History, Statics and Options: Transaction Costs in Institutional Change for Water Resources[1]

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ABSTRACT

Institutions for use of natural resources, including water resources, typically encompass assignments of property rights to various levels of government, private entities and common-property organisations. Institutional reform often involves a change in these property rights, such as devolution of property rights from governments to private resource users.

In institutional economics it is generally accepted that institutional change occurs to reduce transaction costs incurred in economic exchanges and regulatory actions. In many situations, including reform of institutions for use of water resources, there are two additional parameters that affect, or should affect, decisions for institutional change: (i) constraints arising from institutional history; and (ii) option values associated with some institutional structures under conditions of uncertainty about the future. In this paper, a transaction-cost framework is used to incorporate these parameters into decision-making for institutional change. Institutional reform for water use in the Murray-Darling Basin is used as an illustrative example.

INTRODUCTION

In the early to mid 1990s, there was a lot of attention being given by resource economists and policy makers to systems of private property and tradability of water entitlements. The Council of Australian Governments was finalising agenda for water reform that included requirements to define water entitlements and property rights, with some implicit suggestion that these be private-property rights, and to establish market institutions for the allocation and re-allocation of these entitlements. Simultaneously, the rate of institutional reform was at a

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peak in the Murray-Darling Basin with newly implemented "water markets" in New South Wales and processes well under way to privatise government-owned group irrigation schemes in New South Wales and South Australia. There were, however, problems and difficulties in designing and implementing some institutional reforms. For example, in New South Wales difficulties were encountered in defining the security of supply associated with water entitlements; determining allocations of water between consumptive uses and the environment while accommodating steadily increasing public demands for improved environmental management; and defining distributions of rights between individual water users and collective organisations in group irrigation schemes. In both New South Wales and Victoria private water entitlements were being reduced by governments to provide for environmental flows and increasing restrictions were being applied by state governments on water use so as to reduce environmental impacts of irrigation. The Murray-Darling Basin Commission was continuing efforts to exert management control over the entire catchment with respect to levels of water but was impeded in doing so by resistance from some state governments.
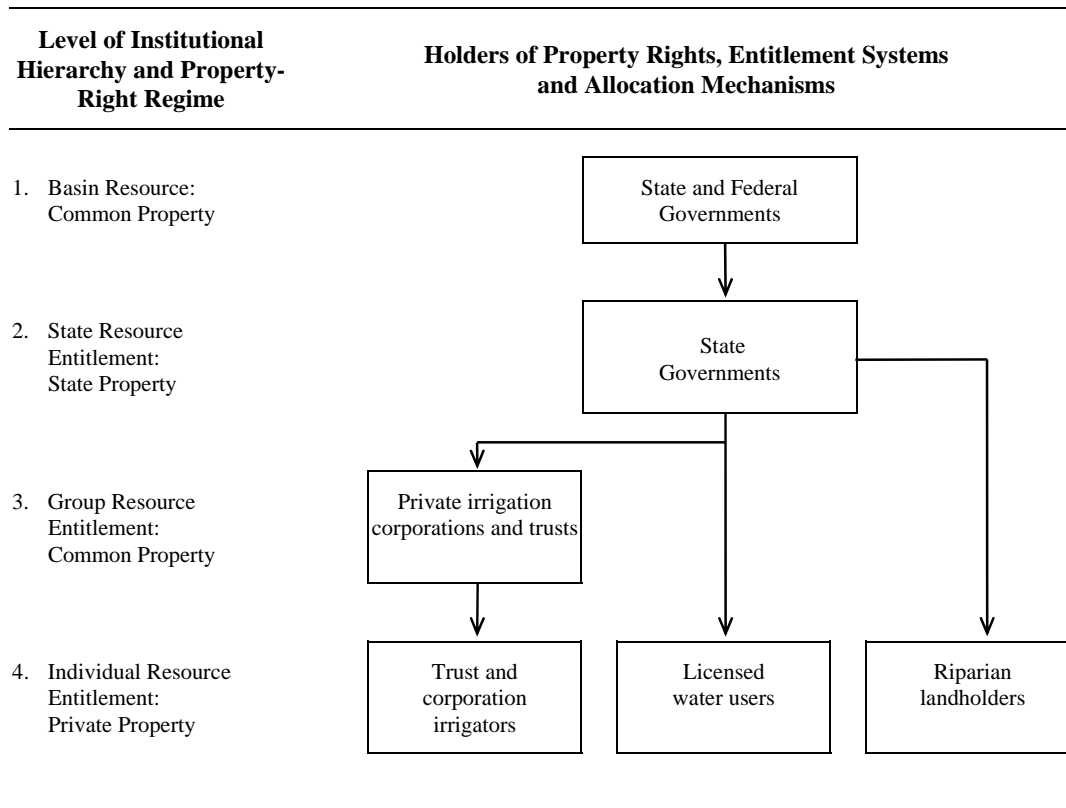
These problems associated with institutional reforms in water use made it apparent that there were many issues associated with allocation of water use that would not easily be resolved by enhancing private property rights in the resources. This is not to deny the economic benefits that have probably resulted from enhancement of private property rights and the introduction of water trading. Rather, it is recognising that the water resource of the Murray-Darling Basin is a large and complex common-pool resource. Many of the issues being grappled with in relation to institutional reform related to collective-action dilemmas and externality problems that complicate and limit the effectiveness of private rights and other existing property-right structures as institutions for resource allocation.

