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Exit fees and termination fees revisited: funding irrigation infrastructure in a manner compatible with water trade*

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It has long been recognised that the mechanism for funding irrigation infrastructure in Australia may be incompatible with efficient trade in the rural water market. If the revenue received by an irrigation operator is dependent on the volume of water entitlements held in the operator's region, out-of-region permanent water sales threaten the operator's revenue stream, potentially leading to higher charges on remaining irrigators, encouraging an inefficient 'rush for the exit'. In response, irrigation operators have imposed restrictions on permanent water trade, such as exit fees and termination fees, to protect their revenue stream. Previous economic analysis has suggested that exit fees, in particular, are a barrier to efficient trade in the water market and should be abolished. In contrast, this paper argues that allowing irrigators to cancel their water delivery rights without fees or charges leads to inefficient trade in the water market, hinders efficient on-farm investment in sunk complementary assets and leads to inefficient network rationalisation decisions. Instead, the revenue stream of irrigation operators should be insulated from water trade decisions, through high termination fees, tying irrigation charges to the land, or tagging the obligation to pay delivery charges to the new owner of the traded water.

Key words: exit fees, irrigation infrastructure charges, sunk complementary investments, termination fees.

1. Introduction

A major focus of the Australian government's reforms to the rural water industry has been the desire to facilitate trade in water rights to ensure that water is able to move from lower- to higher-valued uses (National Water Initiative 2004). However, the desire to promote trade in water has come into conflict with the desire to ensure stable funding of irrigation operators.

In the Murray-Darling Basin, the rights of water users are increasingly unbundled into both a right to receive a share of the available water and the right to have that water delivered to a particular location. The right to receive a share of the available harvested water is known as the water access right or water entitlement. The right to have water delivered to a specific location, usually over irrigation infrastructure, is known as a water delivery right or

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delivery entitlement. The delivery services themselves are provided by irrigation infrastructure operators, which are typically state-owned or member-owned corporations or trusts.

Irrigation infrastructure operators recover their on-going costs through a set of fees and charges. These charges are typically structured as a two-part or multi-part tariff. For example, in 2008/2009, Murray Irrigation Limited (one of the largest irrigation operators in NSW) charged a fixed or non-volumetric network access charge of \$3.66 per unit of water entitlement plus \$8.08 per unit of delivery entitlement per annum. Irrigators also paid a variable charge of \$16.05 per megalitre of water delivered. An irrigator could terminate a unit of delivery entitlement on payment of a fee equal to \$332.55 per unit of terminated delivery entitlement (MIL 2009). Such high termination fees have, for some years, been a source of conflict and tension between irrigators, irrigation operators and policy-makers.

There are two types of trade in water rights. Trade in physical water that has already been allocated to an irrigator is known as temporary trade. Trade in water entitlements – that is, the on-going right to receive water allocations in future – is known as permanent trade.

The basic problem arises when the revenue stream of an irrigation operator is linked, directly or indirectly, to the level of water rights held by irrigators in its region. Historically, infrastructure delivery charges were directly tied to (or 'bundled' with) the level of water rights held by an irrigator. An out-of-region sale of a water right by an irrigator therefore resulted in a direct reduction in revenue received by the irrigation operator. A temporary out-of-region sale of water resulted in the loss of any surplus from the excess of variable charges over the variable cost. More importantly, a permanent out-of-region sale of water resulted in the additional loss of revenue stream from the on-going fixed water charges.

But the on-going costs of maintaining an irrigation network are largely fixed and independent of both the number of irrigators and the volume of water flows (ACCC 2006). In these circumstances, as has been observed many times (Goesch 2001; Goesch and Beare 2004; Roper *et al.* 2006; ACCC 2008b), an infrastructure operator facing a net export of water rights faces a reduction in revenue with little or no offsetting reduction in on-going fixed costs. This places at risk the financial viability of the irrigation operator, forcing it to raise delivery charges on those irrigators that remain, potentially inducing other irrigators to 'sell up and leave'. In the limit, an irrigation operator might be left with 'large fixed costs and no customers' (Goesch 2001).

As a consequence of these concerns, irrigation operators have sought to protect their revenue stream (and, thereby, the prevailing level of irrigation charges) through various restrictions, fees or obligations on out-of-region trades, including:

- Tying the obligation to pay delivery charges to the land – i.e., making the delivery charges an obligation of the landowner;

- Tagging – i.e., passing on the obligation to pay delivery charges to the new owner of an entitlement (who may also be required to pay any delivery charges in the destination area); and
- Imposing fees on the cancellation or termination of a delivery right.

