

Water markets as a vehicle for reforming water resource allocation in the Murray-Darling Basin of Australia

Lin Crase

School of Business, La Trobe University, Wodonga, Victoria, Australia

Phil Pagan

Centre for Resource and Environmental Studies, Australian National University, Canberra, ACT, Australia

Brian Dollery

Economics Department, University of New England, Armidale, New South Wales, Australia

Received 20 October 2003; revised 7 December 2003; accepted 20 January 2004; published 15 July 2004.

[1] Water trade and the establishment of water markets continue to gain popularity among legislators as a vehicle for progressing the reform of the water resources sector in Australia. This has manifested itself at the most recent meeting of the Council of Australian Governments, where a range of changes to address the declining health of inland rivers included the strengthening of water property rights. These views appear to be premised on the belief that nonattenuated water rights are a prerequisite for maximizing the productive benefits of water and are broadly in line with notions often derived from neoclassical market theory. However, in spite of the apparent faith in the market mechanism, there is a growing literature illustrating the limitations of the market framework in the context of water resource management. Accordingly, there would appear to be grounds for a more cautious approach that recognizes the potential for market failures to emerge. This article explores the present growth of water markets and the legislative background that circumscribes them in the Murray-Darling Basin. Recognizing the constraints imposed by the status quo, this study then examines the implications of stronger property rights for entitlement holders and the use of water markets in the context of the goals assigned to Australian water managers. *INDEX TERMS*: 1842 Hydrology: Irrigation; 1899 Hydrology: General or miscellaneous; 6319 Policy Sciences: Institutions; 6615 Public Issues: Legislation and regulation; *KEYWORDS*: Australian water resources, natural resource management, water markets

Citation: Crase, L., P. Pagan, and B. Dollery (2004), Water markets as a vehicle for reforming water resource allocation in the Murray-Darling Basin of Australia, *Water Resour. Res.*, 40, W08S05, doi:10.1029/2003WR002786.

1. Introduction

[2] Water trade and the establishment of water markets continue to gain popularity among legislators as a vehicle for progressing the reform of the water resources sector in Australia. This has manifested itself at the most recent meeting of the Council of Australian Governments (COAG), where a range of changes to address the declining health of inland rivers included the strengthening of water property rights. These views appear to be premised on the belief that nonattenuated water rights are a prerequisite for maximizing the productive benefits arising from water usage and are conducive to the efficient operation of the market framework that could then better allocate resources [see, e.g., *Freebairn*, 2003].

[3] Perhaps paradoxically, interest in water rights and markets is not being driven by concern with the productive returns to water per se. Rather, it relates to the suite of environmental problems confronting much of

the Australian landscape that emanates from decades of agricultural production systems transplanted from European environs. Widespread clearing of deep-rooted native perennial tree and grass species and institutional arrangements that encouraged (and in some cases insisted on) exploitative development rather than conservative management have been combined with ancient soils heavily invested with salt. The result has been rising water tables and salinity that now impacts large tracts of agricultural land [*Murray-Darling Basin Ministerial Council (MDBMC)*, 2000], and in some instances, significant mobilization of acid within soil profiles and extensive biodiversity loss [see, e.g., *Murray Catchment Board*, 2003]. By virtually any standard the economic costs of degradation in Australia are nontrivial, with *Madden et al.* [2000] estimating that it would cost \$A65 billion over 10 years to prevent and repair land degradation and predictions that 1.2 million hectares of land in the Murray-Darling Basin alone will be impacted by salt by 2050 [*MDBMC*, 2000].

[4] In the specific instance of irrigated agriculture the history of development is no more flattering and the

prognosis for the future no less daunting. As *Watson* [2003, p. 214] observes, "...the popular enthusiasm for irrigation over a century or more was always inconsistent with a serious appraisal of physical or economic opportunities facing Australia." Drawing on the earlier work of *Davidson* [1969], *Campbell* [1980], and *Randall* [1981], *Watson* [2003] describes the litany of misconceptions and mistakes that circumscribed the development of irrigation in Australia. First, low rainfall and runoff, accompanied by significant variability, fostered the perception that Australia was, and is, a dry continent. The response to this was the development of state-sponsored irrigation infrastructure that ignored the comparative advantage accruing to dry land agriculture and also failed to acknowledge that Australia already had more water per head of population than many other countries. Second, ignorance of these fundamentals ultimately manifested itself in subsidized production and the underpricing of inputs, particularly water. Third, the desire to encourage closer settlement in a vast land compounded these issues with the interventionist proposition of the "home maintenance area." Assigning returning soldiers to small unsustainable irrigated lots both "condemned early settlers to a frugal existence" [*Watson*, 2003, p. 215] and made rational allocation of water resources more problematic.

[5] This history of institutional failures in the development of irrigation in Australia was also accompanied by a range of technical deficiencies and knowledge gaps. Farmers, with a background in dry land agriculture, often lacked the skills and knowledge to instigate efficient irrigation practice [*Edwards*, 2003, p. 194]. Accompanied by the subsidized price of water, this invariably led to excessive use of water resources in preference to investing in more frugal water technologies. At the district and basin level the problems arising from delivering water to the farm were often given scant regard, ignoring the impact of evaporation and seepage losses via open channels cut through porous soils. This has compounded the historic failure to recognize or understand the connectivity between surface and groundwater for many basins. For instance, over half of the base flow in the Murray River is thought to have, at some time, been groundwater [*Young and McColl*, 2003, p. 225], but this relationship has only received serious attention since the maturation of the Australian water economy.

[6] In sum, one of the legacies of irrigation development is Australian communities confronting well-documented environmental ills. For instance, the *Murray-Darling Basin Commission (MDBC)* [2000] estimated that on present trends the salinity levels at Morgan on the Murray River will exceed the World Health Organization's desirable drinking water standard more than half of the time by 2020. Similarly, the *MDBMC* [2002] has indicated that between 20 and 40% of the water currently extracted for irrigation from the Murray River will need to be returned if the river is to be restored to the status of a "healthy working river."

[7] While most of the aforementioned problems are applicable to many locations in Australia, the region attracting greatest national attention is the Murray-Darling Basin. The Murray-Darling Basin extends from north of Roma in

Queensland to Goolwa in South Australia (see Figure 1). It also includes three quarters of New South Wales and covers half of the land area of Victoria and all of the Australian Capital Territory. In total, the Basin comprises over 1 million square kilometers, has a population of ~2 million, and accounts for 40% of the national income derived from agriculture and almost three quarters of the irrigated land within Australia.

