The Problems of Analysing Markets for Irrigation Water

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Abstract

The view that the price of water is too low and that water does not flow to its highest value end use, have led many analysts to conclude that a market for water, in which price can adjust to accommodate changes in the supply and demand for the product, is essential. However, this solution assumes that the market could approach something close to perfect competition, purely by making minor changes within the existing regime of property rights. In this paper it is argued that problems evident in this market stem from a multitude of market failures and characteristics that are particular to it. To understand this case more fully it is necessary to come to terms with the theoretical formulations of the market for water and the practical difficulties associated with it. It is concluded that it may not be possible to obtain an optimal solution in the market for water, as it currently exists. Thus, the solutions to the problems evident in the water market may need to rely on controlling quantity of water that flows through it, even though price is an ideal economiser of information.

1. Introduction

It would appear from reading the Wentworth Group of Concerned Scientists (2002) submissions that the traditional methods of allocating water[1] in Australia does not achieve all societies' objectives. The current method of allocating water can be described as fixed entitlement system that allows for limited trading. Most entitlements to water are

[1] Water in this paper is defined to include surface water that is regulated and used for irrigation only. It does not include subsurface supplies or unregulated water captured for private use or water used solely for non-agricultural uses. However, the issues discussed in this paper may well have an implication on the way analysts think about these other forms of water regulation.

nothing more than a right to access (pump) a specified quantity of water from a river or canal that has its flow regulated. These entitlements were generally allocated on the basis of geographic location, during or soon after watercourses were regulated. Farmers, the major holders of these entitlements, paid little or nothing for them originally and it is generally accepted that they paid an inadequate price to maintain them. In the beginning, water entitlements were attenuated to the land. After the COAG agreement, the water and land titles were separated in order to allow trading amongst users. Such a move is believed to be a step in the right direction, as it permited the flow of water to its highest valued end-use.

It could be argued that the current markets for water are ideal, as they serve the interests of most participants, *albeit* in a limited way. Farmers can purchase or sell water as required, and the government making purchases on its behalf can satisfy the interests of the environmental lobby. Yet, to call the current method of trading water in Australia a free and fully flexible market system, as economists believe them to be, would involve a huge stretch of the imagination. The market for trading water is extremely thin, mainly involving temporary flows. Most water still ends up in the hands of those who have a traditional entitlement to it. Thus, it could be concluded that if water is now allocated to its highest end use, then the fixed entitlement system was achieving most of this anyway. There is no freedom to enter or exit the market, as in many cases any trader must have an existing entitlement with a water authority. In many cases farmers still pay only a fraction of the true price of delivering water. Furthermore, Catchment Management Authorities (the true suppliers of water) cannot readily alter prices, raising them to update or improve infrastructure or reducing them to sell more water. When these criticisms are combined with claims that not enough (or no) water is allocated to the environment, then it is easy to conclude that perhaps water is undervalued. Not allowing the market for water to operate in the way economists believe they should, has meant that not only is the allocation of water skewed, but that any beliefs regarding what the price of water is or should be that are determined from that market, will not be correct.

If water were traded more freely, without the strictures of the fixed entitlements underpinning it, or the constraints placed on the Catchment Management Authorities, would water be allocated so that it maximised social welfare? Would water end up in uses where it is valued most highly? Would the price for it truly reflect its value? Such questions are important as they have an implication for the way the water market currently operates, what it is believed is delivered from that market and any changes (improvements) that may be made to it.

In this paper it is argued that a number of theoretical and practical considerations need to be evaluated before any firm conclusions are reached on the system of allocating water. If these considerations are valid, then it could be the case that the desired outcomes that are believed to come from the market may not be achieved. The aim in this paper is to specify these theoretical and practical conditions, to make a judgement call on wether they hold and in light of that, suggest an alternative way some of the benefits that are derived from a free market may be delivered to all water users.

2. The Original and Current Systems of Allocating Water in Australia

It is possible to think of different resource allocation systems as a continuum from markets that are free of any government intervention through to command economies. Most resource allocation systems are a combination of a market modified by government intervention in the form of taxes, subsidies and/or regulations. The purpose in this section is to specify the system that has been used to allocate water in Australia, prior to the establishment of a trading system. Without wanting to generalise what is a highly complex system, almost all were highly regulated and can be described as a fixed entitlement systems. These systems were modified to include trading during the 1990s.

At the heart of an entitlement (or resource allocation) system is the specification of the property rights within it. Property rights define the legitimate owner of a commodity or good or service and who is entitled to enjoy the benefits of ownership. Good property rights have well defined rules regarding ownership, use, transferability and enforcement.

It as been recognised by commentators (notably Young and McColl 2003 amongst many others) that the property rights underlying water allocation in Australia, both now and in the past has not been ideal.

