Delivery charges for water

Their impact on interregional trade in water rights

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The low levels of interregional trade in water entitlements in the Murray Darling Basin suggest that some irrigation authorities may restrict out of scheme trade.

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One reason an authority may want to retain water within an irrigation system is to protect itself against the prospect of stranded assets. The risk of stranded assets could be minimised by using a multipart tariff that directly contracted the capital costs of water delivery to irrigators. If trade barriers designed to avoid stranded assets were then removed, the transfer of water to higher value uses would be facilitated.

Introduction

In 1994 the Council of Australian Governments (COAG) endorsed a set of guidelines for reforming the management of Australia's water resources. Within this forum, trade in water entitlements was identified as the key mechanism for maximising the contribution of water to national income. A well designed water market can be a mechanism for facilitating the transfer of water to higher value uses, thereby increasing the allocative efficiency of water use.

Since 1994 there has been a dramatic increase in trade in water entitlements. In 1995 the Murray Darling Basin Ministerial Council decided to introduce a cap on diversions from the basin. The aim was to achieve a balance between environmental and consumptive uses. Prior to the cap there was little incentive to trade since increased demands for water were largely met administratively through increased allocations to irrigators. The cap effectively limited entitlement holders' access to water, forcing them to meet any increases in demand through trade.

Despite the recent increase in water trade, most of this trade has been in temporary entitlements and within local valleys. The low levels of intervalley and interstate trade suggest that there may be some impediments to trading water outside of local valleys. Constraints on trade have the potential to significantly reduce the economic benefits from water use.

Outline

Following a brief review of the extent of trade in water entitlements, and some of the

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constraints placed on trade, is an analysis of a water delivery pricing option that has the potential to significantly free up the trading environment.

Multipart tariff and contracts

A multipart tariff with the capital costs of delivery directly contracted to irrigators is assessed. Such a scheme would significantly reduce the financial risk of irrigation authorities being left with stranded assets. This reduced risk should in turn minimise opposition to the removal of trade barriers that are designed to protect authorities against stranded assets, thereby facilitating the transfer of water to higher value uses.

In addition, contracts can act as a guide for investment, with investments proceeding only when irrigators believe that the higher net irrigation benefits flowing from the investment will cover the cost of the investment.

The importance of using contracts to guide future investments should not be underestimated given that several billion dollars worth of irrigation infrastructure is nearing the end of its effective life, and will need to be considered for refurbishment in the near future.

Trade in water entitlements

While markets for temporary and permanent water entitlements have existed in parts of the Murray Darling Basin since the early 1980s, these markets were fairly inactive until recently. In 1994 the states committed to instituting trading arrangements by 1998 in regions where they did not already exist. This commitment formed part of the COAG agreement on water reform, and was in recognition of the role that trade can play in generating greater economic benefits from water use. The states also relaxed the rules governing trade (trade was initially confined within irrigation systems) to allow intervalley and interstate trade in entitlements.

In 1998-99 almost 11 000 gigalitres of water were diverted for irrigation within the Murray Darling Basin (MDBC 2000). Of the volume diverted for irrigation, around 855 gigalitres, or 8 per cent, was traded. Of the volume traded, almost 90 per cent comprised trade in temporary entitlements, with trade in permanent entitlements accounting for the remainder.

Perhaps more illustrative for the purpose of this article, of the 855 gigalitres traded, more than 90 per cent was traded *within* valleys. Intervalley trade within states comprised a mere 6 per cent of trade, with interstate trade accounting for less than 3 per cent.

Of total diversions for irrigation, intervalley and interstate trade (from here on referred to as interregional trade) accounted for less than 1 per cent.

The low level of interregional trade may have been caused by a number of factors.

First, the difference in the net marginal benefits earned by irrigators in different valleys may be insufficient to encourage trade, or the transaction costs associated with interregional trade may be excessive. ('Net marginal benefit' refers to the benefit earned by an irrigator from the use of an extra megalitre of water *less* all costs associated with using that megalitre of water, including the cost of delivery.)