[8] Management of a complex and diverse basin, such as the Murray-Darling, has created formidable challenges. This has led to the development of unique institutional arrangements such as the *MDBMC* and the *MDBC*. Details of these arrangements and their relationship to COAG are given greater attention in section 2. However, of significance in the present context is the prominent status assigned to water markets as a vehicle for countering the problems confronting the Murray-Darling Basin. For instance, the *MDBMC* [2001] expressed its commitment to water markets in its vision statement of 2001: "water trading (is viewed) as a foundation in maximizing the profitable and sustainable use of water, while protecting the environment and catering for social needs." In addition, clause 5 of the COAG Strategic Framework on Water Resources specifically committed all Australian states and territories to introduce mechanisms for water trade and made commonwealth competition dividends payable to the states conditional on progress toward this goal.

[9] However, in spite of the apparent faith in the market mechanism, there is a growing literature on the limitations of the market framework in the context of water resource management [see, e.g., *Gleeson*, 2003; *Cruse et al.*, 2003]. Accordingly, there would appear to be grounds for reconsidering the nexus between the market framework and the range of goals presently ascribed to water managers. There are several core questions that warrant attention. More specifically, (1) What is the theoretical justification for water markets as a panacea for the environmental problems confronting the Murray-Darling Basin? (2) Is it feasible to create a robust water market to allocate water resources within the Murray-Darling Basin? (3) What progress has been made to date that will assist in the development of water markets? (4) What have been the impacts of water markets in their present form? (5) Are these impacts consistent with the original goals of water reform? (6) How should water markets be modified to achieve these ends?

[10] The remainder of this article explores aspects of these questions by examining the growth of water markets and the legislation that circumscribes them in the Murray-Darling Basin. Recognizing the constraints imposed by the status quo, the article then examines the limitations of water markets in the context of the goals presently assigned to Australian water managers. The article itself is organized into five main parts. Section 2 provides an overview of the legislative framework that has been developed to manage the water resources of the Murray-Darling Basin and the political and social pressures that have prompted the latest reforms. More detailed analysis of the water legislation at the state level is offered in section 3 along with recent data on water trade. This provides the basis for commenting on significant trends in market behavior. Section 4 identifies both



Figure 1. The Murray-Darling Basin (from Murray-Darling Tour homepage, <http://www.mdbc.gov.au/tour/tour.htm>).

constraints to future development and the problems of an expanded water market across the Murray-Darling Basin, while section 5 offers some brief concluding remarks.

2. Legislative and Institutional Background to Water Reform and Water Trade in the Murray-Darling Basin

[11] As outlined in section 1, the Murray-Darling Basin spans several Australian states and territories, and as such, the MDBC is an exemplar of the hydrological institutional model of catchment management described by *Mostert et al.* [1999]. Under the hydrological institutional model, agree-

ment between provinces is required to permit a catchment-based approach to water management, particularly where the federal system is relatively weak [Green, 2003, p. 130].

[12] The MDBMC presently comprises government ministers from New South Wales (NSW), Victoria, South Australia, Queensland, the Australian Capital Territory, and the Commonwealth. The operational arm of the MDBMC is the MDBC, and both organizations owe their existence to the Murray-Darling Basin Agreement, which is set out in the Murray-Darling Basin Act that dates from 1914. The agreement arose from differing development priorities among the states: Victoria and NSW seeking to develop the resource for irrigation, while South Australia

wanted the Murray River as a transport route [Clark, 1971]. The South Australian option would have seen the primary port for transporting produce from the basin located at the river mouth, in South Australia, but as stated by the NSW premier of the time, “NSW (and presumably Victoria) was not prepared to reduce itself to the status of a catchment of South Australia” [Wright, 1978].

[13] The basic principles for sharing water between the states has remained largely unchanged since the agreement’s inception, and three fundamental rules still apply to deal with flow issues. First, river flows at Albury are equally apportioned to NSW and Victoria. Second, water emanating from the various tributaries of NSW or Victoria is retained by those states. Third, both NSW and Victoria guarantee a minimum flow to South Australia [Quiggin, 2001, p. 72].

[14] While these arrangements have proved enduring, a range of environmental and overallocation issues began to emerge in the 1980s. This prompted modification to the management of the basin. A “new” Murray-Darling Basin Agreement was signed in 1992 which included Queensland as a signatory, and the Australian Capital Territory was added in 1998 [MDBC, 2000]. A Community Advisory Committee, whose function is to provide advice to the MDBMC on the views of the basin’s communities, was also included in the “new” agreement. The new agreement also placed greater emphasis on sustainable use of the water, land, and other resources of the basin [see, e.g., MDBC, 2000].

[15] In 1994 an audit of water use in the Murray-Darling Basin was commissioned by the MDBMC and resulted in one of the most significant changes to the management of the basin. An interim “cap” on water diversions at 1993/1994 levels was imposed in 1995 after the audit pointed to the continued rate of growth in water extractions and the resulting deleterious impacts on riverine environments [Department of Land and Water Conservation, New South Wales, 1997, p. 1]. In July 1997, the MDBMC agreed to maintain the cap which restricted future extractive usage of water while allowing for adjustments for annual streamflow and climate changes. One of the primary implications of the cap was that “new” irrigation developments could only occur by sourcing water from existing extractive users. It is against this background that water trading was first proffered as a vehicle for assisting the allocation of water resources to higher-value uses within the constraints imposed by the institutions that had evolved to deal with the legacies of the past.

[16] The status of water trade was reaffirmed with the signing of the COAG Agreement on Water Resource Policy (or Water Reform Framework) in February 1994 and, later, the Competition Principles Agreement in April 1995. One of the ingredients of the Water Reform Framework was the development of a system of water allocations that recognized the legitimate demands of the environment and also broke the nexus between land and water titles. This component of the Water Reform Framework also required the establishment of arrangements within each state for trade in water entitlements, although the idea of transferring water was not altogether new. In many respects, the COAG Water Reform Framework displayed the preference of policy makers to employ price and market solutions to environmental problems. However, these reforms managed to gain

qualified support from prominent environmental groups like the Australian Conservation Foundation [Quiggin, 2001, p. 76].