The history of how water was allocated in Australia is presented in Davidson (1969). Water rights were attached to the land and were, as Challen (2001) has described, a resource quota. In other words, a direct limit was placed on the amount of water a farmer could access. Depending on the system in question, in many years owners may receive more than their entitlement (if the system is run conservatively as in Victoria) or less (if the system is run with less security as in NSW). As farmers contributed only a fraction of the costs of supplying water and governments subsidised the costs of constructing and operating the system, prices played little if any role in the market. To describe this market in a simple analytical way, it could be said that the supply and demand schedules for water were perfectly inelastic, with aggregate demand placed closer to the origin than aggregate supply (see Figure 1). It should be noted that this diagram does not include sales water.

FIGURE 1 HERE

Economists were quite rightly critical of the fixed entitlement system. Besides the point that in the absence of prices, information within the market cannot flow and the input could not be allocated to its most productive and highest value use. In addition, Catchment Management Authorities could not raise prices to update, improve or invest in the infrastructure that delivers the product to consumers. When these criticisms are combined with claims that not enough water was allocated to the environment, it is easy to conclude that water was undervalued. However, the fixed entitlement system of allocating water served its purpose, especially when the water economy was being developed, as it provides a degree of certainty.

By the early 1980s it was generally recognised that Australia had a mature water economy, one in which all readily available supplies of water had been exploited and water users competed for what was considered to be a resource that was becoming scarce. To overcome the shortcomings of the existing system of allocation, state governments

allowed water users to trade water. To accomplish this, it was necessary to separate the title for water from the land title. These arrangements were formalised somewhat under the COAG arrangements in 1994-95.

Godden (1997) and Freebairn (2003) depict how these current arrangements work. The main change is a recognition that the aggregate demand curve for water is downward sloping (see Figure 2). The price for water is determined where supply, which is considered to be inelastic and fixed at the quantity of water available in the system, equates to aggregate demand. To account for trading it is recognised that users have different demands (see Figure 3). By fixing the amount available along the horizontal quantity axis (thus accounting for an inelastic supply schedule), two competing users demand schedules can be imposed on the diagram. If 0Q2 is allocated to user 1 and QwQ2 is allocated to user 2, the market is not in equilibrium. User 2 values the water more highly than user 1, Q2Q1 of water is exchanged and the equilibrium is reached at Q1 deriving price Pw1.

FIGURES 2 AND 3 HERE

3. Limitations of the Current System of Allocating Water

The point to recognise is that the existing arrangements are not a freely functioning market system. All it really achieves above the old existing system is the ability for users to trade in a limited fashion and the (as yet unrealised) potential for governments to buy environmental flows from existing users. Within the existing water markets the amount traded is relatively thin. Temporary flows account for most of this trade and permanent trades are rare. Those who have always had access to it still use most of the water. While activity and prices in the market do rise when water is scarce, trading would appear to have little impact on the overall spatial and temporal flows through the irrigation network.

3.1 Is the view of the demand for water the correct one?

This approach to allocating water focussed analysts attention on to the specification of demand. The aggregate demand for water is usually assumed to be a linear and

continuous function. Yet, as Godden (1997) and Freebairn (2003) acknowledge in their models of the water market, individuals have very different demand schedules, causing the aggregate demand schedules to lose their smooth continuous nature.

To get a smooth specification of aggregate demand requires specification of the Sonnenshein-Mantel-Debreu conditions. These conditions assume that all consumers have the same preferences and proportional incomes (Keen 2001). Clearly, as in the water market, in a situation where the direction and benefits of trade are dependent on differences in demand, imposing these conditions is not an option. These limitations can partially be overcome by estimating demand for water for similar groups of consumers, as Zaman, Davidson and Malano (2004) attempt. Yet within each group of water users, the Sonnenshein-Mantel-Debreu conditions are still implicitly applied.

Furthermore, while it is generally acknowledged that the demand for water is derived from the demand for the products produced from it, little mention is made of the logical problems associated with this view. In the demand for a finished good, it is generally acknowledged that consumers are motivated by a desire to maximise utility. The same thing cannot be claimed with the demand for an input, where the buyers are producers motivated by a desire to maximise profits. Also any of the normal conditions associated with estimating consumer demand, such as the Engel, adding up, Cournot, symmetry, negativity and homogeneity restrictions, may not hold for an input. This leads to the more insidious problem of whether the independence of supply and demand exists in this market (something that is discussed in more detail below).

3.2 Is the supply schedule perfectly inelastic?

Most economic analysts view the supply of water as being perfectly inelastic and set equal to the quantity of water available for sale[2]. The advantage of this approach is that the identification problem (i.e. trying to determine whether changes in prices are due to changes in demand or supply or both) is nullified as all price changes are assumed to be

the result of changing demand. This does not seem to be an unreal assumption to make, as a certain quantity of water is usually available to distribute. In most free markets the supply schedule is upward sloping. However, both these situations may not exist in the market for water. The assumption of an inelastic supply is not only unrealistic, but also has important ramifications in the analysis of the market.

Irrigation systems are not dissimilar to other projects that have a large investment in infrastructure. These are generally classified as decreasing cost industries. Given the overcapacity that is built into the system, these types of industries display decreasing average costs. As is well known, if average costs are declining, so are marginal costs and marginal costs will be lower than average costs. Thus, the supply curve may well be downward sloping.