Moreover, in regions where trade has only recently been introduced, irrigation authorities may be grappling with the implementation of the new operational rules, and therefore concentrating initially on the development of an effective local market.

Some irrigators may also be reticent to purchase permanent water because they are uncertain about the size of future entitlements. This may be the case where environmental flows are yet to be determined, and there is a risk that governments will reduce future irrigation entitlements without compensation in order to source these flows.

Interregional trade may also not occur owing to physical constraints or constraints imposed by irrigation authorities for the reasons explained below. For example, in some years it may not be physically possible to trade water from the upper Goulburn Broken to the upper Namoi.

While it is difficult to comment on the degree to which these factors constrain trade, it is clear that physical constraints preclude trade between some regions, while in other regions where interregional trade is physically possible, irrigation authorities may actively constrain trade outside the scheme.

Trade restrictions

Currently, irrigation authorities impose a raft of restrictions on interregional trade in water entitlements. For example, the Murrumbidgee, Jemalong and Trangie Nevertire irrigation schemes prohibit permanent out of scheme trade, whereas Murray Irrigation prohibits permanent out of scheme trade once the bulk entitlement (that provides irrigation authorities with specified rights and entitlements to water) falls below a certain level (Marsden Jacob Associates 1999). In Victoria, water authorities can refuse permanent out of area transfers if annual net transfers out of an area exceed 2 per cent of the water rights in that area (Brinsley et al. 2000).

These blanket restrictions on trade suggest that constraints have not been imposed to improve the efficiency of resource use, as may be the case, for example, if out of scheme trade exacerbated environmental problems such as salinity in recipient regions or led to higher conveyance losses. Rather, it appears that many of these restrictions have been imposed to retain water within an irrigation system.

Two major reasons why an irrigation authority may want to retain water within a system include the need to protect itself against the prospect of stranded assets, or to maintain the economic viability of the region in which it operates.

The use of a water delivery pricing policy that minimises the potential for stranded assets is the focus in this article, while the reduced economic viability of regions that lose irrigation water is better dealt with directly through structural adjustment packages.

Stranded assets

The term 'stranded assets' refers to a situation where an irrigation authority is stuck with large fixed infrastructure costs and no customers (see box 1 for examples of some of the infrastructure required for irrigation). Such a situation may arise when economic circumstances change or where an inappropriate charging regime is used to collect the costs of delivering water.

Where economic circumstances change and cause the net benefits (both private and social) from irrigation to fall in a particular region — say because of worsening environmental problems associated with water use or a decline in demand for the irrigated produce of the region relative to that from other regions — the closing down of an irrigation system may be the socially optimal response.

As an example, consider two regions connected by a common river. Both regions initially irrigate pasture. However, it is discovered that with recent genetic improvements in viticulture, region A is ideally suited to growing grapes (this is not a viable option for region B because of inappropriate soil type). If the difference in the net marginal benefits from viticulture and pasture are such that all water is traded out of region B, then closing down the region B system (and expanding region A) may be the socially optimal response in that it maximises the benefits from the limited water resource.

The use of infrastructure is inefficient where stranded assets result from a pricing policy that causes irrigators to cease using infrastructure earlier than would otherwise have occurred. Such a pricing regime would be one that allowed irrigators leaving an irrigation system to impose higher delivery charges on irrigators remaining in a system. As irrigation delivery is dominated by fixed costs, these higher charges may result from the fixed costs of delivery being spread over fewer irrigators (for more detail see Goesch 2001). These higher charges may in turn lead

1 Investing in irrigation delivery services

The irrigation delivery service industry requires large fixed investments. Supplying water to irrigators involves the construction of dams and weirs to store and control the flow of water, and channels to divert water from rivers to individual irrigators. Where there is excessive seepage, authorities may also need to line channels with concrete or plastic, or construct pipelines. Other infrastructure, such as pumping equipment, is also required.

to other irrigators trading their water out of the system.

