

Water markets as a vehicle for water reform: the case of New South Wales

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Water reform in NSW is being undertaken using an adaptive approach in recognition of the uncertainty and imperfect knowledge embodied in the riverine environment. However, the reform process also relies, in part, on the ability of markets for tradable water entitlements to develop and thereby assist in allocating scarce water resources to their highest value use. This article explores impediments to the formation of efficient markets in permanent tradable water entitlements in NSW. The article concludes that more attention should be paid to market failures and related problems which manifest themselves in thin markets for permanent water entitlements.

1. Introduction

Historically Australia's water resources have been seen as a factor of production to be harnessed in both agricultural and industrial contexts to provide a stimulus to regional economic development. Water resources and their allocation were thus intrinsically tied to social and strategic objectives associated with regional economic development, such as closer settlement and soldier settlement (Langford-Smith and Rutherford 1966). This view informed water resource policy in Australia until the 1980s (Watson 1990, p. 11). Until then only limited consideration had been given to the true opportunity cost of water usage and the potentially deleterious effects of specific uses.

Since the 1980s the 'development' hypothesis has been supplanted by the 'management' hypothesis consistent with a more mature water economy. This water economy is characterised by 'inelastic supply of "new" water and the need for expensive rehabilitation of aging projects' (Randall 1981, p. 195). The water management regime consistent with a mature water economy also requires policy-makers to broaden the scope of water policy

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objectives to include economic efficiency, sustainable development and ecological sustainability (Watson 1990, p. 12). This is reflected in the increasing pressure on the allocation of water resources to multiple environmental and economic objectives. In the Australian context, this manifests itself in a myriad of legislative reforms to the water industry, including the introduction of market-based solutions to the allocation of water entitlements.

The reform process is of particular interest in NSW which has the largest irrigation industry in Australia. For instance, average annual water extractions in NSW amount to approximately 7 million ML with some 75 per cent being used for irrigation. The NSW irrigation industry occupies about 820 000 hectares and returns some \$A2.1 billion to the state's economy (Brinsley 1998, p. 3; Department of Land and Water Conservation [DLWC] 1998, p. 1). Among the various issues which arise from the reform of the water sector is the identification of a legislative framework capable of accommodating the host of economic and environmental objectives now assigned to water resource managers. In particular, the challenge in NSW is to create a legislative framework that allocates water efficiently while simultaneously recognising the legitimate claims of the environment to this resource.

An integral component of the reform of the water industry resides in the introduction of tradable water entitlements and their exchange in a water market. Markets for tradable water entitlements have often been presented as a mechanism for smoothing the structural adjustment associated with a mature water economy both in Australia and abroad. More specifically, it has been argued that breaking the nexus between property rights for land and water and allowing water to be traded from low-value uses to high-value uses, can release resources that facilitate the requisite adjustment of low-value users. Simultaneously, high-value users are presumed to administer water efficiently since profit-maximising enterprises design their planning processes around the true cost of the resource and in this way provide incentives for extractive users to enhance water efficiency. In particular, increased investment is predicted to flow from the incentive to accrue excess water entitlement which can be sold profitably (Bauer 1997, p. 640). In some cases water markets have even been presented as a mechanism for reducing rural poverty (Thobani 1997). Needless to add, all of these arguments are, in part, contingent on an efficiently functioning water market. Put differently, these arguments may not be sustainable in the presence of significant market failure.

This article explores impediments to the formation of markets for permanent tradable water entitlements in NSW. The article itself comprises five main sections. The second section outlines the legislative response of the NSW government to the water reform process and examines evidence of the development of a market framework in NSW water entitlements.

Potential flaws in the market framework are identified in the third section with reference to other countries where a market framework has been adopted. In the fourth section we examine the existing market impediments in NSW. The article concludes with a brief discussion of the policy implications of the analysis.

2. Legislative background to water reform in NSW

In this section we attempt to establish the legislative foundations of water markets in NSW as an integral component of the reform process. This provides the basis for understanding the development of the water market.

2.1 The national setting

The signing of the Council of Australian Governments (COAG) Agreement on Water Resource Policy (Water Reform Framework) in February 1994 and later the Competition Principles Agreement in April 1995 provided additional impetus to the water reform process which had already begun in many states. The strategic framework outlined a reform process which addressed the perceived economic and environmental inefficiencies of the existing administration of water resources. First, pricing practices were to be reformed so that prices reflected the full economic cost of resources, were consumption based, removed cross-subsidies and made other subsidies transparent. Moreover, by 2001 rural water charges should fully recover cost and wherever practicable show a positive rate of return on the written-down replacement cost of assets (National Competition Council [NCC] 1998, p. 3). Second, a system of water allocations was to be implemented by states which would recognise the legitimate demands of the environment and break the nexus between land and water titles. Arrangements for the trading of water entitlements were also to be implemented. Third, water agencies were required to provide efficient water service delivery which separates regulation, service delivery and water resource management functions, and provides greater financial self-sufficiency (Rigden 1998, p. 6). Moreover, in Section 6(g) of the Water Reform Framework the principle that irrigation customers be given greater control over the management of irrigation areas was entrenched. Fourth, two-part tariffs were to be adopted for urban water users where this was cost-effective. Finally, all future investments in the water industry were to be encouraged only if they fulfilled both economic viability and ecological sustainability criteria.