This argument could be dismissed by recourse to an assumption that most of the costs of an irrigation scheme are those incurred in construction and are therefore sunk. It is further complicated by the fact that the supply of water in the existing system that allows trading is derived from existing entitlement holders, not from a Catchment Management Authority. Importantly, the assumption removes analyst's attention from the supply of water, which is surprising given that the product is assumed to be scarce. How it came about that the true suppliers of water would be excluded from an analysis can only be guessed at.

Another important dimension to treating water supply as perfectly inelastic is that the many uncertainties that are inherent to the water market are glossed over. For instance, it is difficult to assess the temporal aspects of the market, both within and between seasons, if supply is assumed to be given. Furthermore, the role of uncertainty is difficult to understand with a fixed supply schedule. This is especially the case, as the Catchment Management authorities tend to eliminate downside risk in the manner in which they announce allocations.

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[2] While it cannot be proved, it is interesting to note that in most economic assessments of water markets supply is assumed to be inelastic, while in hydrological studies demand is assumed to be perfectly inelastic

Godden (1997), Lim and Dwyer (1999) and Read, Sturgess and Associates and Watson (2001) all concede that the possibility of a natural monopoly exists in the water market. Further evidence can also be found in the early history of running irrigation schemes in Australia. In the late 1800s and early 1900s many user dominated irrigation trusts were declared bankrupt, despite the fact that the government paid the debts they incurred in constructing them (Davidson 1969).

If the supply curve for water is downward sloping, then three important implications arise. First, it might explain why water was always sold at a loss. In such markets the socially optimal price (i.e. where supply and demand are equal) will be below the average cost of supplying water. Second, if water supply was privatised, then a monopolist could enter the market and, by equating marginal costs with marginal revenues, restrict supplies and force up prices. Third, decreasing cost industries are recognised as being a form of market failure and one reason that may justify government intervention.

3.3 Is supply and demand independent in the water market?

It must be asked if buyers and sellers are truly independent in the fixed entitlement with limited trading water market. A necessary assumption of a market is that the actions of producers determine the supply schedule, while those of consumers determine the demand schedule. In the existing water market, these are one and the same people. Wijedasa and. Malano. (2002) found that the demand for water differs through out a season. This means that water users may react differently at different times during the year. An existing entitlement holder can make decisions to buy water in one period and sell it in another period.

How is it possible to analyse any market using conventional techniques, when supply and demand are interdependent? Theoretically and practically it cannot be done. This concern could be nullified somewhat if true suppliers of water (the Catchment Management Authorities) were included in the economic formulations in the market and

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and equal to the evaprotranspiration rate.

demand was modelled from a users perspective, while the water traded was reduced to a residual balancing activity.

3.4 Does it matter if the market for water is thinly traded?

It should be noted that the existing trade for water only accounts for a small proportion of all the water allocated in the system. Zaman *et al.* (2004) report that approximately 20 per cent of all the water allocated in 2003 (a relatively dry year) was traded, most of this being temporary trades. Crase, O'Reilly and Dollery (2000) and Freebairn (2003) argue that the lack of trade reflects uncertainty about future claims for water, the high costs of transfer and inadequate specification of the property right.

The problem with thinly traded markets is that one gets a false sense of the underlying forces driving the market. Perhaps the factors that drive the decisions to access water from their entitlements are different to those that drive the full market for water. Further, the possibility of an individual exerting undue influence on the traded water market exists. In other words, it could be asked: Is the price derived in the market truly representative of the whole market? Furthermore: can accurate policy decisions for the whole market be based on the price derived from the traded water market? Maybe not!

3.5. Is equilibrium even possible in this market?

Given the problems raised above, it must be asked: Is equilibrium even possible in the traded market for water? It would seem that such a situation might only occur rarely in times when water is scarce. Mostly, there is excess capacity in the system, especially if the supply schedule is downward sloping and where the systems are run conservatively (as in Victoria). It is entirely possible to have the supply schedule far to the right of the demand schedule (see Figure 4, where the normal conditions regarding the slopes of the supply and demand are assumed to hold). In such a case, supply and demand cross below the quantity axis, resulting in negative prices. An alternative situation can be envisaged when water is very scarce and the supply schedule is totally above the demand curve, indicating that along its whole range, consumers do not have the capacity to pay for any of it. In these cases, supply and demand do not cross at all.

FIGURE 4 HERE

It would seem that it is possible to think of situations where equilibrium does not exist. To establish the fact that it does, really requires more research. It should however be noted that this situation only really arises from the fact that the market is thinly traded and is run to complement an existing fixed entitlement allocation system.

3.6 Is water a stock or a flow?

Intriguingly, it is interesting to note that the horizontal (quantity) axis of most, if not all, descriptions of the market are specified in physical units (i.e. megalitres of water). Yet, the entitlements are all based on flow (i.e. megalitres per annum). Even proponents of environment flows argue in terms of a fixed physical unit of allocation. Watson (2003) addresses this issue by making the point that if the target variables were turned into instrumental variables of the flow of water, environmental arguments would make more sense.