If the cycle continues, it could lead to a situation where delivery charges were so high that they were beyond the financial capacity of those remaining in the system, leaving the irrigation authority with large fixed costs and no customers.

Cost of delivering irrigation water

The cost of delivering water to irrigators comprises both fixed and variable costs. The fixed costs of delivery include capital and other overhead costs that do not vary with the volume of water delivered. Variable costs, on the other hand, do vary with the volume of water delivered. The irrigation industry tends to be dominated by fixed costs, with variable costs comprising a relatively small component of total delivery costs.

Natural monopoly

The provision of distribution services for irrigation water is often a natural monopoly. A key feature of a natural monopoly is that the average cost of supplying a good or service increases with the number of providers. This can occur because large fixed investments in infrastructure are required by each provider in a region (box 1).

That is, the cost of delivery of irrigation water by a single provider will be lower than the combined costs of multiple providers, each with its own delivery infrastructure. It is therefore more efficient to have only one water distribution system in a geographic area (Watson 1995).

Efficient pricing of irrigation delivery services

In an irrigation system where trade can occur between regions and in the absence of transaction costs and externalities, the net benefits of water use will be maximised where the marginal benefits from irrigation are equal to the marginal cost of delivering water ***plus*** the traded price of water at the source (otherwise known as the opportunity cost of water use). In this instance, 'marginal benefit' refers to the benefit earned from the last megalitre of water delivered less all costs directly associated with the use of that water (for example, the cost of extra seed and fertiliser associated with the use of that extra megalitre of water), excluding the cost of delivery (marginal delivery cost) and the traded price of water.

Under these circumstances there will be no further opportunities to increase the net benefits from water use through trade. Hence, the use of marginal cost pricing for irrigation delivery services is critical to maximising the benefits from water use and the use of delivery services.

For an existing water delivery system, however, the marginal cost of water delivery does not include the capital and overhead costs of delivery. For a natural monopoly, such as a single provider of irrigation delivery services, the setting of charges equal to marginal cost would result in a revenue deficiency as variable costs form a small component of total costs.

Recouping the deficit

There are several options available to irrigation authorities to recover the full cost of delivering water. These include using either variable or fixed fees, or a combination of the two (box 2). The ideal fee would be one that allowed irrigation authorities to recover the full cost of delivering water while facilitating the transfer of water to higher value uses.

Average cost pricing

It is possible for a delivery utility to recover the full costs of delivery by combining its fixed and variable costs into a single charge. This pricing strategy is known as average cost pricing. The problem with average cost pricing is that it can lead to the underuse or inefficient use of irrigation infrastructure, while exposing an irrigation authority to the possibility of stranded assets.

Delivery charges set higher than marginal cost (as is the case with average cost pricing for a natural monopoly) will result in too little irrigation as farmers who cannot meet average costs but can meet marginal costs will choose not to irrigate (Freebairn 1998).

2 Irrigation delivery charge reforms

In 1994 COAG endorsed the full cost recovery of irrigation delivery services by 2001. The state governments and regional water authorities responded by altering both the structure and level of water delivery charges. The table below contains a breakdown of the structure and level of water delivery charges for some irrigation districts within the Murray Darling Basin.

The typical fee structure for delivery services tends to be a small fixed fee to cover office administration, an allocation fee based on 100 per cent of an irrigator's allocation and a volumetric fee based on consumption. Given that irrigation delivery services are highly capital intensive, it is likely that the volumetric fees charged by many irrigation authorities include not only costs directly associated with the volume of water delivered in a season, but also a significant share of the capital and overhead costs of delivery.