[17] While water trade at the state level has been promoted through the COAG Water Reform Framework, exploration of the potential for a basin-wide water market has also been explored by the MDBC and MDBMC. This was facilitated by the addition of a schedule to the Murray-Darling Basin Agreement in 1998. The schedule resulted in the development of an interstate pilot trading project that limited trade to the irrigated areas in New South Wales, Victoria, and South Australia between Nyah and the mouth of the Murray River.

[18] One of the major problems confronting the establishment of water markets across state borders is the differing entitlement and allocation systems and consequent variations in water security; i.e., in the Australian vernacular “water ain’t always water”! These variations are, in large part, a function of the differing institutional histories of the three states. For instance, Victoria, while aggressive in its development of irrigation prior to federation, currently has a relatively conservative water allocation system compared to New South Wales. A Victorian irrigator’s water entitlements are commonly referred to as “water right” and “sales water.” The first category is relatively secure and available in all but the driest seasons, while sales water is less secure and depends on the amount of water in storage, less a provision for the following year’s water right. In addition, Victorian irrigators cannot carry forward unused water right to the following season. In contrast, New South Wales has two main classes of irrigator. “High-security” entitlement holders receive all of their water in all but the driest years, albeit usually a smaller quantity than a holder of a “general security” entitlement. This latter category of New South Wales irrigator relies almost exclusively on the water available in a given season, after all high-security and higher-order claims are satisfied but is able to carry forward unused water to the next season. South Australia, given its position at the tail of the catchment and its original interest in navigation, has the most conservative allocation regime of the three states and has issued only high-security licenses. Irrigators in this state are unable to carry forward water between seasons.

[19] To simplify matters arising from the differing entitlement and licensing systems, only permanent trade of high-security water was included in the interstate trading project. However, the project also employed an exchange rate mechanism for limiting the potential for third-party effects. The exchange rate applied to transfers between New South Wales and Victoria and from either New South Wales or Victoria to South Australia was 1.0. However, since the security of entitlements is higher in South Australia than the other states, upstream transfers from South Australia were assigned an exchange rate of 0.9. The first permanent interstate trade was completed in September 1998, and in the ensuing 2 years a total of 9.8 GL had moved between the three states [Young et al., 2000].

[20] In August 2003, COAG choose to go beyond the MDBC pilot project for interstate water trading initiative and announced that it had agreed on a framework to allow national water trading. While details of this framework are not scheduled to be finalized until the first COAG meeting in 2004, the emphasis on “stable and properly

defined water rights [as being] critical to ensuring investment security” (Deputy Prime Minister Anderson, quoted by L. Mottrim, Interview with John Anderson, ABC online, accessed in August 2003) is clearly embedded in the recent COAG communiqué (29 August 2003, available at http://www.ministers.dotars.gov.au/ja/releases/2003/august/a100_2003_attach.htm) (hereinafter referred to as COAG communiqué, 2003). From a water trading perspective there are several elements of the proposed nationally-compatible system of water access entitlements that warrant attention. First, the framework advocates that access entitlements be defined as “open-ended, or perpetual, access to a share of water resource available for consumption” (COAG communiqué, 2003). Second, the framework promotes the identification and assignment of risks between entitlement holders and the government, proposing that risks that emanate from natural events and from “bone fide improvements in the knowledge of water systems’ capacity to sustain particular extraction levels” (COAG communiqué, 2003) should be borne by the access entitlement holders. Risks arising from “changes to water access entitlements not previously provided for, arising from changes in government policy (for example, new environmental objectives)” (COAG communiqué, 2003) are to be assigned to governments. Third, effort to develop arrangements whereby water entitlement products become compatible across jurisdictions has been advocated.

[21] Interestingly, the announcement of the national framework was accompanied by a pledge from most of the MDBMC signatories to commit \$A500 million to regain water for environmental purposes, particularly for the Murray River. Again, these reforms have received qualified support from the environmental lobby.

[22] Three additional issues have circumscribed the recent enthusiasm for water markets and the accompanying increased attention to water reform within the Murray-Darling Basin. First, 2002–2003 now stands on record as the worst drought in a century throughout most of the basin. This has made both urban and farm dwellers acutely aware of the need to manage water resources cautiously. Second, a group of “concerned scientists,” known as the Wentworth Group, attracted significant public attention with the release of their “Blueprint for a living continent” [*Wentworth Group of Concerned Scientists*, 2002]. In essence, the Wentworth Group advocates a wide range of measures for achieving environmental restoration, including an expanded national water market. Third, the MDBMC released its “living Murray” discussion paper in July 2002. This document is designed to “start community discussion about whether or not water should be recovered from water users for the environment” [*MDBMC*, 2002, p. 29] and proposes 350, 750, and 1500 GL as reference points. Invariably, this discussion has fueled, at times, fierce debate about the efficacy of environmental flows generally and, more specifically, appropriate institutional mechanisms for achieving them. The role of compensation to irrigators has been a particular theme of interest.

3. Status of Water Trade in the Murray-Darling Basin

[23] Inasmuch as there is current support for a basin-wide water market the influence of institutional history cannot be

ignored. One of the consequences of the institutional history described in sections 1 and 2 and the retention of water as a state property right has been the development of markedly different production regimes between states: Horticultural enterprises based on permanent planting are most common in South Australia and then Victoria, while opportunistic annual cropping dominates irrigation in New South Wales. An additional legacy of the differing initial water institutions has been the alternative arrangements that have been required to meet the original targets assigned by the COAG Water Reform Framework. The consequences for trade and the implications for each state’s ability to remain within the 1993–1994 cap also differ. Given that nearly all water trade to date has occurred on an intrastate basis, the legislative status of trade and irrigators’ water rights in each of the states and territories requires specific attention.

3.1. Legislative Status of Trade

3.1.1. New South Wales

[24] The Water Management Act 2000 is the central piece of legislation that governs water resource allocation in this state. One of the major differences between the present act and previous legislation is that it assigns the environment a prior right over consumptive uses. Irrigators are assigned a “share entitlement” that specifies the individual’s share or claim on available water and can be specified as being of either “high” or “general” (read “low”) security (as described in section 2). An “extraction” entitlement is also required to irrigate and controls the timing, rates, or other circumstances under which water is extracted. Both components can be owned and traded separately [*Dyson*, 2002] and independently of land with trades being considered as either temporary (<5 years) or permanent (>5 years). Irrigators that are shareholders of a bulk irrigation scheme may be subject to local rules that constrain some trades. Such rules have generally been invoked to mitigate third-party effects like stranded assets [see, e.g., *Cruse et al.*, 2000]. All licenses are subject to valley-based Water Management Plans which are reviewed every 10 years. Irrigators have no call on compensation when amendments emanate from a conventional adjustment to a plan but may claim compensation at other times or if rights are compulsorily acquired [*Cruse et al.*, 2000; *Dyson*, 2002].