In those regions that have not yet unbundled water delivery rights from water access rights, fees associated with the sale of a water entitlement (and the implicit automatic cancellation of part of a delivery right) are known as *exit fees*. In those regions where the delivery right has been separated from the water access right, the charges for the cancellation of all or part of the delivery right are known as *termination fees*.

Concerns have been raised that exit fees, in particular, can be material and may act as a barrier to efficient permanent water trade (ABARE 2006; ACCC 2006; PC 2006, Roper *et al.* 2006). This paper argues, in contrast to previous analysis, that exit fees are not necessarily an inefficient barrier to trade, but are required to offset an incentive to enter into welfare-reducing trades. In addition, it is shown that high termination fees are necessary to protect the incentive of irrigators to make on-going on-farm investments in complementary assets such as irrigation equipment, vineyards or orchards.

2. Previous analysis

Concerns about the threat posed by out-of-region water trade to the revenue of irrigation operators have been around for some time. Historically, as noted above, irrigation operators have imposed a number of restrictions on out-of-region water trade. A lot of attention has been focused on one such restriction – the use of exit fees. According to Goesch (2001), exit fees were proposed in 1999 to insulate the revenue stream of irrigation operators from permanent water trade decisions. Although Goesch (2001) and Goesch and Beare (2004) argue that it is preferable to establish long-term contractual arrangements for funding network expansions *in advance* of any network investment, these authors seem to accept the need for exit fees for existing infrastructure, to preserve the revenue stream of irrigation operators.

Subsequent economic papers, however, were not so sympathetic to exit fees. For example, Watson (2005) questioned the need for exit fees at all, noting that the movement of water to higher-valued uses is what was intended in the establishment of the water market, noting: ‘Generation of some stranded assets is just what advocates of water trading were looking for’. Heaney *et al.* (2006) and PC (2006) argued that the change in the revenue stream of an irrigation operator resulting from net outward water trade is an example of a ‘pecuniary externality’ for which there is no associated social harm and therefore no need to take action.

Three key reports on exit fees appeared in 2006 (ABARE 2006; ACCC 2006; PC 2006). All three of these reports argued that exit fees were an inefficient barrier to permanent trade in the water market. In fact, in all three papers, the exit fee was described as a tax on trade, leading to an inefficient reduction in the quantity transacted relative to the efficient level, thereby reducing the benefits to trade and the overall market efficiency. The Productivity Commission (PC) (2006), was explicit:

> Exit fees are distortionary – they increase entitlement prices in importing regions, while reducing entitlement prices to sellers in exporting regions, reduce the quantity of water traded, and deny opportunities for the higher value use of water to contribute to overall economic wellbeing. Further, exit fees can lock water into low productivity enterprises and regions … In the Commission's view abolition of exit fees is the preferable course of action.

A paper prepared by staff of the Productivity Commission (Roper *et al.* 2006) went further to argue that *all* mechanisms for recovering the fixed costs of the network introduce economic distortions:

> Imposts (such as ongoing payment of access fees, 'tagging' and 'exit' fees) on the outward transfer of entitlements are an impediment to efficient trade. In effect, they are an economic tax shared by the purchaser and the seller – with the burden falling more heavily on one or the other, depending on the relative price sensitivity of purchases and sales.

ABARE (2006) advocated unbundling of the water access right from the water delivery right. Unbundling of this kind clearly has certain merits. However, unbundling does not, in itself, resolve the issue of the terms and conditions under which the irrigator should be allowed to terminate the delivery right. Should the irrigator be allowed to terminate a delivery right – thereby avoiding all future delivery charges – without any fees or charges? Or should the irrigator be given a choice between paying delivery charges indefinitely, or paying the equivalent amount (in present value) in termination fees?

ABARE did not carry out any formal analysis on the appropriate level of these termination fees. However, they did suggest that if the termination fees were set at a high level 'reflecting the capitalised value of the annual access fee to recover recurrent non-volumetric costs', this arrangement 'would not distort the incentive for trade' and 'remaining irrigators would not face higher infrastructure access fees'.