Examples of the structure and levels of water delivery charges in the Murray Darling Basin, 2000-01 irrigation season

St George Irrigation Area, Queensland

	Water from a channel	Water from Beardmore Dam or regulated section of the Balonne River
Fixed charges		
Annual account fee	$366	$183
Allocation charge	$15/ML **a**	$7.28/ML **a**
Volumetric charges		
Use up to announced allocation	$9.50/ML	$6.20/ML

Murrumbidgee Region, New South Wales

		Yanco and Mirrool Irrigation Areas	Benerembah, Tabbita and Wah Wah Irrigation Districst
Fixed charges			
Administration/service fee		$285	$285
Asset replacement fee on outlets		$10 per pipe or door $50 per small wheel $65 per large wheel	$10 per pipe or door $65 per large wheel $65 per large wheel
Allocation fee		$3.47/ML **b**	$3.47/ML **b**
Asset replacement levy		$1.78/ML **b**	$1.78/ML **b**
Volumetric charges			
Use charge based on total large area water sales — for example:			
Sales	650 000 ML	$13.02/ML	$8.72/ML
	750 000 ML	$11.43/ML	$7.62/ML
	820 000 ML	$10.05/ML	$7.03/ML

Shepparton Irrigation Area, Victoria

Fixed charges	
Water right (charged on size of water right held regardless of use)	$24.02/ML
Volumetric charges	
Use in excess of water right (sales water)	$24.02/ML

Central Irrigation Trust Districts, South Australia

	Berri, Chaffey (Ral Ral), Cobdoglah, Kingston, Moorook, Waikerie Irrigation Trusts (low pressure systems)
Fixed charges	
Irrigation access charge	$5.12/ML $308 minimum charge **c**
Catchment environment levy	$3.50/ML **c**
Rehabilitation contribution	$9.20/ML **c**
Volumetric charges	
Use up to allocation	$34.00/ML
Use between 100 and 120 per cent of allocation	$68.00/ML
Use above 120 per cent of allocation	$136.00/ML

a Based on 100 per cent of allocation. **b** Allocation fee and asset replacement levy based on the greater of 100 per cent volumetric allocation and actual usage. **c** Based on 100 per cent of allocation.

Moreover, if irrigation authorities seek to recoup delivery costs through average cost pricing, and there are regional differences in the mix of fixed and variable costs of delivery, then the regional pattern of water use may be inefficient. For example, if the marginal cost of delivering water and irrigators' willingness to pay for water are identical in two regions, but there are significantly higher fixed costs in one region, then average cost pricing will result in less water being used in that region than in the region with lower fixed costs. If marginal cost pricing had been used, the level of water use in each region would have been the same.

Average cost pricing can also leave an irrigation authority exposed to the financial risk associated with stranded assets. This can occur when all costs are recouped using a fee based on the actual quantity of water delivered. Under this arrangement, if irrigators trade their water out of a region they are no longer liable to pay the fee. As a result, the fixed costs of delivery will have to be spread over fewer irrigators, with the authority having to raise the volumetric fee for those remaining in the system.

Multipart tariffs

One option for meeting the revenue deficiency generated by pricing at marginal cost is to adopt a multipart tariff. Multipart pricing involves the use of a fixed charge, together with a variable charge based on consumption. The variable charge is set equal to the marginal cost of delivery while each irrigator is charged a separate fee, not related to water use, to cover the fixed costs of delivery.

By maintaining the features of marginal cost pricing, a multipart tariff provides the opportunity to maximise the economic benefits from using irrigation delivery services while maintaining the viability of the service provider by allowing the provider to recoup any fixed costs through a fixed fee.

The method of collecting the capital component of the fixed costs of delivery, however, has the potential to affect the use of the infrastructure. Under a multipart tariff, capital costs can be collected either as part of an annual access fee (which includes overhead costs) or separately through a system of long term contracts.

Annual access fee

Irrigation authorities that collect the capital costs of delivery using annual access fees can still expose themselves to the financial risk of stranded assets (Gordon, Kemp and Mues 2000).

Consider, for example, an irrigation authority that has just invested in new delivery infrastructure. If, following the investment, there is a decline in the benefits from irrigated activities in the region, there may be net trade in water out of the region. When these irrigators trade water out of the district, they will no longer be liable to pay the annual access fee. This loss of revenue means that access fees to irrigators remaining in the system will have to increase if the viability of the irrigation supplier is to be maintained. These higher access fees could compromise the economic viability of other irrigators within the district, causing them to sell their entitlement out of the district, and so the cycle continues.