It has become apparent that institutional reform for water and other natural resources must involve more than agenda for creating private property rights in water resources and placing faith in market allocations. Instead, attention should focus on distributions of property rights across private resources users, cooperative organisations, communities and various levels of government. This paper develops a conceptual model for institutional choice that is able to accommodate distributions of property rights across multiple entities.

INSTITUTIONS AND TRANSACTION COSTS

The economics literature relating to institutions for the use of natural resources typically considers institutions in terms of four discrete property-right regimes: state property, common property, private property and open access (Bromley, 1991; Stevenson, 1991). This is a grossly over-simplified representation of institutional structures. For most natural resources, institutional structures are complex with simultaneous existence of multiple types property rights, entitlement systems and mechanisms of resource allocation. For example, institutions for use of irrigation water in the Murray-Darling Basin can be represented as a hierarchy of property rights with elements of state property, common property and private property (Figure 1). Decision-making powers for the allocation and use of water resources are distributed amongst the different parties that hold property rights.

**Table 1: Property-Rights Hierarchy for Surface Water Use
in the Murray-Darling Basin**

Level of Institutional Hierarchy and Property-Right Regime	Holders of Property Rights, Entitlement Systems and Allocation Mechanisms
1. Basin Resource: Common Property	State and Federal Governments
2. State Resource Entitlement: State Property	State Governments
3. Group Resource Entitlement: Common Property	Private irrigation corporations and trusts
4. Individual Resource Entitlement: Private Property	Trust and corporation irrigators / Licensed water users / Riparian landholders

An historical examination of institutions for water use indicates that the development of this institutional structure over the past century has been characterised by two general features.

i. Changes in institutions of water allocation have been incremental, making changes at the margin to an institutional structure that originated in English common law.

ii. Institutional changes involving transfers of property rights down the institutional hierarchy appear to have been much more easily and quickly achieved than changes involving transfers of property rights up the institutional hierarchy. For example, institutional change was achieved quickly and with relative ease in creating common-property rights for group irrigation schemes and introducing market institutions of re-allocation of water entitlements. Both of these changes involved a transfer of property rights down the hierarchy from state governments. On the other hand, institutional change proved difficult for attenuation of riparian rights during enactment of water resources legislation at the turn of the century, and in the more recent creation of institutions for interstate common-property rights. Both of these changes involved a transfer of property rights up the institutional hierarchy, in the first case from private individuals to state governments and in the second case from state governments to an interstate common-property organisation (the Murray Darling Basin Commission).

These characteristics of institutional development are consistent with two concepts from transaction-cost theory and new-institutional economics. Firstly, the motivation for

institutional change over the past 100 years has been the reduction in transaction costs incurred in economic exchanges and regulatory actions undertaken in pursuit of particular objectives for resource use. Secondly, institutional change is constrained by transaction costs arising in the costs of transition from one institutional structure to another.

For want of established terminology, the transaction costs of resource allocation can be referred to as "static transaction costs" and the costs of altering the institutional structure "dynamic transaction costs".

The existence of dynamic transaction costs may result in path dependencies and irreversibilities in institutional change, defined in the broad sense of costly rather than strict irreversibility. Institutional change is path dependent to the extent that for a given institutional structure, some incremental changes to this structure have lower transition costs than others and these transition costs are determined in large part by the existing institutions. For example, development of institutions for management of water resources across the Murray-Darling Basin has been made costly and difficult by previous institutional decisions relating to state boundaries and state property rights over water resources. For the past 100 years, the reluctance of the states to cede property rights over the water resources has hindered the development of institutions for allocation decisions between state jurisdictions. High static transaction costs under the existing common-property institutions of the Murray-Darling Basin Commission have frustrated efforts to alter resource allocations across the basin in ways that would confer net economic and environmental benefits. High transition costs appear to have prevented development of institutions that would reduce the static transaction costs (such as allowing for interstate trade of water entitlements) and allow for more efficient resource allocations.