ACCC (2006) also supported unbundling but expressed concerns that high termination fees would insulate the revenue stream of irrigation operators from the social value of irrigation network and would potentially dampen incentives for rationalisation of the network infrastructure. Instead, the ACCC determined that termination fees should be set at a maximum of eight times the annual delivery charges. As a transitional measure, the ACCC proposed allowing termination fees to be set at a multiple of twelve times the annual delivery charges, declining to a multiple of eight over a period of

8 years. Subsequently, however, the Australian governments agreed that the termination fee would be set at a maximum multiple of fifteen times the annual nonavoidable fixed delivery fees.[1]

In practice, irrigators have not chosen to terminate their delivery rights and pay the termination fee (Frontier 2008). To date, in Victoria, there has only been one instance of payment of the full termination fee multiple of fifteen times the annual fixed charges – in the case of the sale of a deceased estate 'although several negotiations are known to have occurred where the irrigation infrastructure has been rationalised in exchange for waiving future delivery entitlement fees'.

In 2008, as part of its advice to the Minister for Water on water charge rules, the ACCC revisited the issue of termination fees, recommending that the termination fee be set at a fixed multiple of ten times the fixed delivery charge (ACCC 2008b). In February 2009, the Water Minister, Penny Wong, accepted the ACCC's recommendations in full.[2]

This previous analysis raises several fundamental questions. If exit fees are inefficient and should be abolished (i.e., set to zero), as these reports argue, why should not termination fees be also set to zero? Conversely, if it is efficient to set a high termination fee, so that the irrigator has an incentive to continue to pay the on-going delivery charges, as ABARE suggest, why should not exit fees be also set at a level equal to the present value of on-going delivery charges? Is there a justification for setting the termination fee at an intermediate level as the ACCC recommends? These are the questions this paper seeks to address.

To an extent, temporary water trade is a substitute for a permanent water trade. In principle, a water buyer could replicate the effect of any permanent water trade through a series of annual purchases of the corresponding volume of water on the temporary water market. To date, irrigation operators have charged no additional fees on temporary trade. Partly as a result, volumes of temporary trades have far exceeded volumes of permanent trades. Should we be concerned about impediments to permanent water trade when irrigators can simply switch to unimpeded temporary trade?

There remain reasons for concern about impediments to trade in the permanent water market. Although temporary and permanent water trade are substitutes, they are not perfect substitutes. As emphasised in section 3.2 below, irrigators must often make substantial sunk investments in on-farm assets, in reliance on a continuing supply of water at a reasonable price. By locking in a once-for-all price, permanent water trade, unlike temporary trade, provides some assurance to irrigators that they will be able to recover the cost of those investments. Impediments to permanent trade will tend to

[1] Murray-Darling Basin Agreement, Schedule E Protocol, clause 11(5).

[2] Wong (2009), 'New Murray-Darling Water Market and Termination Fee Rules', Media Release, PW 25/09, 11 February 2009.

have a chilling effect on sunk complementary investments and therefore will reduce the extent to which water can move to its highest-value uses.

3. Economic analysis

The fundamental question to be addressed is how to raise sufficient revenue to cover the costs of the irrigation infrastructure while achieving the following three components of overall economic efficiency:

1. Efficient trade in water rights and, thereby, efficient land-use decisions;
2. Efficient investment in on-farm sunk complementary assets; and
3. Efficient decisions regarding the rationalisation and/or augmentation of all or part of the irrigation network.

The subsequent sections explore each of these objectives in turn. I will maintain three assumptions:

- First, I will assume that an irrigation operator must incur material *on-going* fixed costs in the form of maintenance costs and/or the costs of an on-going process of infrastructure renewal. In the absence of material on-going fixed costs, a reduction in demand for irrigation services can be addressed through a simple one-off downward revaluation of the relevant asset base (e.g., Roper *et al.* 2006). Such a one-off revaluation raises potential sovereign risk issues (which, in other industries occasionally result in explicit compensation for the affected firms), but otherwise has no further economic implications for trade, investment or rationalisation decisions.
- Second, I will assume that all environmental externalities (such as salinity issues) have been controlled through separate mechanisms and do not need to be taken into account in the structure of irrigation infrastructure charges discussed here.
- Third, I will assume there is no congestion in the delivery network.