3.1.2. Victoria

[25] Water use in Victoria lies within the scope of the Water Act 1989 and its most recent amendments embodied in the Water (Irrigation Farm Dams) Act 2002. By far, the most significant extractive use of water in Victoria occurs in irrigation districts that hold bulk entitlements. Water is assigned to the environment at the bulk entitlement level [*Tisdell et al.*, 2002]. Irrigators within these districts hold licenses that comprise “right” and “sales” components (as described in section 2). The right component cannot be altered within existing statutes without attracting compensation, but the sales component can be amended without compensation to ensure consistency with the cap or to meet other claims. Bulk entitlements can also be altered without compensation. Bulk entitlements can be traded by authorities, and irrigator’s water rights and licenses are all tradable on either a temporary or permanent basis. Trading rules are established through a combination of legislative and administrative arrangement and are specified in considerable

detail, nominating trading zones and boundaries, for instance [MDBMC, 2002].

3.1.3. South Australia

[26] In 1997, South Australia enacted its Water Resources Act. The act is based on a water planning hierarchy, ranging from the State Water Plan at the top to Catchment Water Management Plans and optional Local Water Management Plans at the bottom [Tan, 2002]. This planning framework applies special emphasis to environmental considerations, allows for the monitoring of environmental demands for water, and permits a reduction in consumptive use without compensation. These arrangements effectively cap extractive use [Dyson, 2002].

[27] Irrigation licenses are perpetual in South Australia, but allocations are clearly adaptable, either by intervention by the Minister as part of the allocation plans or via the 5 yearly review of plans. All water allocations in this state are transferable and can be held without attached land [MDBMC, 2002].

3.1.4. Queensland

[28] The Queensland Water Act was introduced in 2000 to provide a planning framework that endeavors to achieve the most appropriate use of water while minimizing potentially adverse social, economic, and environmental outcomes. Water Allocation and Management Plans have been developed to establish the balance between environmental, social, and economic demands, and these are executed through Resource Operation Plans [Tan, 2002].

[29] Entitlements to take water for consumptive purposes are defined in a water allocation which is separable from land and can be transferred within limits and rules set out in Resource Operation Plans [MDBMC, 2002]. Each water allocation defines a volumetric limit, the location of extraction, and the uses to which water can be applied. Existing water rights are being converted to water allocations and, in some instances, reduced without compensation in accordance with the pertinent Water Allocation and Management Plan. New water allocations can also be created under some Water Allocation and Management Plans [Tisdell et al., 2002].

3.1.5. Australian Capital Territory

[30] The Australian Capital Territory government agency with responsibility for water resources management is Environment ACT (within the Department of Urban Services). The Water Resources Act 1998 specifies the sequential process for managing water resources in the territory. This involves the implementation of a Water Resources Management Plan that has been developed under Environmental Flow Guidelines before any consumptive use allowances are made. These plans are made at the subcatchment level. The ACT Environmental Flow Guidelines recognize that the values that the community holds for different subcatchments vary and proffers four categories of aquatic ecosystems within the Guidelines (natural, modified, water supply, and created). Separate guidance is provided in relation to achieving the different management goals (reflecting different values) for each of these, and consequently, the level of allowable water extraction varies significantly between subcatchments [Environment ACT, 1999].

[31] The Water Resources Management Plan specifies an allocation provision (amounts for granting as new allocations) for each subcatchment for the period of the plan. Allocations are issued in perpetuity and can be specified as

either a volume, rate of flow, or share of the resource. The granting of a license to take water, however, is also required in order for the allocation holder to extract water. This license can stipulate where and how the water is taken and how it is used and may impose other conditions on the license holder.

[32] The Water Resources Act 1998 provides for the trading of water both within the Australian Capital Territory and interstate, but specific arrangements are not currently in place to accommodate either of these forms of trade. The act does not require that compensation be paid for changes in allocations.

3.2. Market Status of Trade

3.2.1. Intrastate Trade

[33] In line with the objects of the original COAG Framework, all states and territories in the Murray-Darling Basin have now enacted legislation that at least partially, specifies water property rights and, among other things, enables trade. However, the extent of actual trades on a permanent basis has been relatively modest. In New South Wales and Victoria, the states with the largest irrigation sectors and where arrangements for trade have the longest history, annual permanent trade of water is commonly of the order of <1% of entitlements per year. In contrast, temporary trade has grown significantly to represent as much as 10% of the total water access entitlements of both states [see, e.g., Department of Natural Resources and Environment (DNRE), 2001, p. 12; Crase et al., 2000, pp. 308–309]. A summary of the growth of temporary and permanent intrastate water trade in these states is provided in Figures 2a and 2b.

3.2.2. Interstate Trade

[34] In section 2 of this article we noted the arrangements under Schedule E of the Murray-Darling Basin Agreement that led to the establishment of the interstate pilot water-trading project. Recent data on permanent trade of water in the pilot zone reveal that ~13.7 GL had been traded by June 2001, mostly to South Australia [DNRE, 2001, p. 68]. Between 1997 and 1998 and 2000 and 2001, temporary interstate trade exceeded 50 GL. In both instances this suggests that the attention to the issue of interstate trade has been disproportionate to the actual volume of trade.

4. Water Markets and Their Performance in the Murray-Darling Basin

[35] Having examined the considerable efforts of legislators to create tradable water entitlements and a viable water market in the Murray-Darling Basin, it is now propitious to briefly review the theoretical foundation of these initiatives in the context of the problems confronting the basin.

4.1. Productive Case for the Water Market

[36] From a productive perspective the case for establishing a water market in which rights are nonattenuated is, at least theoretically, compelling. First, the often-cited benefits of the water market itself include enticements to move the resource to its highest-value use, the incentive to adopt water-saving technologies, encouragement for retiring degraded lands, and even the capacity to reduce rural poverty [Rosegrant et al., 1995; Doolan and Fitzpatrick, 1995].

