and significant at the 1 percent level. Alternatively, the INFORMING and REPORT parameters are positive and significant at the 1 percent level. The dispersion of the INSPECTORS, INFORMING and REPORT parameters is statistically significant at the 1 percent level, given a Wald-statistic of 8.864, 24.845 and 14.128 (outside the ± 1.96 critical value range) respectively and a p-value < 0.01 for all parameters. This indicates significant heterogeneity in the preferences of respondents toward the INSPECTOR; INFORMING; and REPORT attributes. The sources of heterogeneity could be further explored by interacting socio-economic, situational and psychographic variables with the attributes or the ASC of the ML model. This would enrich our understanding of respondents' preferences for a compliance regime (see, Cooper and Crase, forthcoming).

6.0 Discussion and concluding remarks

Policy formulation often occurs in an environment which presupposes perfect compliance achieved at no cost. As acknowledged earlier, when problems arise with a policy, enforcement is commonly deemed to be responsible for the policy failure, with the outcome being the demand for improved enforcement (Sutinen and Kuperan 1999). This study sought to establish people's preferences for urban water restrictions compliance regimes as this is an important element to developing effective policy. More specifically, identifying people's preferences for a compliance regime may enhance social welfare and will likely be attended by lower political costs, particularly if we accept that water restrictions are likely to be a medium to long term component of urban water management.

The four attributes that comprised the compliance regime proved to significantly influence respondents' choice. The model suggests that respondents were more likely to select a compliance regime option as opposed to the status quo when it: embodied a lower cost, offered a more vigilant inspection regime (i.e. less households per water inspector), provided a lower level frequency of information exposure and offered a means of reporting others for breaching water restrictions.

Clearly, the average respondent values modifying the compliance regime surrounding water restrictions. This implies that respondents, on average, support mandatory approaches, to some degree, rather than a purely voluntary regime, at least given their current state of knowledge. Put differently, if respondents, on average, have a preference for more inspectors and being able to report others then it would seem there is a preference for mandatory enforcement. These results also cast some doubt over the persistent calls for 'informing the community' (see, for instance, Victorian Women's Trust 2005) as a rational vehicle for dealing with this public policy dilemma.

These results have a number of implications for policy in the context of water restrictions. In particular, the findings from the choice model give a clear indication of the extent of heterogeneity around this topic. Namely, the results indicated that preferences for water inspectors, exposure to informative campaigns and being able to report your neighbour will vary in their strength across different segments of the communities.

Again, policy makers looking for a one-size-fits all response might find some discomfort in these results. To an extent, this captures the heterogeneity associated with drivers of compliance behaviour. The key dimensions of compliance behaviour were illustrated in the 'compliance cube' framework presented in Figure 1. The information gained on individuals' preferences might be applied to the 'compliance cube' presented in section three (see Figure 1). This could be used to usefully segment the population and to lower the costs of securing compliance. For instance, if social norms are a prominent dimension of compliance then formal deterrence enforcement mechanisms are unlikely to be cost effective, at least for that segment. This would enable the application of compliance mechanisms that are more closely aligned with motivations, and thus more likely to be effective.

A useful extension of this work would involve interacting socio-economic, situational and psychographic data to identify sources of preference heterogeneity across preferences (see, Cooper and Crase, forthcoming). Estimating individuals' willingness to pay for each

attribute of the enforcement regime would also be a valuable extension. This could further inform policy formulation and provide a basis for policy reform in the context of enforcing mandatory urban water restrictions.

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