Furthermore, for simplicity, I will assume that irrigation charges have been rebalanced so that fixed irrigation costs are recovered entirely through fixed charges on irrigators, while variable costs are recovered through variable charges on irrigators. There are two reasons for making this assumption: First, this tariff structure is economically efficient, in that it induces efficient water use decisions at the margin (Goesch 2001). More importantly for our purposes, if variable charges are above variable costs, irrigation operators have an incentive to limit temporary out-of-region water trade in a way closely parallel to the distortion in permanent trade discussed below. This assumption allows us to focus exclusively on the effect on the permanent water trade market. In recent years, because of the prolonged drought, there has been (at least in NSW) a partial rebalancing of irrigation charges in the opposite direction – that is, in the direction of higher variable charges, as a risk-sharing and income smoothing measure for irrigators.

3.1 Efficient water trade decisions

Let us start by examining the effect of the mechanism for recovering infrastructure costs on the efficiency of permanent trade in water and the efficiency of the water use decision. As we will see, as long as the water trade in question does not alter the decision to rationalise (i.e., to shut down all or part of) the water network, economic efficiency requires isolation of the water trade decision from the traders' fixed delivery charges. In essence, infrastructure costs that cannot be avoided by irrigators as a group should not be able to be avoided by any individual irrigator through trade.

Let us consider a potential transaction between a water buyer and a water seller. Let us suppose that the value of water to the buyer and the seller is V^B and V^S, respectively (the value of water is the difference in the present discounted value of the cash flow from land with and without irrigation). Let us suppose that a water transaction results, directly or indirectly, in a change in the fixed infrastructure charges paid by the buyer and seller equal to ΔF^B and ΔF^S, respectively (including any termination or exit fees). Let us take ΔF^B to be the amount of *increase* in the fixed charges paid by the buyer and ΔF^S to be the amount of the *decrease* in fixed charges paid by the seller, so that both values will normally be positive. Finally, let the price at which the water is transacted (if the transaction occurs) be P.

Let us assume, to begin with, that this water trade results in no rationalisation or augmentation of the water network (that is, no parts of the network are closed down and no new irrigation network is created), so the fixed costs of the water infrastructure are independent of whether or not the trade occurs. Under this assumption, it is socially efficient for this transaction to occur if and only if the value of water to the buyer exceeds to the value of water to the seller – that is, if and only if $V^B \geq V^S$, or equivalently, if and only if:

$$V^B - V^S \geq 0 \tag{1}$$

But now consider the private incentives for the trade to occur. In the absence of any termination fees, the seller receives a net benefit of V^S if he chooses not to trade and $P + \Delta F^S$ if he trades, so he will trade if and only if $P \geq V^S - \Delta F^S$. Similarly, the buyer receives a net benefit of zero if she chooses not to trade and a net benefit of $V^B - P - \Delta F^B$ when she trades, so she will trade if and only if $V^B - \Delta F^B \geq P$. Putting these two results together, in the absence of transactions costs, we can see that trade will occur if and only if $V^B - \Delta F^B \geq V^S - \Delta F^S$. Or, equivalently, trade will occur if and only if:

$$V^B - V^S \geq \Delta F^B - \Delta F^S \tag{2}$$

Comparing equations (1) and (2), we can see that trade will not be distorted if and only if $\Delta F^B - \Delta F^S = 0$. Water trade may occur more often or less often than it is socially beneficial for trade to occur – due to the impact of the trade on the fixed delivery charges.

Let us first consider the case where a seller transacts with a buyer who faces no increase in the fixed delivery charges from purchasing a water right (so that $\Delta F^B = 0$). This might arise if the water purchaser is not connected to a water irrigation infrastructure (i.e., is a private diverter) and so pays no delivery charges and does not need to invest in additional capacity to deliver the additional water. It might also arise where the water buyer already holds an adequate volume of water delivery rights and the fixed delivery charges are independent of the volume of the water entitlement held by the irrigator.

In the absence of any exit or termination fees, the seller may be able to avoid part or all of his delivery charges, so $\Delta F^S > 0$. Under these assumptions $\Delta F^B - \Delta F^S < 0$, and there is *too much* incentive for trade. Trades will occur, even when the value of the water to the buyer is smaller than the value of the water to the seller.

The problem here, of course, is that in the absence of termination fees the delivery charges are privately avoidable but are not socially avoidable. The solution is to raise the termination fees or exit fees to a level which ensure the seller cannot avoid his on-going delivery charges through termination of the delivery right. In contrast to the earlier analysis, exit fees cannot be said to be an inefficient tax on trade. Rather, in the case where the buyer does not incur any additional fixed charges as a result of the water trade, exit fees are *required* to achieve efficient outcomes in the water market.