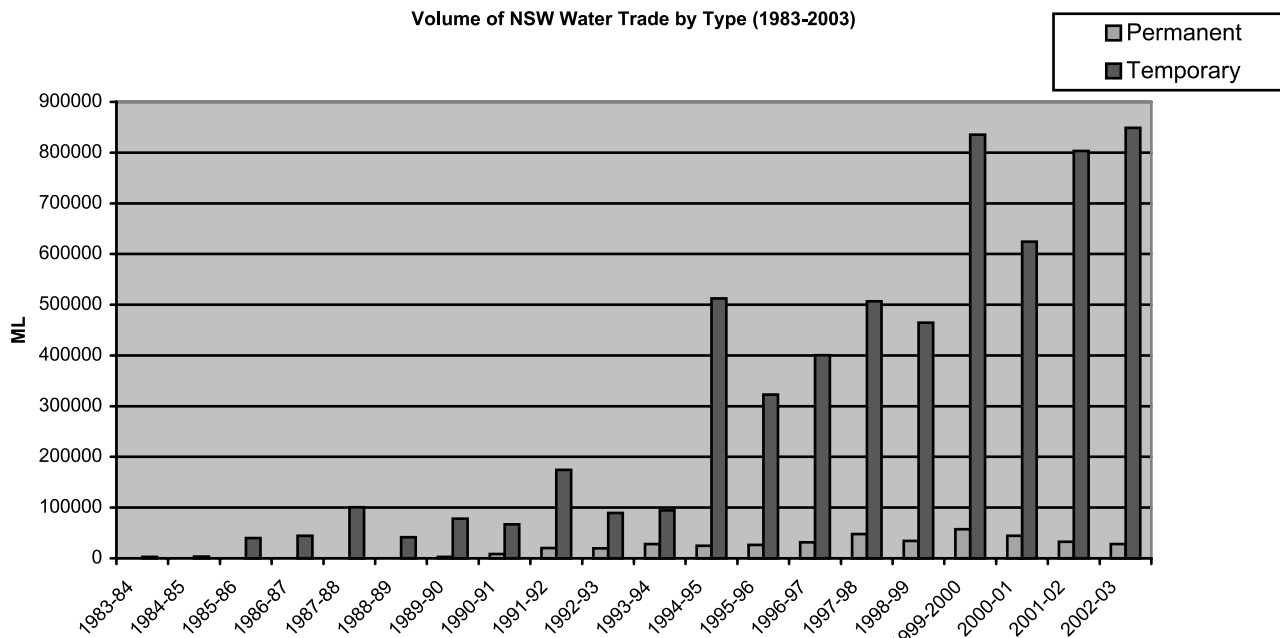


Figure 2a. Permanent and temporary water trade in New South Wales. Note that some trades for the Barwon Region are not yet recorded by State Water. (From D. Barnes, NSW State Water, personal communication, 2003).

Second, there is ample literature to attest that a prerequisite for an efficient water market is the nonattenuation of property rights for potential traders [Pigram and Musgrave, 1989; Crase et al., 2000; Dudley, 1990]. Third, the data on existing trades in Australia provide convincing support for some of these arguments. In Victoria, for instance, permanent trade has resulted in a contraction of low-return irrigated grazing enterprises and a commensurate expansion of higher-valued dairying and horticultural enterprises [DNRE, 2001, p. 13]. Similarly, Young et al. [2000, p. 3]

concluded in their review of interstate water trade that trading had unequivocally raised the value of water use, and the High Level Steering Group on Water [2001] observed that “the impact of water trading for Australia’s regional economies is strongly positive.” Perhaps it is these types of outcomes that have resulted in Australia being assigned the status of an international icon of water reform. More specifically, Australia has been recently described as “the country that takes top prize for sensible water management” [The Economist, 2003].

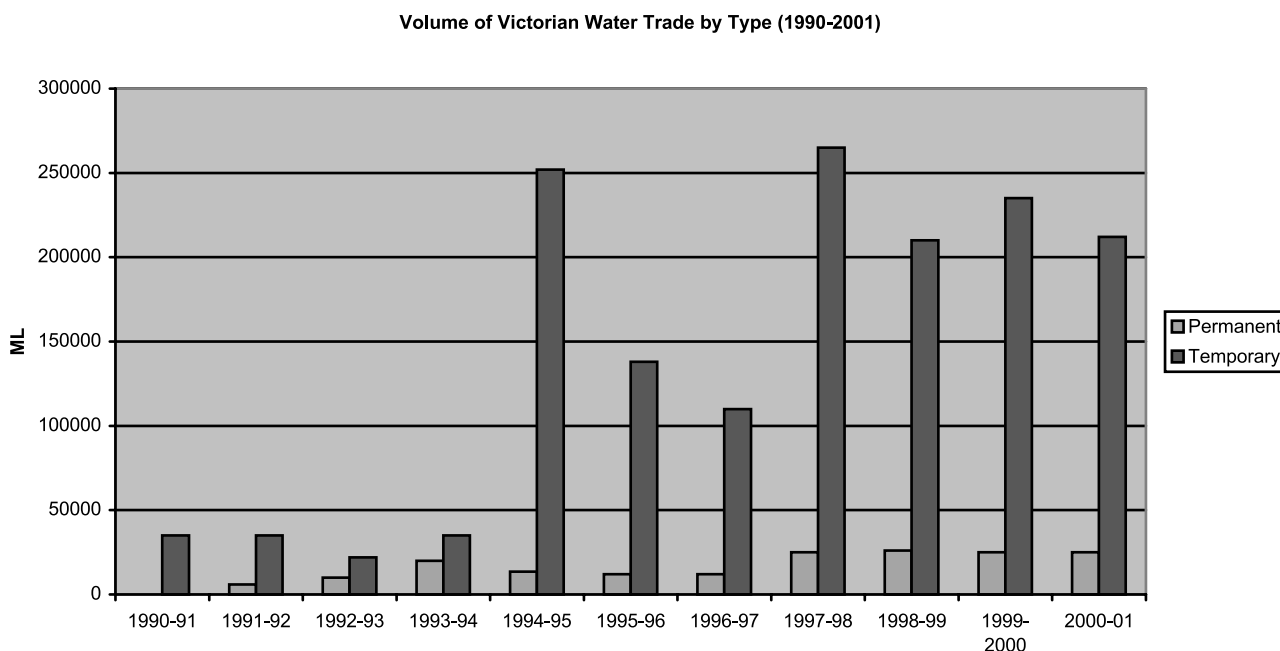


Figure 2b. Permanent and temporary water trade in Victoria (from DNRE [2001]).