Notwithstanding the complexity of these issues, subsuming the water reform process within the ambit of National Competition Policy (NCP) provides clear and significant financial incentives for states and territories to

implement these policies. More specifically, satisfactory progress against the NCP reforms entitles individual states and territories to a per capita share of around \$A16 billion in transfers from the Commonwealth over eight years to July 2006 (Furmage 1998, p. 3). Discussion of the ability of states to introduce all of these policy changes lies beyond the scope of this article. However, details of the various payments do provide a useful background to legislative reform within NSW. The first tranche of payments was assessable in 1997 but excluded an evaluation of water reform which was first included in 1998. The second round of payments requires the effective implementation of all 1994 COAG agreements on the Water Reform Framework and is assessable by July 1999. This includes adherence to the pricing principles advocated by the Expert Group on Asset Valuation Methods and Cost Recovery endorsed by COAG in 1995. The final tranche of payments relates to assessments to be conducted by July 2001 and requires full implementation and continued observance of all COAG agreements with respect to water (NCC 1998, p. 3).

A review of the institutional framework of the Murray–Darling Basin Commission (MDBC) is also necessary to appreciate the complexity of the policy environment in NSW. The MDBC is the operational arm of the Murray–Darling Basin Ministerial Council (MDBMC) which comprises government ministers from NSW, Victoria, South Australia, Queensland and the Commonwealth. The MDBMC has a broad mandate to coordinate the management of the Murray–Darling Basin. Both the MDBC and the MDBMC owe their existence to the Murray–Darling Basin Agreement which is set out in the Murray–Darling Basin Act dating from 1914. The Agreement arose from protracted discussions between the states relating to the ‘ownership’ of the water resources of the Murray–Darling Basin. More specifically, conflict arose between South Australia, which sought to protect and develop the river for trade purposes, and NSW and Victoria, which intended to exploit the river for irrigation purposes (Clark 1971, p. 26). Despite several alterations to the Agreement since its inception, the basic principles for the sharing of water resources between the states have remained largely unchanged from 1914 (Alaouze and Whelan 1996, p. 16). However, since the 1980s, modifications to the Agreement reflect growing concerns over the environmental health of the basin and the need to accommodate environmental objectives.

In 1994 an audit of water use in the Murray–Darling Basin was commissioned by the MDBMC. An interim cap on water extractions at 1993–94 levels was imposed in 1995 after the audit pointed to the continued rate of growth in extractions and the deleterious impact of the rate of extractions on riverine environments (DLWC 1997, p. 1). The Independent Audit Group was formed and provided reports to the MDBMC on progress

in the implementation of the cap and recommendations for its final form. In July 1997 the Council agreed to maintain the cap which restricted future extractive usage of water while allowing for adjustments for annual stream-flow and climate changes. The Independent Audit Group continues to monitor each state's progress and compliance with the cap and attempts to provide an equitable arrangement between states. The structure of the MDBC and its regulations highlight the complexity of the water industry in NSW. More specifically, in reviewing legislative arrangements and the impact of reforms at a state level, it is important to note the significant influence of the multiplicity of legislative tiers within the water industry and, in particular, the impact of the cap on extractive users in NSW.

2.2 NSW water reforms

Management of irrigation water in NSW

In reviewing the national Water Reform Framework, we indicated that the reform agenda included the sequestration of regulation, service delivery and water management functions while simultaneously affording irrigation customers greater management control over irrigation areas. After adopting this view in September 1997, a bulk water delivery business, NSW State Water, was created, whose role is to efficiently deliver water to users as determined by the resource assessment conducted by the resource manager (Fishburn, Immaraj and Shields 1998, p. 4). The DLWC has retained the role of resource manager or steward and NSW State Water operates as an unincorporated arm of the DLWC reporting to the Director General. All state irrigation schemes in NSW became autonomous private companies or state-owned corporations in 1995 and 1997, respectively. In the case of the former, the corporation is owned and operated by constituent irrigators who hold shares in the irrigation company on the basis of established water entitlements. In the latter case, the corporation operates independently of DLWC although the government retains ownership through shareholder Ministers. Each entity is licensed under the Irrigation Corporation Act, 1994 for a period of 15 years.

Pricing of water in NSW

An integral component of the water reform process resides in the efficient pricing of the resource itself since under-pricing leads to inefficient water use, particularly if the market for entitlements is not well developed. NSW has been at the forefront of pricing reform for bulk water (Furmage 1998, p. 5). Consumption-based pricing was first introduced in NSW by the Hunter Water Corporation in 1982. Since November 1995 the Independent Pricing

and Regulatory Tribunal (IPART) has determined bulk water prices for irrigators and major urban users, employing a process which is both transparent and independent. The pricing principles used have sought to capture broad economic costs, including provision for environmental costs, though this continues to be a vexatious issue. The 1996 IPART interim report on bulk water prices advocated five principles to be used in establishing bulk water prices. First, water charges should be based on the efficient provision of water services. Second, financial stability and sustainable service delivery should be achieved. Third, pricing should encourage the best overall outcome for the community. Fourth, costs should be borne by the specific impactor or beneficiary. And finally, pricing should promote ecologically sustainable water use (IPART 1996).