When the buyer faces an increase in fixed charges following a water trade, a situation can arise where there is *too little* incentive for trade. For example, suppose that an irrigator who is directly connected to a river system (e.g., a private diverter who pays no fixed delivery charges so that $\Delta F^S = 0$) sells a water entitlement to a new irrigator located in an irrigation district who, as a result of the transaction, must incur a fixed delivery charge (so that $\Delta F^B > 0$). Now $\Delta F^B - \Delta F^S > 0$, so there is too little incentive for trade. Trades that are socially beneficial will be foregone.

This problem of too little trade cannot be solved by adding additional fees or charges on the buyer or the seller. Instead, however, the problem can be solved by *reducing* the fixed delivery charges incurred by the buyer to the level of delivery charges avoided by the seller (so that $\Delta F^B = \Delta F^S$, as above). If the seller does not save on delivery charges as a result of the trade, neither should the buyer incur any additional fixed charges (no matter what the level of delivery charges in his or her irrigation district).

This discussion suggests that there are two possible ways of designing the mechanism for funding infrastructure operators so as to avoid distorting trade in the water market:

1. Leaving unchanged any existing obligations to pay water delivery charges on both the seller and the buyer (so that $\Delta F^S = \Delta F^B = 0$), either by requiring on-going payment of any existing fixed charges (perhaps by tying the obligation to pay water delivery charges to some immobile factor such as land) or by permitting a one-off payment equal to the present

value of the future fixed charges foregone (i.e., a termination fee). In any case, the level of delivery charges for both the buyer and seller must be independent of the level of their water right; or

2. Passing the obligation to pay water delivery charges avoided by the seller to the buyer (so that $\Delta F^B = \Delta F^S$), either by requiring the buyer to make on-going payments to the seller's irrigation operator (this approach is known as tagging) or by permitting a one-off payment equal to the present value of the future fixed charges. The buyer must not incur any additional fixed charges in the importing region as a result of the water trade. If the seller is able to avoid no fixed delivery charges as a result of the transaction (e.g., if the seller is a private diverter), the buyer should not be required to pay any additional fixed delivery charges on water associated with this entitlement, no matter what the normal level of fixed charges in his/her district.

The government of Victoria (VIC 2004) has announced proposals for tying and tagging arrangements, which are broadly consistent with this analysis.

3.1.1 Impact of changes in network costs

The analysis above focused on the case where no network rationalisation opportunities arose and no network expansions were required as a result of the water trade. How does this analysis change when a water trade might give rise to an opportunity either to decommission parts of the seller's irrigation network or the need for an expansion in the buyer's network?

Let ΔC^B and ΔC^S be the increase in the fixed (non-volumetric) costs of the buyer's network and the decrease in the fixed costs of the sellers network, respectively, arising as a direct result of the water trade. It is straightforward to verify that water trade will occur when it is socially efficient if and only if $(\Delta F^B - \Delta C^B) - (\Delta F^S - \Delta C^S) = 0$. In other words, the results above apply, when we interpret ΔF^i to be the difference between the fixed charges and the fixed costs for the buyer and seller, respectively.

For example, consider the case where the water trade requires an additional network investment by the buyer's network (so that $\Delta C^B > 0$), but, as before, there is no scope for rationalisation in the seller's network (so that $\Delta C^S = 0$). In this case, if the seller is able to avoid his fixed charges as a result of the trade ($\Delta F^S > 0$), there will be inefficient incentives for trade unless the fixed charges of the buyer equal the foregone fixed charges of the seller plus the costs of the additional investment in the buyer's network (i.e., unless $\Delta F^B = \Delta C^B + \Delta F^S$).

As mentioned earlier, for simplicity, this analysis focuses on fixed water delivery charges and costs and puts to one side variable water charges and costs. If we take these variable charges and costs into consideration, we find that socially efficient trade can be achieved if the change in revenue paid in (fixed and variable) charges by the water seller or buyer matches the change in (fixed and variable) costs incurred by the corresponding irrigation infrastructure operator. For example, if the variable charges for the water seller exceed the variable water delivery costs in the seller's irrigation network, and if there is no scope for rationalisation of that network, the fixed charges paid by a water seller following a water trade should *increase* by an amount equal to the difference between the foregone revenue from variable water charges and the cost saving from the reduction in water deliveries. Alternatively, the seller could be permitted to pay a termination fee that exceeds the present value of future fixed charges by an amount equal to the present value of future foregone variable charges less variable costs.