[37] However, in spite of the publicized successes of the water market and the accompanying attempts to reduce the attenuation of water rights, there remains cause for some skepticism from a productive perspective. As we observed in section 3, the majority of trade continues to be on a temporary rather than permanent basis. This is of concern for two reasons. First, permanent trade is likely to be the primary vehicle for achieving the scale of structural change that will deliver significant water efficiency benefits in the basin. Permanent trade is “the key to new development” [DNRE, 2001, p. 15], and “. . . very few irrigators will make investments in more efficient irrigation and drainage or permanent high value crops without the long term security of water” [Bjornlund and McKay, 2001, p. 75]. Accordingly, the relative magnitude of temporary versus permanent trade provides grounds for qualifying the longer-term productive benefits of trade. Second, the growth of the temporary market might arguably slow the exit of less efficient water users. Assured of an income stream from leasing excess entitlements, inefficient irrigators might well continue to remain in production, particularly in light of the rising capital value of water entitlements in the permanent market.

[38] The divergent growth of the two markets has been speculatively attributed to such factors as differential transfer and transaction costs, unclear or poorly defined property rights for permanent water, variable supply, infrastructure impediments, hoarding behavior and speculation, and cultural or sociological attributes that limit participation in the permanent market [Cruse et al., 2000]. However, an alternative interpretation is that irrigators simply cannot afford the up-front costs of purchasing permanent water, particularly when the taxation incentives favor temporary trade [DNRE, 2001, pp. 15–16]. The attenuation of water property rights has been repeatedly cited by policy makers and irrigators as the major barrier to farmers undertaking additional investments in efficient water saving technologies [see, e.g., Cullen, 2002]. However, if the relative underdevelopment of the permanent water market is indicative of a lack of financial resources to undertake any investment, this argument is significantly weakened. Put simply, it is hard to see how accompanying on-farm investments will be encouraged by the issuing of perpetual rights if there is insufficient funds to pay for the water. Arguably, the sale of a portion of rights would yield some funds to undertake water-saving investments. However, the contingent data collected by Cruse et al. [2002] revealed a reluctance on the part of sellers to employ this strategy: sellers were only interested in exiting agriculture altogether. In addition, this would still not resolve the small number of buyers willing to make offers that reach the reservation price of sellers.

[39] Further, there is evidence that actual trade may not significantly change as a result of strengthening rights. Contingent data collected and analyzed by Cruse et al. [2002, 2003] revealed that reducing uncertainty about water rights would invariably increase the demand for entitlements, thereby raising the bids for water and that suppliers of permanent water were primarily motivated by price. However, extrapolating these data to the water market per se was likely to realize only a modest increase in the surplus generated by the water market. In essence, this is a function of the low price elasticity of supply for permanent water and the relatively modest increase in offers from potential

buyers. Again, these results cast some doubts over claims that further strengthening of water rights will give rise to significantly expanded production benefits in the basin.

[40] The concept of higher-value use and the time frame for measuring efficient, sustainable production have received only cursory attention in most assessments of the impact of the market to date. However, it is worth noting that throughout New South Wales in 1998–1999 more than half of the water sold (both temporary and permanent) was purchased for rice production (M. Isaac, To market, to market—Why dogma hasn’t worked with water, 2002, available at http://www.brisinst.org.au/resources/brisbane_institute_isaac_water.html), which is commonly portrayed as a low-value crop in the basin [see, e.g., MDBMC, 2002]. The motivations for this type of trade can be traced to the accompanying infrastructure and longer payback period required for investments in alternatives, like grapes and intensive horticulture. Thus, within the existing constraints faced by many farmers, rice is clearly a high-value crop, despite its presentation to the wider community as being otherwise. Moreover, if the institutional history of the rice-growing regions of New South Wales had been more akin to the subsidized development of horticulture in other states, these circumstances might be very different. It is difficult to see how further strengthening water rights will either alter the existing behavior of these irrigators or address efficiency and equity concerns arising from institutional history.

4.2. Environmental Case for the Water Market

[41] There are also theoretically compelling environmental grounds for supporting further reform that includes a water market with nonattenuated rights. The market model has been proffered as a remedy for a wide range of environmental ills experienced in the basin [Jones and Fagan, 1996; Doolan and Fitzpatrick, 1995; Industry Commission, 1992]. Some of these arguments arise from synergies between the environmental goals and the individual farmer’s incentives to undertake efficient on-farm production. For instance, it is presumed that water efficiency delivers both a production dividend to irrigators and environmental externalities like reduced water logging, retirement of degraded land, cessation of rising water tables, and the like.

[42] Equally impressive is the argument that trade in a market setting on behalf of the environment can be used to address environmental objectives. For instance, Young and McColl [2003, p. 229] argue that an independent environmental trust of water entitlements, when combined with a functioning water market, could provide a dynamic water management option. By selling water in drought years and buying it back in wet years the trust would simultaneously raise revenue for environmental restoration and assist in equating the marginal benefits of water from different uses over time.

[43] However, there are a number of features of the trade in the basin and of the mechanisms that circumscribe that trade that caution against excessive zeal for the market paradigm in this context. First, much of the water that has been traded to date is sleeper (never activated) or dozer (partially or intermittently activated) water entitlement. The effect of this and the accompanying interpretation of sleeper and dozer entitlements as being superior rights to some

other users has been twofold. In a productive sense, assigning such rights higher status than “weaker” irrigation entitlements with a history of use has effectively redistributed access to less productive users (assuming that the resources idleness is indicative of its productive value) [Quiggin, 2001, p. 87]. Moreover, once activated by trade, this water now stands to undermine the cap and the accompanying environmental benefits of attempting to halt extractive use at 1993–1994 levels. The issue of activated sleeper and dozer entitlements has received insufficient attention from some of those proclaiming the benefits of trade and advocating its expansion. For instance, the “unequivocal” conclusion of *Young et al.* [2000] that interstate trade had moved water to higher-value uses gives only scant regard to the fact that 99% of the water traded was previously unused.