Water administration and licensing in NSW

The DLWC was formed in 1995 from the former Department of Water Resources, Conservation and Land Management and some areas of Public Works. It is empowered to set conditions on the extraction of water and administer rural water licences in NSW. Currently about 5000 licences operate on regulated rivers, some 12 000 licences apply to unregulated rivers, and around 70 000 relate to ground water extractions (Fishburn *et al.* 1998, p. 3; Alaouze and Whelan 1996, pp. 1–2; Brinsley 1998, pp. 3–4). In addition to the Irrigation Corporations Act, 1994, which covers shareholder irrigators operating within the recently privatised and corporatised irrigation schemes, there are also some 50 aspects of state legislation which govern the activities of licence holders. These include Regional and Local Environmental Plans, State Environmental Planning Policies, Environmental Planning and Assessment Act, Threatened Species Conservation Act, National Parks and Wildlife Act, NSW Wetland Policy, River and Foreshore Improvement Act, Soil Conservation Act, Pesticides and Allied Chemicals Act, Protection of the Environment Operations Act, and the Murray–Darling Basin Act (Schroo 1998).

Among the most important legislation in the current context is the Water Act which dates from 1912. This Act specifies the licensing to take water and in this respect water rights accruing to irrigators can be appropriately described as state property regimes (Bromley 1991). The Act itself is generally more consistent with the ‘development’ hypothesis of water management than the features of a ‘mature’ water economy. Moreover, ‘in some areas the legislation was not sufficient to prevent over-allocation of the resource’ (Brinsley 1998, p. 3). There are a number of other issues embedded in the legislation which are inconsistent with the current reform agenda, such as the specification of some water licences in terms of the area that can be irrigated rather than the volume of water that can be extracted. While

amendments to the Water Act have attempted to address some of these issues, many have tended to be piecemeal in approach and have resulted in a complex and often inconsistent set of administration principles (*ibid.*, pp. 3–4). The more recent Water Administration Act of 1986 has also required amendment to reflect the changing philosophy of water management. For instance, in 1997 the Act was amended to include Ecological Sustainability Development Principles.

In the present context the water allocation arrangements that operate in the southern regions warrant specific discussion since water trading is concentrated in these areas (Marsden Jacob and Associates 1999, p. 3.9). Historically the NSW management regime has, in part, aimed to maximise water available for irrigation per season. However, the reliability with which a water entitlement is met depends largely on the hydrology of the river system and by implication seasonal conditions. Some horticultural enterprises and urban users are issued with high-security licences which guarantee supply in all but the most severe droughts, although most water licences in southern NSW have general security entitlements (Alaouze and Whelan 1996, pp. 2–3). That is, there is a nominal entitlement, with licensees relying on regularly announced allocations to make production decisions. For example, announcements are made in August with respect to the percentage of entitlement that can be accessed by licensees on the basis of water currently in storage. Subsequent rainfall in spring may see an upward revision of the announced allocation and licensees are also permitted to use ‘off-allocation’ extractions when instream flows are adjudged sufficient. Although this administrative system has proved to be relatively robust, it does produce significant risk and uncertainty for some irrigators (Musgrave 1996, p. 48). Moreover, the inverse relationship between increased extractions and reliable supply, accompanied by pressure from environmentalists to reduce the security of water entitlements, has resulted in a complex legislative and administrative framework. As this framework evolves from the perceived changes to the objectives of water management, there are significant implications for the attenuation of extractive rights for irrigators.

In 1995 the NSW government announced six additional reforms that were introduced in that year. First, water was specifically allocated to the Macquarie Marshes and the Gwydir wetlands, reflecting the environmental significance of these areas. Second, the Healthy Rivers Commission was established to make recommendations with regard to rivers referred to it by government. Third, processes were initiated for the development of interim water quality and flow objectives. Fourth, the setting of bulk water charges was referred to IPART and a water management charge was imposed on most users with the stated intent of funding asset refurbishment. Fifth, the Water Advisory Council was established to provide a vehicle for community

advice on policy reforms. Finally, an embargo was placed on the issuing of new licences on most coastal, unregulated streams and several groundwater systems throughout the state (DLWC 1998b, pp. 2–6). In 1997 these reforms were subsequently built upon by the establishment of River Management Committees, extensive community consultation processes and the release of numerous discussion papers and support packages. Perhaps the most significant of these publications in the context of water markets is the discussion paper titled *Access and Use* (DLWC 1998b). This paper raises many of the difficult issues relating to property rights of water and the transfer of these rights in a market setting. Following community consultation the NSW government has scheduled the implementation of new licensing regulations in 1999–2000.¹

Tradable water entitlements in NSW

The Water Reform Framework relies, in part, on the use of market mechanisms to deliver an efficient allocation of water resources between the competing demands of irrigators, urban/industrial users and the environment (Topp and McClintock 1998, p. 1). To date, the role of water administrators in NSW has included the setting of annual allocation of general security licensees on the basis of hydrological data. An efficient allocation of water resources by such a framework appears unlikely since some users are consistently 'over-allocated' whereas others are consistently 'under-allocated'. Voluntary trade of the resource between users is seen as a logical mechanism for improving the allocation of the resource, particularly where there is an embargo on new licences. The extent of the mis-allocation created by an administrative structure without trade has been estimated to be around \$A50 million annually in the Murray–Darling Basin alone (Hall, Poulter and Curtotti 1993).