Irreversibility of institutional changes arises where the transition costs of making an institutional change are exceeded by the transition costs of reversing that change. This may occur, for example, where transition costs include political repercussions of changing property rights. Horn (1995) suggests reasons why there may be net political costs associated with some transfers of property rights but not others, and also why a particular transfer of property rights may be very politically costly to reverse. This reasoning has to do with the concentration of costs and benefits associated with a proposed institutional change. Generally speaking, the political ramifications of institutional change are greater if the costs and or benefits of change are incurred by small and/or concentrated groups in society that are able to mobilise resources for political lobbying, as opposed to large and/or dispersed groups. Consequently, it is relatively easy (low cost) for political decisions to be made that transfer property rights from a large dispersed group to a small concentrated group, but relatively difficult (high cost) to make the reverse change.

The concepts of path dependency and irreversibility have direct ramifications for institutional change within an hierarchical model of institutions for use of natural resources. For the most part, property rights at lower levels of an institutional hierarchy tend to be held by smaller societal groups with more focused interests than at higher levels in the hierarchy. Taking the example of the institutional hierarchy for regulation of water resources in the Murray Darling Basin, property rights held at the top level of the hierarchy are held in common by the state and commonwealth governments and the respective members of the Australian public: a large and dispersed group. Down the hierarchy, property rights are progressively concentrated in state governments, common-property irrigation organisations, and individual property-rights holders in particular irrigation industries or regions. The history of

institutional development suggests that it is relatively easy (low political costs) to transfer property rights down such an institutional hierarchy, but difficult (high political costs) to transfer property rights back up the hierarchy. Furthermore, if decisions for institutional change at any time are constrained by past institutional development, then the corollary holds that decisions for institutional change may constrain the set of possible institutional changes in the future through affecting future transition costs. This represents a new transaction-cost consideration in the problem of institutional choice: the dynamic transaction cost arising from constraints on future institutional options imposed by a current institutional change.

There are thus three transaction-cost considerations relevant to institutional change, indicated in Figure 1. Firstly, a reduction in static transaction costs is the motivating force for institutional change. Secondly and thirdly, dynamic transaction costs of two types are incurred in institutional change. These comprise transition costs and an intertemporal opportunity cost. The latter arises where institutional change in the current period increases the transition costs of possible future institutional changes, ie current institutional change reduces the flexibility of the institutional structure to respond to changing circumstances in the future. Both types of dynamic transaction cost arise as a result of path dependencies and irreversibilities in institutional change.

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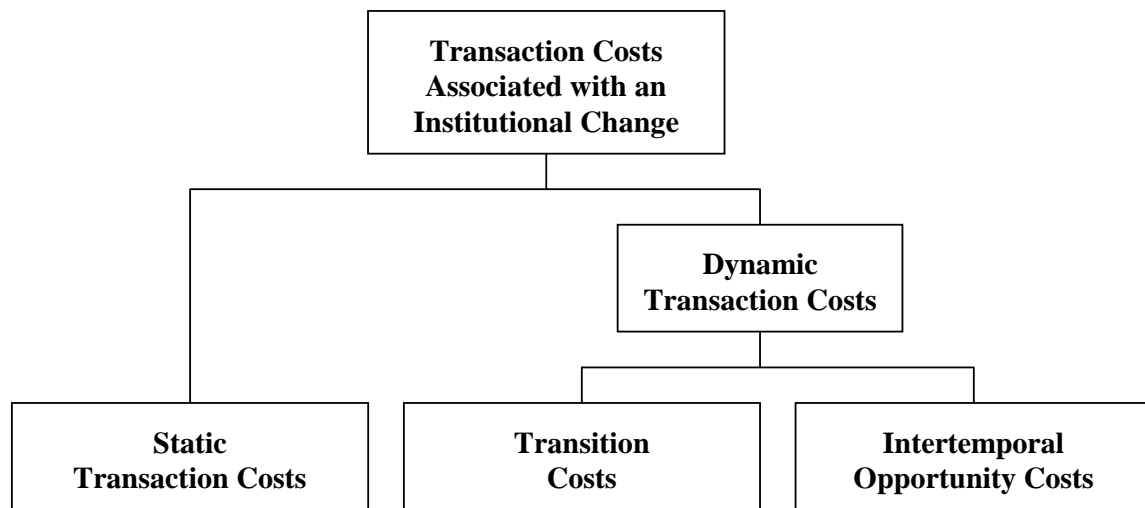
Figure 1: Transaction Costs Pertinent to an Institutional Change

Consideration of the dynamic transaction costs is important to policy analysis where certain conditions hold or are recognised in the analysis.