If the argument applies to environmental flows, then surely it is applicable to the whole system, the farm sector included. Hydrologists control the system by measuring flows. The capacities to move and pump are all specified in terms of a flow. Farmers measure the amount of water they need as an evaprotranspiration rate, which is a flow. So if flows are important to those who use and control the systems, why is it that economists and policy makers persist in using the stock of available water?

By representing the quantity as a flow may allow policy makers to concentrate the issue of the rights current holders have to water, how they may be altered and what implications this has. Presently, with physical units of a stock being analysed, the true nature of service being provided, i.e. the regulation of water, is hidden.

3.7 Is water a right or a good or a service?

With the present structure, existing water holders control the system, as they have a ‘right’ to water. However, one of the real problems regarding irrigation in Australia lies in the belief that the provision of water is a ‘right’. In other words, it is believed that

people have a right to certain quantity of good quality water for drinking and agricultural pursuits.

It should be noted that the concept of 'rights' is a particularly North American thing embodied in their culture, political mindset and system of distributing natural resources. They are not a particularly Australian ideal, or for that matter, one that comes from a British heritage. Rather than enshrining the ideals a society desires in a set of prescribed, inalienable and overriding rights, as they do in the United States, in Australia a much more flexible approach is taken. Be that as it may, thinking of water as a right, in the United States definition of the term, leads to the conclusion that the costs of providing that 'right' must be ignored. This concept of water rights is questioned, but not challenged in Australia, and is used by both sides of the current debate on environmental flows. Farmers and irrigators believe they have a 'right' to water, while the conservationists believe they have a 'right' to a clean environment. However, if the costs of providing these rights are considered, then water is not a right, but is a good, which can be traded like any other commodity. The belief now embedded in the current system of allocation is that water availability and its supply is not a 'right' that people can insist upon. It is a 'good' that comes at a cost and which people can buy and trade it as they see fit. What is tragic is that the owners of the 'right' to pump water are the first arbiters of who can use the water and yet they pay little for those monopoly 'rights'.

However, is the provision of water a 'good'? While it is accepted that it is not a right, perhaps it is not a good either. It could be a 'service'. According to Petit (1987, p.314) the "…neoclassical approach, … attaches little theoretical importance to the distinction between goods and services." Yet there is a subtle difference between the two. Goods deal with tangible products, while services account for intangible products. In another way of looking at this, Noble (1995) argues that services cannot be stored or transferred. So sectors such as finance, transport and (according to Noble) water are all services. The real argument is, what is being dispensed by the Catchment Management Authorities and what are users buying and trading. If it is water *per se*, then it is a good. Or is it the ability to regulate water, which would make it a service. To treat the water sector as a

service industry changes the whole way the market is dealt with. Thinking of water as a service allows buyers and sellers to think about periods pf adequate service and inadequate service, not whether they get their full entitlement or not. It allows participants in the market to think about temporal questions and channel sizes.

3.8 Does the allocation system achieve its objectives?

The present system should ultimately be judged by its abilities to meet its objectives. That would mean that it delivers water where and when it is needed. Consequently, it must be asked if it is achieving the savings in water use that are needed to provide more water to the environment? As it turns out, it is too early to resolve this question and more research needs to be undertaken on it. If water is to be saved so that it can be allocated to the environment, it could be asked should the savings in water flow be achieved from the users or from the system? At a more fundamental level, the need for system of allocating water should be investigated, as the whole issues is dependent on assessing how scarce is water?

3.8.1 Has allowing trade led to greater water availability?

It would appear that this question is yet to be addressed by any analysts in any detail, as the allocation system has not as yet actually had a chance to deliver. However, a number of issues can be raised which may shed light on this question. It is well known that opening a market up to trade leads to an increase in overall efficiency. Inefficiencies are traded away as production occurs in its most optimal place. So if there is greater efficiency, shouldn't there be more water available? Well not necessarily.

Allowing trade within a fixed entitlement allocation system possibly causes more problems than it solves. The rules of the trading scheme mean that only existing account holders can trade in the market. New entrants face considerable costs in accessing the market. So the possibility of achieving efficiency gains through transferring the product would appear limited, especially seeing that not much is traded. Few of the inequalities evident in the original distribution of water licences and the inefficiencies derived from

them are not addressed by these reforms, except if in the rare case of when a permanent trade in water entitlements occurs.

Most importantly the over allocation of water in select areas may well have been enhanced by these reforms. As Young and McColl (2003) point out the new arrangements provided those who held water licences but had never developed irrigation infrastructure on their land (i.e. dozers or sleepers) with a valuable resource that they could trade. Prior to trading, water not used stayed in the reservoir. Some governments have attempted to institute rules that suggest that water entitlements should be surrendered if are not used. Yet what is considered use, if it is on-sold, is it used? It would appear that allowing trade may have increased the pressure on what was considered to be an over stretched system.

3.8.2 Should the savings in water flow be achieved from the users of the system? It would appear that the bulk of the savings of water are to be made from the users, not from efficiency gains from running the systems more efficiently. This belief is based on the fact that the major change in the fixed entitlement system was made to allow trade. Sure, Catchment Management Authorities had to charge prices that cover their costs, yet the only way they earn income is from the sale of water. Sell more water, at a fixed price and their revenues rise. If they sell less, then their prices need to rise to cover the losses[3]. It could be asked if the users have the capacity to save the required water?