Annual transferability of water entitlements was first introduced in NSW in 1983 while permanent transferability commenced in 1989 (Cummings 1990, p. 186). The temporary trading of water between valleys has been possible in recent years although permanent transfers are generally restricted to intra-valley arrangements. A limited amount of permanent interstate trade commenced in 1994–95 and the establishment of the MDBC interstate water trading pilot project in 1998 has sought to expand this trade.² As much as 550 000 ML has been traded in total during some years with temporary inter-valley trade between the Murrumbidgee and the lower Darling, and the

¹ Most recently, the government released a white paper for consolidating and updating water management legislation as the next phase of implementation.

² The MDBC pilot project is restricted to private diverters in the Mallee border region of NSW, Victoria and South Australia.

Murrumbidgee and the Murray accounting for as much as 20 000 ML and 100 000 ML, respectively (Brinsley 1998, p.6). There are a number of legislative or administrative caveats at the local level which complicate the operation of the water market. These limitations are largely designed to reflect environmental, physical and operational constraints but have developed on an *ad hoc* basis (DLWC 1998a, p. 21). For example, in the largest irrigation district, the Murray Irrigation Limited (MIL) area, licensors are only permitted to permanently trade a maximum of 40 per cent of the entitlement originally ascribed to a landholding. Any transfer is also subject to an assessment of the hydrological loadings of properties. In some cases 'temporary' trades of more than one year can be negotiated between private individuals although local trading rules only officially recognise annual trades. Alternatively, in the Murrumbidgee Irrigation Area even temporary transfers outside the irrigation district have been restricted by local rules to preserve the engineering integrity of the irrigation infrastructure. Constraints may also arise at the state level where the DLWC intervenes in transfer arrangements in its capacity as water resource steward. For instance, trading of sleeper and dozer licences on unregulated rivers is currently prohibited. Sleeper licences have an entitlement which has been consistently unused while dozer licences have a proportion of entitlement which is inactive. The activation of these licences either threatens the MDBMC cap or the access rights of other users. Thus, the DLWC must make a determination on the treatment of these licences in the longer term and the trading rules that will apply to such licences.

2.3 The development of water markets in NSW

Much has been made of the benefits that can be derived from trading in water entitlements. While reliable and comprehensive data on the quantity and nature of trade are not yet available (Marsden Jacob and Associates 1999, p. 3.6), statistical information obtained from the DLWC Water Analysis and Audit Unit points to the robust growth of temporary water transfers in NSW (see table 1).

In recent years the volume of water traded annually on a temporary basis has varied between 200 000 ML and 700 000 ML (DLWC 1998a, p. 4). This represents as much as 10 per cent of the licensed volume of extractions from regulated streams in NSW. By way of contrast, it is more difficult to proclaim the growth of the permanent water market. While the Water Analysis and Audit Unit of the DLWC has only recently compiled information on permanent transfers of water entitlement which are distinct from transfers of land, there is the added complication that trades negotiated by private treaty for up to five years are treated as temporary trades. Notwithstanding this limitation, data from the DLWC Water Analysis and Audit Unit point to a

Table 1 Summary of temporary transfers of water licences in NSW by volume, number and year

Year	Intra-valley transfers		Inter-valley transfers*	
	No.	Volume (Ml)	No.	Volume (Ml)
1983–84	4	2573	0	0
1984–85	17	3490	0	0
1985–86	56	40054	0	0
1986–87	39	44478	0	0
1987–88	215	100718	0	0
1988–89	104	41714	0	0
1989–90	202	78247	0	0
1990–91	147	66778	0	0
1991–92	458	174321	0	0
1992–93	310	68858	4	20800
1993–94	297	89391	10	5354
1994–95	1528	385887	504	126638
1995–96	815	281359	82	41359
1996–97	741	358668	68	41978
1997–98	1847	444213	133	62781

Note: * Operational data.

Source: Justine Harris, Water Analysis and Audit Unit, DLWC, 1999, e-mail, 30 June–1 July.

relative paucity of trade in permanent water entitlements independent of land title. These data support anecdotal evidence from local water managers about the thinness of the permanent water market and appear in table 2.

For the years for which data are currently available the recorded volume of permanent trades has failed to exceed more than 0.5 per cent of the total water entitlement available for trade. This supports the observation by

Table 2 Permanent water entitlement transfers by volume and number in NSW

Year	Intra-valley transfers	
	No.	Volume (Ml)
1989–90	5	2700
1990–91	33	8299
1991–92	65	20497
1992–93	78	19670
1993–94	66	28099
1994–95	99	24599
1995–96	66	26371
1996–97	112	31249
1997–98	125	47603

Source: Justine Harris, Water Analysis and Audit Unit, DLWC, 1999, e-mail, 30 June–1 July

Marsden Jacob and Associates (1999, p. 3.7) that only 5 per cent of all water entitlements transferred in 1997–98, including interstate transfers, were permanent trade. It thus appears that the transfer of a small number of water rights does not constitute a water market *per se*. Only when consumers and producers undertake significant continuous voluntary exchange over time can a market be proclaimed (Katz and Rosen 1994; Michelsen 1994).

In economic parlance, market failure arises where the unfettered market produces an outcome which is not economically efficient in Pigouvian and Paretian terms. Since efficiency implies that all mutually beneficial gains are fully exploited, an alternative description of market failure centres on the question of why some mutually beneficial trades remain unexploited by rational economic agents. Gravelle and Rees (1992, p. 513) suggest that there are three basic reasons why advantageous exchange may not occur. First, individuals may not have sufficient control of a commodity or resource to undertake the necessary exchange. Second, high transaction and information costs can erode the advantages of trade. And finally, the individuals involved in trade may be unable to negotiate and agree upon the terms of mutually advantageous exchange. In the case of the market for permanent water entitlements in NSW it may be that these causes manifest themselves in a paucity of actual market interaction.