A closer look at the fixed costs of delivering irrigation water reveals that some costs are more fixed than others. Whereas capital costs are ongoing regardless of whether the delivery system is operated, the annual overhead costs of operating and maintaining the system can be avoided if the system is not operated. In the more realistic case where only some irrigators leave the system, the consequent decline in the intensity with which the delivery system is operated may lead to a decline in the overhead costs of delivery.

Long term contracts

The potential for stranded assets could be minimised if the capital costs of delivering irrigation water were separated from the annual overhead costs of operating the system.

A system of long term contracts could be introduced to pay for new or refurbished infrastructure, with the contract stating the obligations of the service provider and the irrigation licence holder. In return for agreed rights of access to the delivery system the irrigator would agree to repay (either over time or as a lump sum) the capital costs

associated with the new infrastructure (box 3). The contract would remain binding even if irrigators sold their entitlement. Alternatively, at any time, the remaining debt could be included as a condition of sale of the licence, with the purchaser being responsible for the debt.

A system of contracts effectively internalises the costs imposed on other users within a system when irrigators choose to trade water out of the system.

Such a system of contracts would therefore provide long term revenue security to the service provider, reducing its risk in undertaking new investments. Instead of the service provider assuming the investment risk — as is the case where capital costs are covered by an annual access fee that can be avoided when irrigators opt out of the system — under a system of contracts the risk is effectively spread among the irrigators.

By removing the possibility for irrigation authorities that capital costs will not be met when irrigators choose to trade their water out of the system, long term contracts will reduce the perceived need by some authorities to restrict trade in water entitlements.

While a system of long term capital contracts does not avoid the potential for stranded assets, as irrigators can still impose higher overhead costs on other users if they trade their entitlement out of the system, it does minimise the possibility.

In reality, the emergence of a stranded assets problem is more likely to occur in regions where there are few irrigators than where there are many, and where these irrigators earn small profits.

The impact of the loss of an irrigator in a small system in terms of the higher fixed costs imposed on those remaining in the system is likely to be much greater than in a system with many irrigators. The risk of stranded assets increases where a large proportion of water is used by irrigators who earn small profits. In the southern regions of the Murray Darling Basin, for example, a significant proportion of water is used for lower value broadacre production.

Exit fees

Exit fees have been proposed as a means of reducing opposition to permanent out of scheme trade in water rights (Marsden

3 Contract design and implementation

A system of long term contracts for new and refurbished infrastructure would legally bind both irrigators and irrigation authorities. Irrigators would be liable to pay for the capital costs of infrastructure, and would remain so even if they chose to permanently trade their water right. It would be expected that the capital costs would not include maintenance costs as these costs can be avoided if the system is not operated. Moreover, the terms of payment under the contract could be flexible (that is, allow payment in instalments or as a lump sum) to avoid undue cash flow problems for irrigators.

Irrigation authorities would be required to provide long term access to infrastructure under prespecified terms and conditions. These terms and conditions could, for example, spell out how access to infrastructure is determined when capacity is constrained. Hence, under a system of long term contracts, irrigators would have more secure access to infrastructure than they currently have.

While the transfer to a system of long term contracts for new and refurbished infrastructure is expected to lead to significant economic benefits (largely associated with the freeing up of trade in water rights), there are also potential costs associated with its introduction. For example, implementing the new system will involve negotiations between irrigation authorities and irrigators. Irrigation authorities will need to convince irrigators that it is in their interest to sign the contract, while irrigators may be reticent because of the increased financial risk they face by signing the contract compared with the status quo.

In addition to negotiation costs, there will be administration and enforcement costs. As with any contract, in the event that either party should choose not to abide by its terms and conditions, there will be costs associated with pursuing a legal and financial solution.

Jacobs Associates 1999; Brinsley et al. 2000). The aim of these fees is similar to that of long term contracts — that is, to prevent the imposition of higher costs on irrigators remaining in a scheme when other irrigators choose to leave it. Western Murray Irrigation currently imposes exit fees.