One way of saving water from users is to restrict the allocations, forcing them to buy water on the market, thus increasing the prices for water. This would mean that farmers would use water more prudently and invest in technology that uses less water. Such an approach implies that the costs of altering the on-farm water distribution technology are low. Yet this is not the case. Any move from flood to drip irrigation technology depends of the marginal increases in water costs and by how much extra value is obtained form the output. Given that water prices are currently so low, it could be argued that water

[3] Such a response is dependent on the true slope of their average cost functions. If they are upward sloping the response is unambiguous. If the average cost function is downward sloping, then it could rise or fall.

prices may need to increase by a lot to achieve this, especially if the output is sold on the export market. Another way of getting the price to rise significantly, is for the government to step in and force the price up by buying any water that becomes available and use it for environmental flows. Such an approach is not ideal as what it would do is reward the dozers and sleepers and encourage a degree of speculation into the market that may be destructive.

Given these problems, it may be more prudent to think of water savings being derived from the distribution system. Yet, there is little incentive to do this. Hence, it could be surmised that the current system for allocating water may not achieve this objective.

3.8.3 Is water really a scarce resource in Australia?

If water is not a scarce resource in this country, then all the efforts made to resolve problems in this field are misguided. However, some doubt exists about just how scarce water is in Australia.

It is usual to think of Australia as a dry country, one of the driest continents in the world. It is this sort of thinking that resulted in the development of irrigation schemes in the first place. It is the sort of thinking that persists today in comments that underlie beliefs regarding the move to a mature water economy and the need to find water for environmental flows. The National Land and Water Resources Audit (2000) would appear to confirm this view. Yet, it must be asked if water was once scarce without the provision of irrigation, why is it still scarce once the service was provided and why do the prices for water remain low?

To understand these questions it is necessary to first understand how water is measured. In terms of the distribution and consistency of rainfall, there is little doubt that Australia is a dry place. Alternatively, in terms of available and useful/useable supplies of water per head of population, Davidson (1969) suggested that Australia was one of the wettest countries in the world. In Australia, because of the infrastructure invested in irrigation schemes, there is more water available for use than in any other country in the world,

with the exception of Iceland (Lomborg 2001). So if regulated supplies of water are scarce in Australia, one might like to ask how much more is required to regulate the rivers and expand the environmental problems that are believed to result from it.

The real issue is that the abundance of water results in it being a low cost input, which as a consequence, is not always used as wisely or as efficiently as it should be. Where water is used to produce high value exotic crops (such as cotton and rice) rather than low value pastures, water becomes a scarcer resource because exotic crops are more dependent on it. To get the highest returns the least expensive techniques of flood irrigation are employed. These techniques can be employed because water is readily available at such a low cost. If water was not so available, its price would be higher and farmers might conserve it by employing more efficient practices. While these issues are at the heart of why irrigation does not result in a drought-proofed state, they also reveal that water users do not consider water to be a scarce resource.

To put it another way, the only way that water could become scarcer is if the demand had expanded more than its supply. Given the evidence from Lomborg (2001) and if there is excess capacity in the system at select times, then it would be impossible to argued that water is scarce. Rather, the issue of scarcity arises from the way the system is run on a temporal basis. However, it does seem feasible that demand may have risen, as sleepers are now active in the market, the environmental lobby is requesting more water and in places were water was over allocated farmers are requesting more reliable supplies. Supply may not have expanded. Why the price did not rise to equate supply and demand was because it was regulated at a low level.

This leads to the conclusion that the problem is possibly not one of scarcity, but one of how water is allocated. A scarcity problem could be solved by providing more product, say by running a more efficient system. An allocation problem can be tackled by either freeing up prices and/or changing the allocations in the market. This is a political problem, which has economic consequences. Scarcity is an economic problem that has political consequences.

4. A Free Market Approach to Allocating Water

Given the problems with the current method of allocating water, it must be asked if it would not be simpler to resume all the entitlements to water and let users buy it from the Catchment Management Authorities in an open market? By freeing the market up in this manner, it could be argued that societies benefits would be maximised. However, such an approach has a number of flaws that make it unlikely to be ever considered.

In this view of the water market supply is not fixed and perfectly inelastic. Godden (1997) suggests that as the marginal costs of water are low and the supply curve is upward sloping. The benefits that accrue from free and open trade in water are maximised and price becomes the economiser of information, regulating suppliers and demanders in a transaction free world, without any government intervention[4].

It could be suggested that moves that allow more trade in water are always beneficial. The belief is that the more open and free that a market is the greater the benefits to society are and the lower are the costs of controlling the market. The ideal of a perfectly competitive will however, only occur if a strict set of assumptions holds. It could also be the case that extraneous events in the water market are such that these benefits cannot be realised. These include those already mentioned surrounding the specification of the demand and supply schedules (see Sections 3.1 and 3.2).