The relative thinness of the permanent water market in NSW has also been analysed by Crase and Jackson (1998). In their review of strategic responses of over 200 landholders to reduced water availability in the Murray Land and Water Management Plan area, Crase and Jackson (1998) established that only 2 per cent of farmers indicated that they would consider the sale of their permanent water entitlement separate from land. Moreover, only 3 per cent indicated a preparedness to purchase permanent water when confronted with limited access to the resource. Therefore, the question arises as to the nature of the obstacles that appear to be limiting the development of the permanent water market in NSW. In the context of the broader reform of the water sector, this issue needs to be addressed if policy-makers are to achieve the goals of reform since an active temporary water market is unlikely to substitute adequately for the security needed to encourage optimal investment in high-value enterprises. For example, increased investment in high-value horticultural enterprises may be incompatible with a movement of temporary water alone. A smoothly functioning permanent and temporary market would enable producers to select a mix of temporary and permanent entitlements which reflected their individual risk preferences. More specifically, accessing temporary entitlements involves greater production risk since in some years there may simply be no water for sale. Alternatively, purchasing permanent entitlements could involve greater financial risk as the enterprise must either hold excessive general security

licences or convert these licences to high security entitlements according to the administrative discounting factor applied at the time. While in principle there should be an equivalence of the opportunity cost of both forms of risk, a thin permanent water market seems likely to manifest itself in under-investment in high-value irrigation enterprises.

3. Explaining thin markets for permanent entitlements

3.1 International evidence

Among the most thoroughly researched water transfers are those in the western United States where transfers of water rights have occurred since prior appropriation laws, over a century ago. The prior appropriation doctrine implies 'first in time, first in right', and initially resulted in highest priority access rights being acquired by miners and agricultural settlers. The subsequent and significant movement of these rights from agriculture to industrial and urban users is often cited as evidence of the active water markets in these regions (see, for example, Colby, Crandall and Bush 1993). However, closer examination of these claims suggests that, in many cases, the analysis relates only to temporary transfers (see, for instance, Howitt 1994), or that longitudinal data sets have been compiled from many years to build a sample suitable for analysis. For example, Colby *et al.* (1993) examined price dispersions appertaining to the sale of permanent water entitlements in the Gila-San Francisco Basin. Econometric analysis using a hedonic pricing approach was used to test the significance of property right priority, the flexibility of the water right, the high profile nature of participants involved in the trade, the date of the transaction, and the size of the transfer. While it was shown that these variables were significant and generally met *a priori* expectations, the data set comprised only 95 water transactions between 1971 and 1987. This is an average of less than six transactions per year and raises serious questions about the extent to which so few transactions constitute an active and functional market.

On the basis that water markets are defined by continuous voluntary exchange, Michelsen (1994) sought to distinguish the administrative, institutional and structural characteristics which give rise to active permanent water markets. His review of the Colorado-Big Thompson project is particularly useful in the present context since it provides insight into those features which may help explain the relative 'thinness' of permanent water markets in Australia. Michelsen found that the Colorado-Big Thompson scheme was among the most active markets for permanent water rights, with over 2000 transactions between 1970 and 1993 which accounted for over a third of the project's total water entitlement. The success of this particular

market is attributed, in part, 'to the establishment of clearly defined water rights, the high reliability of supply [within the scheme] . . . , a well developed distribution system, the large number and diversity of market participants, and especially to institutional rules and administrative procedures that minimise transfer restrictions and transaction costs' (Michelsen 1994, p. 981). These conclusions appear to support earlier work by Young (1986) which identified the lack of defined property rights for water, institutional restrictions and transaction costs as impediments to the development of permanent water markets. However, having identified the criteria for encouraging the development of an effective permanent water market, Michelsen (1994, p. 981) nevertheless concluded that 'the Colorado-Big Thompson market [is] unique and unlikely to be duplicated in other situations'.

Gaffney (1997) also analysed the development of permanent water markets in the United States and expressed disquiet at the number of obstacles that were 'gluing up the market' (*ibid.*, p. 476). In many respects, the analysis presented by Gaffney goes beyond the more conventional market constraints identified by others. The lack of motivation for sellers is identified as a critical element limiting the market's development. More specifically, water rights tend to be hoarded by all except those completely exiting agriculture or those confronted with the cash drain implicit in holding excess land subject to debt or property taxes. Hoarding behaviour is further explained by the perception that demand will increase perpetually. In this respect, Gaffney (1997, p. 480) observed that 'demand keeps growing — so why not hold out another year?'. An additional consideration is the notion that holders of water rights, when faced with uncertainty about property rights, withhold them from sale for fear of creating the public perception that there are surplus entitlements. Institutional inconsistencies in the treatment of groundwater and implied and actual subsidies in some districts are also identified as factors inhibiting the development of a functional market. Finally, it is worth noting the contradiction between the 'firming' of property rights and the efficient operation of the market. Gaffney (1997) postulated that the process of firming property rights has not received sufficient attention in the United States. Moreover, 'giveaways', where public property is simply divested to the private sector for the purpose of enhancing the operation of the market, tend to undermine the market process and encourage rent seeking (*ibid.*, p. 487).