[44] A second related environmental problem arises from the emerging trading patterns within the basin. While there is widespread evidence of water generally moving to higher-value uses (albeit within a relatively narrow definition of value), there are some instances where the environmental impacts have been clearly negative. This has arisen because trading water to higher-value areas does not guarantee a coincidence of sustainable irrigation or that the new point of extraction will necessarily improve river health. Again, the unequivocal conclusion of *Young et al.* [2000, p. 3] that water in the interstate pilot project had moved to higher value uses must be considered against their own concession that “in the long run, inter-state trading can be expected to have a negative impact on river salinity.”

[45] In addition to the history of basin trade pointing to the need for caution, there are several general caveats that warrant consideration in the context of the environmental impacts of non-attenuated water rights and the role of water markets. Earlier we acknowledged that stronger property rights and a functioning market could potentially be used by an environmental trust to secure water for the environment. There is nothing new about these proposals nor the convincing logic of using the market to regain water from consumptive users. Lower-value users will always have a greater disposition to sell than higher-value users, all else being equal. However, all of these benefits are contingent on the will of governments to draw upon the public purse to achieve environmental ends. Thus, further efficiency gains from a production perspective have to be considered against the potential for the state to inefficiently allocate resources and effort to achieve environmental objectives. In addition, as *Challen* [2000] observed, there may be significant intertemporal costs if the state tries to regain such rights after they have been devolved to individual irrigators.

[46] The supposition that on-farm efficiency is synonymous with returning water for environmental amenity also requires qualification. Water use efficiency may also deprive systems of return flows, and unless institutional mechanisms are in place to ascribe saved water to the environment, amenity improvements cannot be guaranteed.

[47] Finally, the assignment of risks encapsulated in the COAG communiqué raises general concern from the perspective of the environmental health of the Murray-Darling Basin and the role played by markets to achieve environmental ends. In section 2 we noted that the proposed framework for entitlements will assign risks arising from climate change, drought, and new knowledge about the

extractive capacity of water systems to irrigators. However, governments are to be required to bear risks arising from altered government policy that impacts on extractive users. Notwithstanding the challenge of defining the dichotomy between the two genres of risks, the strengthening of water rights in this way raises significant public policy dilemmas. The proposed strengthening of rights in this manner might be regarded as analogous to compensating the tobacco industry for amendments to government policy aimed at reducing smoking. Moreover, the mounting scientific knowledge pointing to the dangers of tobacco consumption appears to have had little impact on the industry itself. The states’ intervention to counter the ills of tobacco consumption may have been less resolute had the government been required to pay for enhancing the public good. Similarly, public intervention to ensure the environmental health of rivers may be less steadfast in these circumstances.

5. Concluding Remarks

[48] The initial COAG reforms to the Australian water sector have made significant progress toward altering the way Australians view and use water resources. This has been reinforced by recent serious drought, a myriad of institutional changes at the state and basin level, and unprecedented publicity of water-related issues. Undoubtedly, the driving force for much of this discourse has been the deleterious environmental impacts of excessive extractions by consumptive users, particularly for irrigation.

[49] The acknowledged achievements of water trade and enhancements in the definition of property rights emanating from the first series of COAG reforms appear to have spurred even greater enthusiasm for the role of markets in allocating resources across the Murray-Darling Basin. Trade in water entitlements has grown steadily throughout most of the reform period, albeit mostly in the form of temporary trade. There is also substantial evidence that trade has ostensibly moved water to higher value uses, notwithstanding the relatively narrow definition of production.

[50] However, the successes of trade must be considered in the context of significant environmental issues which, paradoxically, were the genesis for much of the interest in water rights and water trade. Much of the water trade to date has been in sleeper and dozer entitlements that have been activated by the market mechanism. Water destinations have not always coincided with sustainable production or preferred environmental outcomes. There is also some cause for skepticism about the capacity of the state to “efficiently intervene” in the market on behalf of the citizenry who may be seeking environmental enhancements.

[51] Perhaps of greatest concern is the mounting support for even stronger property rights for entitlement holders. The property right amendments proffered as part of COAG Mk II raise serious public policy concerns, particularly against a background of incomplete knowledge of riverine ecosystems and the potential for future demands for environmental flows. More generally, the supposition that assigning stronger property rights will lead to less environmental degradation may itself be flawed. As *Gleeson* [2003, p. 1] observes, “For over two centuries Australian agriculture has operated within institutional arrangements that have defined land rights and enabled market-based transfer of

those rights. Over the same period we have extensively degraded our land resource. However, this has not deterred the Wentworth Group and others from the notion that applying similar arrangements to water will markedly improve the environmental impacts of how we use water.”

[52] In the context of these concerns, a more circumspect approach to water property rights is advocated. Much of the legislation developed and being implemented at the state level already provides assignment of risks and scope to adjust entitlements in line with environmental demands. The extent of intrastate trade stands as testament to the capacity of irrigators to continue to trade within these constraints and, as irrigators and communities adjust to the water sharing arrangements in each state, trade and efficiency may well improve. Moves to strengthen irrigators rights and enthusiasm for the development of a national water market at this time appear overly zealous. International observers and commentators might do well to reserve judgment on the efficacy of the Australian water reforms until sufficient trade data is available to attest the benefits of reform.