Musgrave (1981) argues that the assumptions of a perfectly competitive market can be classified into negligibility, domain or heuristic categories. Negligibility assumptions are those that exclude irrelevant issues. Domain assumptions are those that are used to specify the conditions under which the theory applies. Heuristic assumptions are those that are known to be false, but which are made in order to gain a more general understanding. While it is generally thought that the assumptions that underlie perfectly

competitive markets (i.e. that there are numerous buyers and sellers, the product is homogeneous, freedom of entry and exit and information is perfect and costless) are in the negligibility category, this is not the case, particularly in the market for water. Furthermore, as they are rarely investigated or altered they are not of the heuristic type either. These are domain type assumptions. Hence, one could question whether the perceived benefits from a perfectly competitive market would ever be realised, either in the market for water or in any market for that matter. This finding should not be used to question whether a freer approach to the market would be beneficial. Rather, all that is being said is that a perfectly competitive market structure is unlikely to achieve the desired benefits, as the domain assumptions are too restrictive.

The existence of a decreasing cost industry (discussed earlier in Section 3.2) is not the only form of market failure evident in the market for water. Many analysts (see Beare and Heany 2001 amongst many others) have recognised that the provision of water may cause externalities. Most of the arguments surrounding the issue of greater environmental flows are based on mitigating the effects of an externality. While market solutions exist to correct for market failures, it is generally accepted that the transaction costs associated with them in the market may well require a more formal response from the government. Freebairn (2003) and Edwards (2003) both recognise that because of reuse issues (i.e. that some water may be returned to the river) and the inability to exclude certain users, water may display the characteristics of a public good. Finally, it would be difficult to argue that perfect information exists in this market, as the aim of running the schemes is to overcome uncertainty in the supply of water.

Rather curiously, it should be noted that a free market for water would appear to suffer from all the characteristics that have been identified with market failure. The problem then is that if the Theory of Second Best holds, rectifying one market failure may not result in an improvement in social welfare. By recognising that significant market failures exist, it can be concluded that a freely functioning market in which users buy

[4] To obtain this type of market structure would require users to relinquish their existing entitlements and to trade more openly in a market competing for the available supplies of water, something that would be

water directly from a Catchment Management Authority will not deliver the benefits economists expect from it. Hence, aiming for the idealised free market approach may not be feasible and some form of government-modified market is required.

5. An Alternative Entitlement System

Given the limitations evident in the fixed entitlement systems, both with limited trading and in the absence of trading, and with a free market in water, is it possible to specify a system in which many of the current problems evident in allocating water are overcome? Such a system should endeavour to attain all the flexibility of an open market system in which water is used in its highest value use, yet overcomes the failures evident in that type of market. The system presented below is only a suggestion, offered more than anything to prove the point that many alternatives exist to the seemingly vexed question of allocating water. It is presented more to provoke thought and to encourage some lateral thinking on the issue of allocating water. This alternative system relies on controlling quantities, rather than on attempting to obtain a competitive price to allocate water.

It should be remembered that at the heart of any allocation system is the regime of property rights that underpin it. Given that it would seem that users fixed entitlements to water prevents greater flexibility in the market, perhaps the government should resume all existing water licences. This can be done, admittedly not easily, by either reducing the allocation to a minimal amount and putting the rest of it on the market, or by buying them out. Reality would seem to dictate that the supply of water is controlled by Catchment Management Authorities. If, as suspected, they are natural monopolies, then it will be necessary to curb their activities with government regulations of some sort or another. This may even imply that governments should take total control of them. So far this is little different to the free market approach specified above. What is different in this alternative system is what buyers and sellers would trade in this market and who controls it.

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politically difficult to achieve.

If analysts viewed the water market as a service (see Section 3.7 for more details), then Catchment Management Authorities would sell the benefits of regulated flows of water and buyers would purchase them. For instance, a farmer could go to the Catchment Management Authority with the desire to plant crop that requires water to survive. The Catchment Management Authority can accept the contract to supply an amount of water to keep soil moisture at select levels (or within a set of specified parameters) on that crop. Farmers pump water on to the crop when the Catchment Management Authorities advises them to do so. It should be noted that the environment (through an agent like the Government) could conduct business in the same manner. Thus, water in this system is sold as a service, not as a good. The Catchment Management Authorities are in the business of selling soil moisture, not bulk water. Users are buying moisture. Between the two could be a set of agents who monitor and facilitate the trade between buyers and sellers.

A clear implication of this approach is that the importance of determining the price of water, a holy grail if you like of the current debate on water allocation, is no longer important. If anything, the price of providing a service is what becomes important under this system. This opens up the question of whether water should be controlled by a price mechanism, or by a quantity mechanism. Weitzman (1974) puts forward a compelling case for when a market, which is dominated by uncertainty and externality concerns, should be controlled by price or quantity.