Analyses of permanent water markets in other parts of the world also provide support for the view that active markets for permanent water entitlements are more the exception than the rule. A review of Chilean water markets is instructive in this respect. Chile has progressive, pro-market policies for the allocation of water resources following the proclamation of the Water Code (1981). This legislation is unique in its embrace of market

philosophy which even accepts a role for speculation within the market. Bauer (1997, p. 639) argued that 'no other country has gone so far, for so long in the direction of pro-market water laws'. The Water Code is also cited as the key stimulus in encouraging greater agricultural diversity, higher rates of adoption of new water technologies and significant increases in water use efficiency (Frias 1992; Munita 1994; Rosengrant, Gazmuri and Satya 1995; Thobani 1997). However, despite apparently embracing market philosophy, the strengthening of individual property rights to water and attempts to foster a market mentality, there have been only limited transactions of permanent water which are separate from land (Bauer 1997). This view is supported by Hearne's (1995) analysis of water markets in Central and Northern Chile which revealed demonstrable benefits from trade, but only a limited number of actual transactions.

Bauer (1997) has identified four kinds of obstacles which seem to have limited the development of dynamic markets for permanent water entitlements in Chile. First, there are geographic and infrastructure restrictions to the functioning of permanent water markets in Chile. These include the difficulty and expense of moving water between basins and the rigidity of associated infrastructure. Second, legal and administrative factors, such as the uncertainty surrounding many titles, have constrained the development of a permanent water market. This is exacerbated by the unspecified number of unused valid rights that could be exerted and thus impinge upon rights of existing users. Third, cultural and psychological attitudes are cited: it has been argued that

it would be hard to exaggerate the real and symbolic importance of irrigation in this semi-arid country, where it has taken centuries of labour and willpower to bring water to dry lands and transform them into productive fields. . . . This history joins the constant threat of drought to reinforce Chilean farmers' ingrained determination to hold onto their water supplies at almost any cost.

(Bauer 1997, pp. 647–8)

Finally, prices and values are presented as factors which have stifled the development of permanent water markets. In particular, it is contended that ambiguous and uncertain price signals may invoke the view that the value of permanent water is not well represented by the market price. Only the most desperate offer permanent water for sale and many hold permanent rights for speculative reasons.

In sum, the international literature on permanent water markets points to at least six factors which seem to have impeded the development of permanent water markets overseas. These included unclear or poorly defined property rights to access the resource, unreliable and variable supply, infra-

structure impediments, excessive transaction and transfer costs, hoarding behaviour and speculation, and cultural or sociological attributes that limit market participation. In many respects, this list is neither comprehensive nor exclusive and often cause and effect are difficult to separate. The remainder of this article explores the current NSW water reforms against these obstacles in an effort to explain the apparent thinness of the market for permanent water entitlements.

4. Obstacles in the NSW market for permanent water entitlements

4.1 Unclear or poorly defined rights to access and use the resource

An efficient market in tradable water entitlements is possible only where the property rights associated with those entitlements are non-attenuated. This implies that the right to use water must be clearly specified, enforceable and enforced, exclusive, and capable of voluntary transfer (Pigram and Musgrave 1989, p. 109). However, the question arises as to whether the regulatory regimes currently being developed in NSW for managing the public good uses of water are compatible with an efficient market equilibrium. In this respect Dudley (1990, p. 81) observes that it is

important not to choose institutional arrangements which will increase uncertainty [in the water industry]. Allowing reservoir allocation and carryover policies to be modified at the discretion of politicians or administrators, other than through market intervention, is likely to be especially damaging.

To date, the realisation of environmental goals has rested heavily on administrative or bureaucratic restrictions on irrigators in preference to government-subsidised purchases of water for the environment through the water market. Purchasing water for the environment directly from water markets simultaneously 'internalises' potentially deleterious third party effects, legitimises the environment as a consumer of water, and presumably instills confidence in the property rights regime for those currently holding water licences. However, these actions imply direct and discernible costs to the public purse. On the other hand, regulation implies costs which are easier to disguise and conceal from the public (Delforce, Pigram and Musgrave 1990, p. 58). This view contrasts with the recommendations of the Snowy Water Inquiry (1998, p. 17) which contends that '[T]he market in permanent water is nowhere near large enough to cope with the demand [for environmental flows] in the medium term' and thus recommended the use of efficiency savings from irrigation to provide environmental flows east of the divide.

In NSW environmental objectives are ascribed to an administrative framework in part because of the lack of knowledge of the natural environment:

NSW has adopted an adaptive approach to water management. The water required to maintain the fundamental health of river and groundwater systems cannot be 'set in stone'. Firstly, as new information becomes available, it is probable that there will be better ways of achieving the environmental, social and economic targets. Secondly, community attitudes change over time — the answer to the question 'how healthy do we want our rivers to be?' will not stay the same.