3.1.2 Ex post negotiation

The analysis above implicitly assumes that ex post negotiation between irrigators is infeasible. If a trade is welfare-reducing, is there not scope for an agreement between the affected parties which eliminates the incentive to enter into the trade, no matter what the level of the termination fee?

In practice, the number of affected irrigators will often be too large to permit efficient ex post negotiation. However, in a few cases, the number of affected irrigators may be small enough that it is possible to envisage some form of negotiation between the affected irrigators in a region.

It turns out that, if irrigators can negotiate costlessly and efficiently with one another before any water trade takes place, inefficient trade will be prevented, even in the absence of exit fees or termination fees. In effect, to prevent an irrigator from carrying out an inefficient trade, the remaining irrigators must induce the trading irrigator to reconsider his/her trade decision by offering to lower his/her fixed charges.

In the absence of termination fees, an individual irrigator is tempted to sell when the value of water to the irrigator is less than the revenue from the sale plus the savings on the fixed charges. This sale is inefficient if the value of the water to the irrigator is less than the revenue from the sale. To show that inefficient trades can be prevented, we need to show that there exists some reallocation of the fixed charges of the network such that all irrigators have an incentive to remain on the network.

Let us suppose that we have a set of N irrigators with water valuation $V_1,\ldots,V_N$. Suppose that the value of the water on the water market to the ith irrigator is P_i. Let us assume that water is more valuable in its current use than the value obtained when it is sold (i.e., for all irrigators $V_i > P_i$) and let us assume that there is sufficient surplus from irrigation such that it is not worth shutting down (i.e., $\sum_i V_i - C \geq \sum_i P_i$). Under the assumptions above, even in the absence of exit fees or termination fees, there exists an allocation of the fixed charges $F_1,\ldots,F_N$ which are positive $F_i \geq 0$ and which sum to the total fixed costs of the network $\sum_i F_i = C$ and for which no individual irrigator has an incentive to sell water (i.e., for each irrigator $V_i - F_i \geq P_i$).

To see this, let us define s as follows: $s = C/(\sum_i V_i - \sum P_i)$. By the assumptions above $0 \leq s \leq 1$. Define $F_i = s(V_i - P_i)$. This is an allocation of the fixed network charges as $F_i \geq 0$, and $\sum_i F_i = s(\sum_i V_i - \sum_i P_i) = C$.

Finally, with this allocation of the network charges, no individual irrigator is tempted to sell as $V_i - F_i = (1 - s)V_i + sP_i \geq P_i$.

However, as we will see in the next section, this result does not imply that overall economic efficiency will be achieved. Inefficient trade is prevented by lowering the fixed charges on irrigators who are tempted to sell when it is inefficient to do so, and raising the fixed charges on the remaining irrigators. The threat of higher fixed charges itself has a chilling effect on sunk on-farm investment, as the next section shows.

3.2 Efficient incentives to make sunk complementary investments

The previous section addressed the question of how to fund irrigation infrastructure while preserving incentives for efficient trade and the associated land-use decisions. Now let us look at the question of how to design the funding mechanism so as to ensure that irrigators have appropriate incentives to invest in on-farm sunk complementary assets.

As in many other industries (Biggar 2009), irrigators must make significant sunk investments to extract the most value from irrigation services. These investments are often long-lived and might include, for example, investment in:

1. customised long-lived on-farm irrigation equipment or irrigation channels;
2. trees or vines which take many years to mature; or
3. specialised knowledge in the particular farming techniques which rely on irrigation.

Let us first consider the circumstances under which it is socially efficient for an irrigator to make a sunk on-farm complementary investment. We will assume that the irrigator must make the sunk investment before learning the market price for water. As before, let us assume there is no scope for rationalisation of the irrigation network whether this irrigator chooses to sell his/her water.