The advantages of selling the service attributes of water are numerous. Initially, the market for water is far more flexible and the benefits approximate those of a free market (which is basically what it is). Most importantly, the incentive to sell more water to existing customers is not as strong. Rather, Catchment Management Authorities have every incentive to spread the flow of water as lightly as possible, in order to satisfy as many customers as possible. Further, the current practice of users' requesting water and then cancelling it could be minimised. In addition, the problems of enriching dozers and sleepers are eliminated. Trading water between catchments or even interstate (an issue

not addressed above, yet very real in the minds of policy makers) is more readily available, as the real suppliers (the Catchment Management Authorities) are dealt with. Finally, as the Catchment Management Authorities own the water from the dam, through the channels and farms and back to the river, the vexing issues of externalities and public goods are resolved more easily. Thus, the Catchment Management Authorities are responsible for any externalities that occur and could attempt to solve it using a Coasian approach. Any water reuse problems are the preserve of those who own them.

Several problems still exist, especially if the natural monopoly instincts of the Catchment Management Authorities are not reined in. Understanding and estimating the demand for water are still not resolved. Monitoring soil moisture on a catchment basin is not easy, but is also not beyond being technically solved. In addition, the question of valuing the environmental flows is still a problem.

6. Summary

It can be concluded that analysts, in assessing a move from a fixed entitlement system to one that allows trading, still need to come to terms with a host of problems that may affect the expected outcomes from that process. These include a better understanding of the demand conditions in the market and the need to come to terms with the fact that the true suppliers in the market are excluded. The trade in water is undertaken by existing water right holders, thus making it difficult to determine the outcomes from the system.

A number of unknowns were identified which need further research. Initially research needs to be conducted to illicit the true nature of supply and demand in the market. Also needed is research to determine the true impact of market failures on the market. This should lead to an analysis of the different ways water could be allocated. Finally, research needs to be conducted on whether water should be regulated using quantities, rather than the preferred mechanism of price.

Not withstanding these researchable issues, it can be concluded that people do not appear to value water, as its price is low, and that not enough is allocated to environmental flows. Viewing water as a commodity in a fixed entitlement system that allows trade, does not seem to address these issues adequately. All the fixed allocation system with limited trading does is enrich existing holders of a water entitlement and force Catchment Management Authorities to sell more water to raise revenues. There are alternatives to this approach. One, which may be used, is to allow Catchment Management Authorities to sell water as a service.

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Figure 1: A Fixed Allocation System.

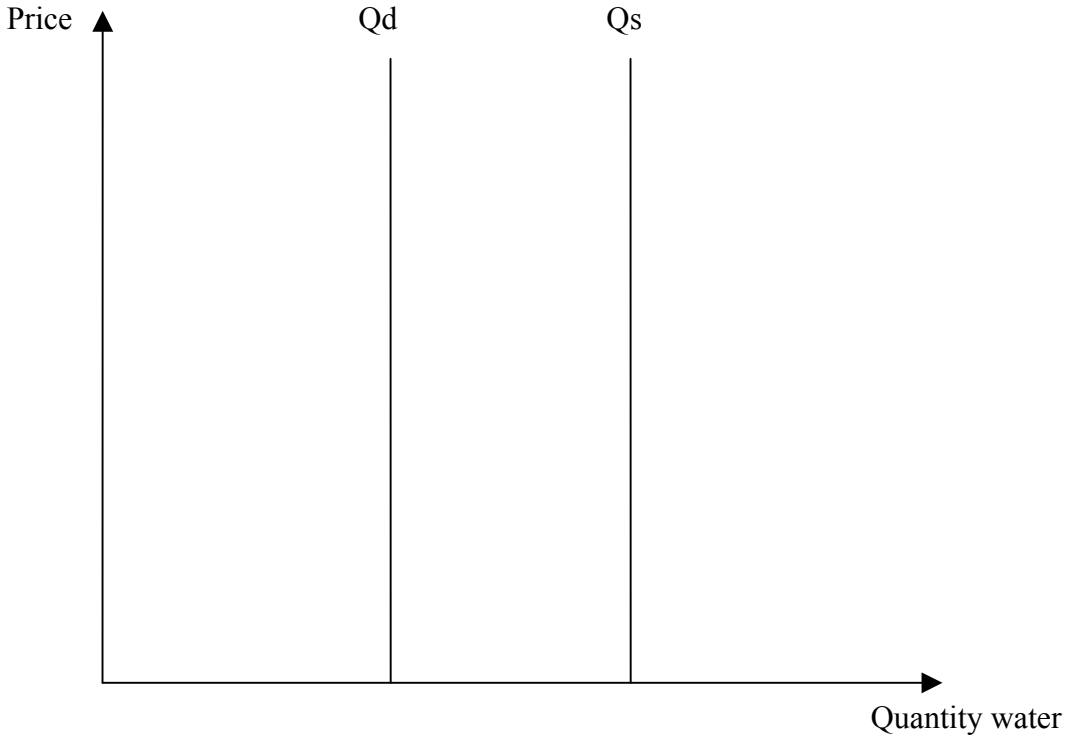


Figure 2: A Fixed Allocation System that Permits Trading: Aggregate Demand.