(DLWC 1998a, p. 11)

While this approach may reinforce environmental objectives, it undermines the property rights of permanent water entitlements which manifests in market failure. Even Peter Brinsley, Director of Access, DLWC concedes that 'water users have expressed concern that the rules under which they can extract water have been constantly changing. Continual changes are making it difficult for water users to undertake forward planning for and investment in enterprises. There is a need for some stability in the water sharing and administration system' (Brinsley 1998, p. 4). These comments are consistent with the broader observation of Alston, Eggertsson and North (1996, p. 4) that

[I]n an economy where entrepreneurship is decentralised, economic actors will hold back on long-term investments unless the state makes credible commitments to honour its contracts and respect individual ownership rights. Because the state is usually the most powerful agency in the community, and because circumstances often tempt rulers to take the short view and expropriate wealth, institutional arrangements for controlling opportunistic behaviour by the state have profound implications for economic growth.

In short, the propensity for frequent legislative change undermines the market process and prevents permanent water entitlements moving to their highest-value use.

4.2 Variability of supply

Notwithstanding the aforementioned legislative changes, the supply of water in NSW is inherently unreliable relative to many other parts of the world (Brennan and Scoccimarro 1999, p. 72). One way of expressing this variability is by observing the ratio of maximum annual flow to mean annual flow. In Europe and America this ratio commonly ranges between 3 and 15. The Darling River, which drains three-quarters of NSW, has a value of

11 000. To combat this variability, irrigation storage in NSW holds four times more water per hectare of irrigated land than Egypt and ten times the volume held in India. Variability by location in the supply and demand for water adds to the distinctiveness of the water industry in NSW. Approximately 75 per cent of the state's surface water occurs on the coastal fringe while 80 per cent of the demand for water lies west of the divide (Burton 1993, pp. 1–2). While the variability of water supply systems may suggest that a complete non-attenuation of water entitlements is impossible, we argue that sufficient knowledge on the part of market participants and legislative certainty would permit the development of an equilibrium which could at least approach efficiency. Sufficient longitudinal data on the variability of river flows and storage are available to establish the parameters of the probability distribution of supply. Such data would permit the market for entitlements to establish prices which reflect this variability. However, the uncertainty that stems from legislative and administrative change is more vexatious. There is no equivalent longitudinal data set to assess the parameters of the probability distribution pertaining to the response of water policy-makers. As a result, '[T]he uncertainty surrounding possible changes in environmental allocations, which has already resulted in a reduction in (off allocation) water normally available to farmers in NSW, adds to the existing problems associated with attenuated water rights' (Brennan and Scoccimarro 1999, p. 70).

4.3 Infrastructure obstacles

A water transportation infrastructure has developed in NSW comprising regulated river systems and thousands of kilometres of channels. While this infrastructure has provided considerable economic and regional development benefits, the over-allocation of water resources to extractive uses has brought considerable environmental costs. In transferring ownership of the irrigation infrastructure to private corporations, the NSW state government acknowledged a responsibility to 'deferred maintenance'. Notwithstanding increased expenditure to improve infrastructure and environmental remediation, river channel constraints, such as the Barmah Choke and sections of the Murray river between the Hume Dam and Yarrawonga, will always place some limitation on the flexible transfer of water entitlements and therefore constrain the development of the market (MDBC 1998, p. 13).

4.4 Excessive transaction and transfer costs

A number of transaction costs arise in the market for tradable water entitlements. In general, the transaction costs of participating in the market

for permanent water entitlements are significantly greater than those associated with the market for temporary water. It seems that this may partly explain the relative paucity of trade in the former. First, search costs derive from participants' efforts to establish the price of permanent water. In this respect Challen (1997) noted evidence of price dispersions in South Australian water markets and the need for regulatory agencies to provide market information to improve the efficiency of the market. This issue is of less significance in the temporary market where price information is readily available. For example, the Southern Riverina Irrigation Districts Council operates a water exchange which posts the monthly history of minimum, maximum and average prices as well as the quantity of temporary water traded on the Internet. Alternatively, permanent trades are usually conducted by private treaty, where price information, in particular, remains confidential. Thus, reliance on agents for price information acts as a restraint on trade in the permanent water market relative to the temporary market. Second, conveyancing requirements associated with permanent transfers are more onerous and generally require professional legal assistance which raises the cost of trade. Third, permanent transfers face additional administrative costs. For example, in the MIL area administrative and conveyancing fees imposed on temporary trades comprise a 3 per cent commission paid by purchasers and a \$A75 processing fee levied by the DLWC. By way of contrast, the administrative costs for a permanent internal transfer comprise a \$A200 environmental assessment fee and a \$A250 conveyancing fee, both payable to MIL, and a \$250 processing fee levied by the DLWC. As noted in the second section, environmental assessment and infrastructure assessment are also required before a permanent transfer can be approved at the local level. Such assessments consider drainage, soil salinity and other environmental factors as well as the capacity of local infrastructure to carry additional flows. Any transfer is therefore subject to veto at the local level. Permanent transfers are further constrained by local requirements such as the MIL rule that no more than 40 per cent of the transferor's original entitlement be permanently traded. Once approved by the local irrigation company documentation is forwarded to the DLWC to ensure that it meets specific state criteria. Licensees holding entitlements outside irrigation districts, such as river pumpers, also face higher administration cost for permanent trades than temporary trades. Moreover, there are lengthy administrative tasks to be completed which commonly delay the issuing of a replacement licence by between six and twelve months (Marsden Jacob and Associates 1999, p. 4). For example, at the state level all new irrigation developments require the preparation of a Farm Water Management Plan showing how best management practices will be employed. This requirement persists despite evidence from South Australia suggesting such plans are

not uniformly implemented and may be of limited use (Bjornlund and McKay 1998, p. 1569). By way of contrast, such delays and processes are not applicable to temporary trades of less than five seasons. Finally, if we accept a broad definition of transaction costs, the taxation treatment of permanent and temporary trades may have implications which inhibit the development of the former against the latter. Currently, there is greater flexibility in the structure of payments for temporary trades which can minimise the potential payment of stamp duty. For example, a significant volume of temporary water can be purchased in small lots which fall below the threshold payment that attracts stamp duty.³ Similarly, purchasing permanent water entitlements could attract future capital gains tax while temporary purchases are currently regarded as a production expense.⁴ In short, both state and federal taxation laws may further erode any arbitrage opportunities in the permanent market which inhibit the long-term movement of the resource to its highest-value use.