References

- Bjornlund, H., and J. McKay (2001), Australian water market policies: Current issues and future directions, *Water J. Aust. Water Assoc.*, 28(2), 74–78.
- Campbell, K. (1980), *Australian Agriculture: Reconciling Change and Tradition*, Longman Cheshire, Melbourne, Australia.
- Challen, R. (2000), *Institutions, Transaction Costs, and Environmental Policy: Institutional Reform for Water Resources*, Edward Elgar, Northampton, Mass.
- Clark, S. (1971), The River Murray question: part 1—Colonial days, *Melbourne Univ. Law Rev.*, 8, 11–40.
- Cruse, L., L. O’Reilly, and B. Dollery (2000), Water markets as a vehicle for water reform: The case of New South Wales, *Aust. J. Agric. Resour. Econ.*, 44(2), 128, 299–322.
- Cruse, L., B. Dollery, and M. Lockwood (2002), Transaction costs emanating from policy flexibility in water markets, in *Water Policy Reform: Lessons from Asia and Australia*, edited by D. Brennan, pp. 31–47, Aust. Cent. for Int. Agric. Res., Canberra.
- Cruse, L., B. Dollery, and M. Lockwood (2003), Water down property rights for the sake of the environment: A consideration of the environmental benefits of attenuated water rights in New South Wales, *Aust. J. Environ. Manage.*, 10(1), 25–34.
- Cullen, P. (2002), The Australian water experience: Some ways forward, paper presented at 3rd Rosenberg International Forum on Water Policy, Univ. of Calif., Canberra.
- Davidson, B. (1969), *Australia Wet or Dry? The Physical and Economic Limits to the Expansion of Agriculture*, Melbourne Univ. Press, Melbourne, Australia.
- Department of Land and Water Conservation, New South Wales (1997), Water audit—Implementation of the diversion cap in NSW, report, Murray-Darling Basin Minist. Council, Canberra.
- Department of Natural Resources and Environment (DNRE) (2001), The value of water: A guide to water trading in Victoria, report, Melbourne.
- Doolan, J., and C. Fitzpatrick (1995), Protecting our rivers through property rights and water trading, paper presented at National Agricultural and Resource Outlook Conference, Aust. Bur. of Agric. and Resour. Econ. (ABARE), Canberra.
- Dudley, N. (1990), Alternative institutional arrangements for water supply probabilities and transfers, in *Transferability of Water Entitlements*, edited by J. Pigram and B. Hooper, pp. 103–120, Cent. for Water Policy Res., Armidale, Australia.
- Dyson, M. (2002), Research report on using existing legislation to recover and protect environmental flows in the River Murray, Murray-Darling Basin Comm., Canberra.
- Edwards, G. (2003), Water policy: Setting the scene, *Aust. Econ. Rev.*, 36(2), 193–202.
- Environment ACT (1999), Environmental flow guidelines, administrative document, ACT Gov., Canberra, May.
- Freebairn, J. (2003), Principles for the allocation of scarce water, *Aust. Econ. Rev.*, 36(2), 203–212.
- Gleeson, T. (2003), Have the scientists got it right this time?, *Connections Farm Food Resour. Issues*, 3(1), 1–3.
- Green, C. (2003), *Handbook of Water Economics Principles and Practices*, John Wiley, Hoboken, N. J.
- High Level Steering Group on Water (2001), A national approach to water trading, report, Murray-Darling Minist. Council, Canberra.
- Industry Commission (1992), *Water Resources and Waste Water Disposal*, Aust. Gov. Print. Serv., Canberra.
- Jones, R., and M. Fagan (1996), Estimated demand and supply for irrigation water in southern NSW, paper presented at the 40th Annual Conference, Aust. Agric. and Resour. Econ. Soc., Melbourne.
- Madden, B., G. Hayes, and K. Duggan (2000), National Investment in Rural Landscapes: An Investment Scenario for NFF and ACF with the Assistance of LWRRDC, report, Virtual Consul. Group, Albury, Australia.
- Mostert, E., E. van Beck, N. Bouman, E. Hey, H. Savenije, and W. Thissen (1999), River basin management and planning, paper presented at International Workshop on River Basin Management, Delft Univ. of Technol., The Hague, Netherlands.
- Murray Catchment Board (2003), Murray catchment blueprint, Dept. of Land and Water Conserv. (DLWC), Albury, Australia.
- Murray-Darling Basin Commission (2000), A brief history of the Murray-Darling Basin Agreement, report, Canberra. (Available at http://www.mdbc.gov.au/about/governance/agreement_history.htm)
- Murray-Darling Basin Ministerial Council (2000), The salinity audit of the Murray-Darling Basin: A 100-year perspective, report, Murray-Darling Basin Comm., Canberra. (Available at http://publications.mdbc.gov.au/view_details.php?id=204&MDBCPublications_Session=f49fc599b8db5fe65a509b929db3fee)
- Murray-Darling Basin Ministerial Council (2001), Vision statement for water trading, Murray-Darling Basin Comm., Canberra.
- Murray-Darling Basin Ministerial Council (2002), The living Murray: A discussion paper on restoring the health of the River Murray, report, Murray-Darling Basin Comm., Canberra. (Available at <http://www.ncc.gov.au/publication.asp?publicationID=167&activityID=30>)
- National Competition Council (2003), Water: National Competition policy assessment of water, report, Canberra.
- Pigram, J., and W. Musgrave (1989), Transferability of water entitlements in Australia, paper presented at the Annual Meeting, Univ. Council. on Water Resour., Minneapolis, Minn.
- Quiggin, J. (2001), Environmental economics and the Murray-Darling River system, *Aust. J. Agric. Resour. Econ.*, 45(1), 128, 67–94.
- Randall, A. (1981), Property entitlements and pricing policies for a mature water economy, *Aust. J. Agric. Econ.*, 25(3), 128, 195–220.
- Rosegrant, M., R. Gazmuri, and S. Yadav (1995), Water policy for efficient agricultural diversification: Market-based approaches, *Food Policy*, 20(3), 337, 203–223.
- Tan, P. (2002), Legal issues relating to water use, *Issues Pap. 1*, Murray-Darling Basin Comm., Canberra.
- The Economist (2003), Survey: Liquid assets, 368(8333), 13.
- Tisdell, J., J. Ward, and T. Gradzinski (2002), The development of water reform in Australia, *Tech. Rep. 02/5*, CRC for Catchment Hydrol., Melbourne, Aust.
- Watson, A. (2003), Approaches to increasing river flows, *Aust. Econ. Rev.*, 36(2), 213–224.
- Wentworth Group of Concerned Scientists (2002), Blueprint for a living continent: A way forward from the Wentworth Group of Concerned Scientists, report, World Wide Fund for Nature, Sydney.
- Wright, D. (1978), The River Murray: Microcosm of Australian federal history, in *Federalism in Canada and Australia*, edited by B. Hodgins, pp. 277–286, ANU Press, Canberra.
- Young, M., and J. McColl (2003), Robust reform: The case for a new water entitlement system for Australia, *Aust. Econ. Rev.*, 36(2), 225–234.
- Young, M., D. H. MacDonald, R. Stinger, and H. Bjornlund (2000), Interstate water trading: A two year review, report, CSIRO Land and Water, Canberra.

L. Crase, School of Business, La Trobe University, Albury-Wodonga Campus, PO Box 821, Wodonga, Victoria 3690, Australia. (l.crase@aw.latrobe.edu.au)

B. Dollery, Economics Department, University of New England, Armidale, New South Wales 2351, Australia. (bdollery@metz.une.edu.au)

P. Pagan, Centre for Resource and Environmental Studies, Australian National University, Canberra, ACT 0200, Australia. (pagan@cres20.anu.edu.au)