Brinsley et al. (2000) propose that exit fees 'be based on sound and consistent principles which reflect the true cost of water leaving the system', and suggest that the fee be calculated as the net present value of the outstanding future annual charges that the individual would have faced had they remained in the system.

As long as volumetric delivery fees are set at marginal cost, the question whether capital costs are recouped through a system of long term contracts or exit fees is likely to have little impact on efficiency. So long as irrigators are aware that they are liable for any outstanding costs in the form of an exit fee, they will consider their capital costs to be sunk, and base their decision on whether to irrigate or trade water on the opportunity cost of water, which includes the marginal cost of delivery. Moreover, these irrigators will be unable to impose higher capital costs on other users if they leave the system.

The inclusion of annual noncapital overhead costs in an exit fee (as suggested by Brinsley et al.) is likely to be less warranted, however, as some of these costs may be avoided if the irrigation system is operated less intensively when water is traded out of the system.

Irrigators should also be given the choice to repay outstanding capital costs annually or as a lump sum. Any requirement that these debts be repaid as a lump sum could cause cash flow problems for some irrigators, and act as a deterrent to trade.

Whether there is any economic justification for recovering the outstanding capital costs of existing (as opposed to new or refurbished) infrastructure will depend on whether the infrastructure has an alternative use (opportunity cost). If not, as is likely to be the case with much irrigation infrastructure, the capital costs should be considered sunk since the infrastructure has no resale value. Seeking to recover capital costs under these circumstances will not increase the efficiency with which irrigation infrastructure is used and, in fact, may reduce it. This is because irrigators who cannot afford to pay these capital costs, but can afford to pay the remaining costs, will choose not to irrigate.

Given that exit fees and long term contracts have similar beneficial impacts if appropriately designed, a practical option for irrigation authorities may be to use long term contracts for new investments in infrastructure (both new and refurbished) and to recover any outstanding debts for existing infrastructure (where appropriate) from those leaving the system via exit fees.

The advantage of contracts is transparency

The advantage of using long term contracts over exit fees for new investments is that irrigators will know their capital liability in advance of the investment taking place. The irrigators' willingness to pay will then determine whether the investment takes place. That is, irrigators will be prepared to pay for the investment only if they believe that they will receive an acceptable return on funds invested. Hence, the use of long term contracts effectively imposes a market test on new investments and, in doing so, increases the likelihood that these investments are only undertaken where they are economically viable. This is consistent with COAG guidelines.

The argument in favor of introducing a system of contracts to guide future investments is strengthened by the fact that several billion dollars worth of irrigation infrastructure in Australia is nearing the end of its effective life, and will need to be considered for refurbishment in the near future.

Conclusion

The low levels of intervalley and interstate trade in water rights could, in part, be the result of some irrigation authorities imposing restrictions on out of scheme trade. One reason why authorities may want to restrict out of scheme trade is to protect themselves against stranded assets. The type of pricing policy used to collect the costs of delivering water to irrigators can influence the level of risk posed to irrigation authorities by stranded assets.

Currently, many irrigation authorities impose delivery charges that more closely resemble average cost pricing than marginal cost pricing. Apart from risking the underuse or distorted use of infrastructure, the use of average cost pricing (or a volumetric tariff to collect some of the fixed costs of delivery) also leaves an irrigation authority exposed to the possibility of stranded assets.

While the benefits from the use of irrigation water and infrastructure will be enhanced by the use of a multipart tariff with the volumetric fee set at the marginal cost of delivery, it may be possible to increase these benefits further if the capital costs of delivery are funded separately through a system of contracts rather than through annual access fees.

Long term contracts allow irrigation authorities to protect themselves against stranded assets. Hence, this option is likely to minimise opposition by irrigation authorities to the removal of barriers to trade in water, thereby facilitating the transfer of water to higher value uses. The use of long term contracts also ensures that the decision to invest in infrastructure is transparent, increasing the likelihood that these investments are economically viable.

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