Let V_0 and V_1 be the value of water to an irrigator before and after a sunk on-farm investment, respectively (where $V_1 > V_0$). Let F be the fixed infrastructure charges payable by the irrigator. Finally, let P be a random variable reflecting the future water market price. Ex post, if the irrigator can avoid all future fixed delivery charges through the sale of the water, the irrigator will choose to sell if and only if $P \geq V_i - F$. The ex ante expected payoff to the irrigator is $E(\pi_i) = E[\max(P, V_i - F)]$. The value of the sunk complementary investment to the irrigator is equal to the difference in the expected payoff with and without the investment. The value of the investment is therefore:

$$\Delta E(\pi) = E(\pi_1) - E(\pi_0) = E[\max(P, V_1 - F)] - E[\max(P, V_0 - F)]. \quad (3)$$

The appendix shows that this expression is decreasing in F. In other words, in the absence of termination fees, the larger the charges that can be avoided through a water sale the lower the benefit of sunk complementary investment. Intuitively, the reason is clear: the higher the fixed charge the greater the incentive to sell ex post, and therefore the lower the probability that the sunk investment will be put to beneficial use. The ability to avoid irrigation charges through water sales has a chilling effect on sunk complementary investment.

Furthermore, the previous section showed that the fixed charges payable by an irrigator may actually be increasing in the water price, for two reasons: The first reason is that higher prices induce a larger number of other irrigators to 'sell up and leave', leaving the remaining irrigators to shoulder a larger burden of the fixed irrigation charges. The second reason is that (where *ex post* negotiation is possible) the higher the market price the larger the number of other irrigators who are tempted to sell and who must be bribed to remain through lower fixed charges, increasing the delivery charges on the other irrigators. Either of these two reasons could cause the fixed delivery charges on an irrigator to increase with the water market price.

Importantly, as the appendix shows, where the delivery charges are increasing in the water price, the above effect is exacerbated – that is, the value of a sunk on-farm investment is lower the greater the extent to which the fixed charges increase in the water price. Termination fees, by eliminating the possibility of inefficient trade ex post, increase the value of sunk complementary investment ex ante.

3.3 Incentives to rationalise the irrigation network

As noted above, a third primary concern regarding the effect of exit fees and termination fees relates to their impact on incentives to rationalise (i.e., to shut down) parts of the irrigation network. Much of Australia's irrigation infrastructure was constructed in the first half of the 20th century with no consideration of recovering the full social costs through user charges (Beare *et al.* 2006). In recent years, Australian governments have agreed to move to full cost recovery for irrigation infrastructure (NWI 2004). As Beare *et al.* (2006) note, 'progress toward full cost recovery may… mean rationalising existing delivery infrastructure to ensure the longer term viability of irrigation utilities'.

The decision to decommission part or all of an irrigation network is, almost always, inherently a collective action problem; the decision to decommission requires the mutual agreement of a group of irrigators and water users. Concerns have been expressed that high termination fees, by insulating irrigation operators from water sales decisions, do not provide any direct incentive for network rationalisation and therefore may 'act as a barrier to rationalisation' (ACCC 2008b).

When transaction costs are low, so that negotiation between groups of irrigators is feasible, irrigators can themselves identify non-viable segments of the network and voluntarily choose to cease maintaining the irrigation infrastructure. Provided the change in the infrastructure charges for the group as a whole arising from the rationalisation reflects the avoidable costs of that segment of the network, the resulting rationalisation decisions will be efficient. Where full cost recovery has not been achieved, there may be a need for an external party (such as the irrigation operator) to offer a payment equal to the difference between the socially avoided on-going cost and the infrastructure charges that could be avoided by the relevant irrigators, to ensure that the full social benefits of rationalisation are reflected back to the irrigators themselves.

Incentives for rationalisation, therefore, are only necessary, when transaction costs are sufficiently high to prevent effective negotiation between the affected irrigators. In general, it would be expected that water valuations would vary across irrigators in a region and across different units of water consumed by the same irrigator. Different irrigators in a region could be expected to trade different volumes of water at different times. In this context, does it make sense to set a termination fee less than the present value of future annual delivery charges, to place pressure on irrigation operators for network rationalisation?

The primary problem with this approach is that it is a blunt instrument for achieving the objectives of efficient trade and efficient rationalisation. As long as water valuations differ across irrigators, there is no necessary link between the revenue lost by an irrigation operator as a result of trade decisions and the scope for rationalisation of that operator's network. The volume of revenue lost depends on the volume of out-of-region water trade while the scope for rationalisation depends on the geographic concentration of such trades. Any link between the scope for rationalisation and the volume of revenue foregone would be purely fortuitous.