4.5 Hoarding behaviour and speculation

Persistent changes to the legislation and administration of water resources in NSW are not only manifest in confusion about property rights. In addition, there is anecdotal evidence from irrigators that suggests the clawing back of access rights makes existing water entitlements more valuable. In a recent review of water trading commissioned by the DLWC, David Ledgerwood from Murrumbidgee Irrigation offered the following view: 'Why would anyone sell water permanently when government decisions are driving up the value and therefore the future price? These same decisions have also made the temporary market increasingly lucrative for someone with excess water' (Marsden Jacob and Associates 1999, pp. 4–5).

Similarly, the risk of reduced access encourages the holding of excess water entitlements since additional entitlements are now required to access an equivalent quantity of water. For example, many farm businesses in the MIL area historically used 100 per cent of their entitlement and an additional 10 to 20 per cent 'off-allocation' flows prior to the introduction of the MDBMC

³ Pursuant to the Stamp Duties Act s11 ss(h) duty is payable on a statutory licence. The duty on temporary licences depends on how the agreement is drawn up (assuming there is an agreement). The duty is payable on the agreement only if it exceeds \$A3 000 for the term of the agreement.

⁴ Some uncertainty surrounds the application of Australian taxation law within the reform agenda. Marsden Jacob and Associates (1999, p. 5.3) have recommended that the DLWC clarify the rules applied by the Australian Tax Office to prevent negative impacts on the water reform process.

cap (Crase, Jackson and Toohey 1998, p. 3). The imposition of the cap and the recommended provision of environmental flows to the Snowy through 'efficiency savings' leave many irrigators holding water entitlements to counter the risk of further legislative reductions in access rights.

In the second section we observed that NSW has been at the forefront of pricing reform for bulk water (Furmage 1998). Theoretically, any underpricing or overpricing on the part of IPART should be corrected by a functioning market for entitlements. Moreover, the opportunity cost of a megalitre of water should reflect the sum of delivery charges and the market value of the entitlement such that any change in the delivery charge gives rise to an opposite and compensating change in the value of the entitlement. However, if the market for entitlements is not well developed, such compensating changes in the value of entitlements may not arise immediately. This provides a clear incentive to hold entitlements for speculative purposes particularly if there is a perception that delivery charges are underestimated.

4.6 Cultural or sociological attributes that limit market participation

We have already noted the influence of cultural features in semi-arid countries such as Chile which prevent the formation of active permanent water markets. Evidence from Australia suggests that a similar impediment may exist to the development of a permanent water market in NSW. Bjornlund and McKay (1996), in reviewing lessons of tradable water entitlements in South Australia, observed that almost half of those offering entitlements for sale stated that their primary motivation was the 'need for money'. Put differently, only cash-strapped irrigators offer their entitlement for sale since this is equivalent to 'selling the back paddock'. Similarly, modelling of the strategic responses of Murray irrigators to reduced water has shown a significant correlation between the probability of exit and those offering permanent water entitlements for sale (Crase and Jackson 1998). While champions of the water market would point to this as evidence of market efficiency, restricting sellers only to those exiting agriculture leaves the market excessively thin.

5. Conclusion

A review of the legislative and administrative reform of the water industry in NSW has indicated that the success of many of the reforms rests partly on an efficient market for tradable water entitlements. The available data on trades suggest that, while the market for temporary transfers is active, the same growth is not evident in the market for permanent water entitlements.

Moreover, the paucity of transactions in the permanent water market is likely to be accompanied by under-investment in high-value enterprises. In this respect, the failure of the permanent water market stands to undermine the effective reform of the NSW water sector.

Our discussion of the market for water entitlements abroad suggests that many of the common obstacles to the formation of robust water markets overseas are also present in NSW. Property rights are not well defined and the use of an adaptive management framework, in particular, undermines the certainty of current entitlement holders. The general hydrology of the region is inherently unstable and unreliable, though data are readily available for the market to encapsulate hydrological variability in the price of entitlements. The distribution system, while adequate and the subject of recent infrastructure improvement, produces geographical obstacles which will always inhibit the transfer of some entitlements. Transaction and transfer costs are relatively high for permanent water. Price information can often only be obtained with the services of an agent and there are considerable delays and administrative burdens associated with a trade of permanent water. There are also cultural factors which preclude the interaction of some players in the permanent water market while others appear to hoard entitlements because of uncertainty and the potential for speculative gain. In general, these factors operate on the supply side of the market with only the most desperate licensees offering their entitlements for sale. Further research of each of these impediments is warranted if the reform process is to realise the economic and environmental goals sought by policy-makers.

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