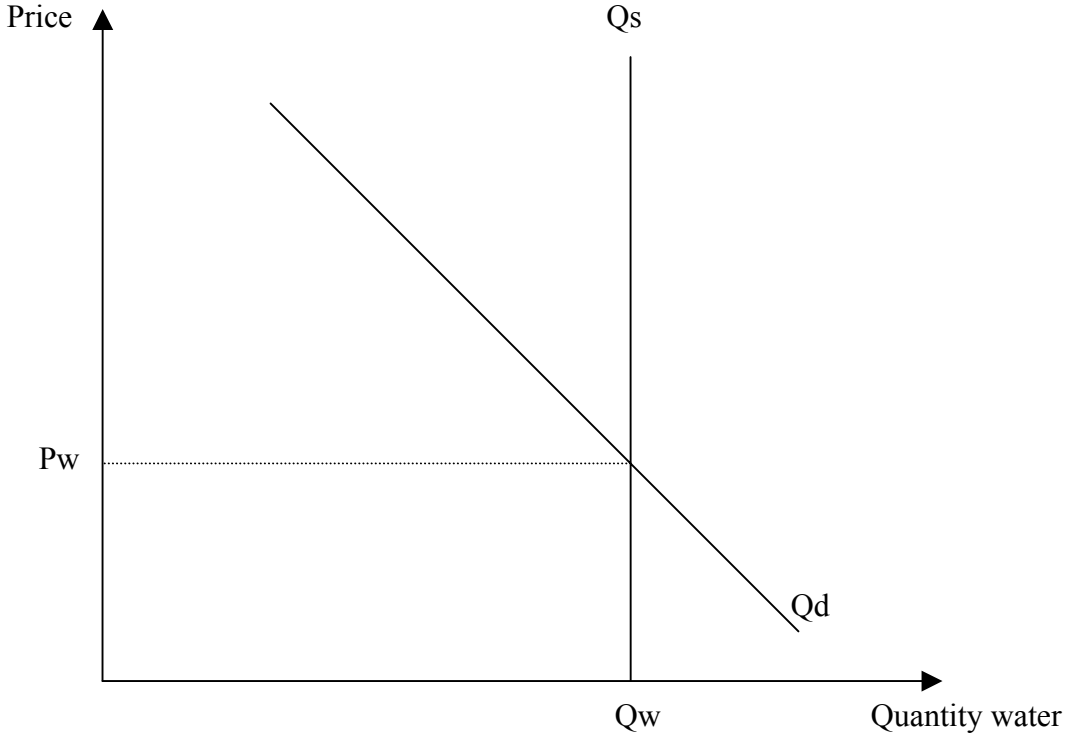
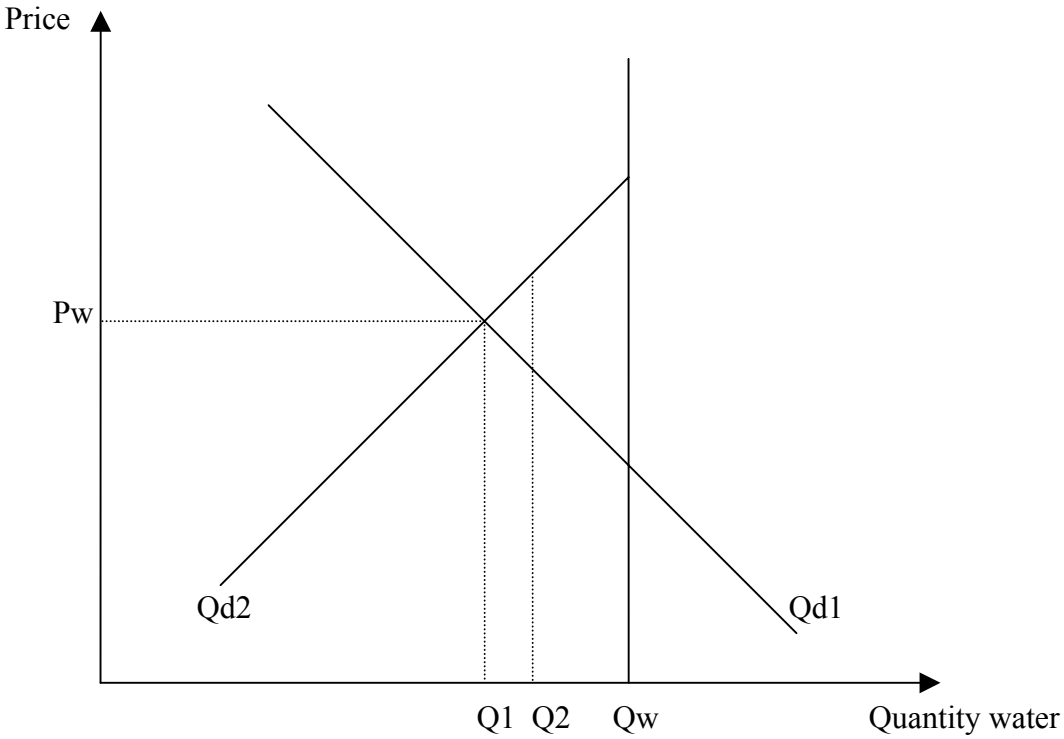


Figure 3: A Fixed Allocation System that Permits Trading: Multiple Use.



Source: Freebairn (2003)

Figure 4: Disequilibrium in the Market