In its draft advice, the ACCC noted that rationalisation opportunities would be limited in the short term (ACCC 2008a) and acknowledged that 'the weight of submissions suggest efficiency savings through rationalisation are not likely to remove the requirement to increase prices for remaining irrigators upon exhaustion of reserves of termination fee revenue'.

Furthermore, the analysis above shows that setting termination fees below the present value of annual delivery charges will itself lead to inefficient water trade and therefore shut-down decisions – so that even those rationalisation decisions that are observed are not necessarily efficient. As we have seen above, where ex post negotiation between irrigators is not feasible, if termination fees are set below the present value of annual delivery charges, some irrigators may be induced to trade away their water even when it is socially inefficient to do so. Even if ex post negotiation is feasible, if termination fees are set below the present value of annual delivery charges, some irrigators may not have adequate incentives to make sunk investments in on-farm complementary assets. In either case, the apparent social benefit of retaining the irrigation network for the remaining irrigators is reduced, potentially inducing an inefficient shut-down decision.

As is conventional in public policy, it is not usually possible to achieve two or more objectives with a single policy tool. As we have seen, setting termination fees at a level greater than the present value of future delivery charges will ensure efficient water trade and on-farm investment decisions. Some other instrument is necessary to achieve efficient rationalisation decisions. For example, one possible approach would be to require some authority (such as the irrigation operator) to identify those parts of the network which are potential candidates for rationalisation. Irrigators in these regions could be given the opportunity to reach agreement or, failing that, a long notice period of the intention to retire the network.

4. Conclusions

This paper explores the issue of how to raise sufficient revenue to fund the on-going fixed costs of irrigation operators in a manner compatible with (i) efficient water trade and land-use decisions; (ii) efficient incentives for on-farm sunk investment and (iii) efficient decisions regarding rationalisation of the network.

As we have seen, in the absence of rationalisation opportunities, it is only possible to achieve efficient trade in the water market, efficient incentives for on-farm complementary investments and efficient rationalisation decisions when the funding for the irrigation operator is separate from the water trade decision. Trading irrigators should not be able to avoid network charges as a result of a water trade decision except to the extent that the water trade lowers network costs. In practice, this implies that the obligation to pay irrigation charges should either be tied to the land or should be able to be passed to the purchaser of the water right, in a process known as tagging.

In either case, the obligation to pay on-going water delivery charges could be allowed to be terminated on payment of a one-off termination fee. That termination fee should be at least as large as the present value of the expected future irrigation charges, and possibly larger if variable water delivery charges are in excess of variable costs.

In many respects, the analysis in this paper contradicts previous arguments made by the PC, ABARE and the ACCC. Those papers argued that exit fees distorted trade (leading to too little trade) and that the stranded asset problem was an example of a pecuniary externality for which there was no resulting harm and therefore no government action required. In contrast, I have shown that in the absence of unbundling, some form of exit fee or termination fee is necessary to preserve the level of irrigation charges paid by a water seller, and thereby to ensure efficient incentives for trade. In addition, exit fees or termination fees are necessary to achieve efficient incentives for carrying out sunk on-farm complementary investments and to ensure efficient decisions regarding rationalisation of the irrigation network.

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Appendix

Let V_0 and V_1 be the value of water to an irrigator before and after a sunk on-farm investment. Let p be a random variable reflecting the future water market price. Let $F(p) = F + \alpha\delta(p)$ be the fixed infrastructure charges payable by the irrigator, which are increasing in p ($\delta(\cdot) \geq 0$ and $\delta'(\cdot) \geq 0$, α is a fixed parameter).

Let p_0 and p_1 satisfy $V_i - F(p_i) = p_i$, for $i = 0, 1$. It is straightforward to verify that p_0 and p_1 are decreasing in α (i.e., $dp_i/d\alpha \leq 0$). As in equation (3) in the text, $\Delta E(\pi) = E[\max(p, p_1)] - E[\max(p, p_0)]$. The derivative with respect to α is $\frac{d\Delta E(\pi)}{d\alpha} = -\int_{p_0}^{p_1} \delta(p)f(p)dp \leq 0$ where $f(p)$ is the density function for the random variable p. Taking $\delta(\cdot) = 1$, we have the special case that: $\frac{d\Delta E(\pi)}{dF} = -\Pr(V_0 - F \leq p \leq V_1 - F) \leq 0$.