Firstly, transition costs will be important when it is recognised that static transaction costs are incurred in any decision-making for resource allocation and that the position in an institutional hierarchy for which the transaction costs of an allocation decision are minimised will vary according to the nature of the decision. For example, efficient decisions for the allocation of water between irrigation activities at the farm level or between farms in an

irrigation district may be made at lowest transaction cost when the decisions rest with individual farmers who can respond readily to signals of commodity prices, seasonal conditions, etc.   For other decisions such as allocation of water to the environment, transaction costs may be minimised by having the decisions rest with state governments or at the level of common property between state governments, where the decision-making body is the Murray-Darling Basin Commission. Because the static transaction costs are positive for any institutional structure, a policy objective exists to develop new institutional structures in response to changing circumstances.   Transition costs will be incurred when changing institutions.

Intertemporal costs will be important where (i) uncertainty or ignorance exists in relation to future institutional arrangements that will need to be in place for resource allocation, and (ii) institutional change is characterised by path dependencies and irreversibilities.   In the presence of uncertainty and irreversibilities, the value of learning about the resource system and other parameters that affect resource use will be dependent upon the costs of making appropriate changes in the institutional structure. The value associated with flexibility for institutional change in response to learning is effectively a quasi-option value, as defined in relation to irreversibility in development of environmental resources (Arrow and Fisher,1974; Fisher and Hanemann, 1985; Boardman *et al*., 1996 p.228).

If these general conditions apply to a policy problem for institutional change, then the problem is necessarily an intertemporal one, and needs to consider dynamic transaction costs.

THE INTERTEMPORAL POLICY PROBLEM FOR INSTITUTIONAL CHANGE

Conventional transaction-cost theory deals with static transaction costs and generally considers the benefits of institutional reform to be a reduction in these transaction costs (Eggertsson, 1990 *passim*).   The rationale for this approach to problems of institutional change is that in the absence of transaction costs, all institutional structures for allocation of a resource produce the same 'efficient' outcome, a result that has become embodied in the 'Coase theorem'.   Williamson (1979) argues that "*if transaction costs are negligible, the organisation of economic activity is irrelevant, since any advantages that one mode of organisation appears to hold over another will simply be eliminated by costless transacting*." However, where transaction costs are positive the benefits from resource allocation under any institutional structure will fall short of benefits arising from an hypothetical 'zero-transaction-cost' allocation. A measure of transaction costs is the discrepancy between these two outcomes, which is essentially a dead-weight loss. The institutional structure that most closely approaches the most efficient allocation is that with the lowest transaction costs. The policy goal in considering institutional change is to minimise the static transaction costs of decision making for resource allocation and thereby maximise welfare.

The objective of selecting an institutional structure to maximise welfare can be expressed as:

$$\max_{I_i} \ W = a_i\{I_i\} \tag{1}$$

where:

$W =$ welfare derived from resource use;

I_i = alternative institutional structures, possibly comprising a vector of institutional characteristics such as distributions of property rights, entitlement systems, and allocation mechanisms ($i = 1 \dots m$); and

$a_i\{I_i\}$ = net benefits of resource use under institutional structure I_i.

By the argument presented above, the net benefits of resource use under an institutional structure is a function of the level of static transaction costs incurred in decisions for resource allocation. Thus the objective of maximising welfare can be expressed as a cost effectiveness problem of minimising static transaction costs:

$$\min_{I_i} \; C = c_i\{I_i\} \tag{2}$$

where:

C = transaction costs of decision making for resource allocation; and

$c_i\{I_i\}$ = static transaction costs incurred in decision-making for resource allocation under institutional structure I_i.

Consider, in this case, allocation of water resources. An efficient allocation of water exists where the marginal benefit of water use is the same across all water uses. A social planner pursuing such an objective of efficiency could allocate water across all potential uses and users, but the ability to achieve an efficient allocation would be constrained by the static transaction costs associated with requirements for very detailed information on benefit functions across alternative uses. Alternatively, a market system could be relied upon to allocate water, although the capacity of trading to achieve an efficient water allocation would be constrained by the static transaction costs of market search and contracting. On a conceptual level, the allocation mechanism that would best be able to achieve an efficient allocation, and thus maximise social welfare, would be that with the lowest static transaction costs.

The statement of the policy problem for institutional change in Equation 7.2 is incomplete in so far as it does not consider dynamic transaction costs: the transition costs and intertemporal costs. The magnitude of transition costs is largely affected by the institutional *status quo*, associated distributions of vested interest, and by other institutional arrangements that determine the process and costs of decision making and implementing a new institutional structure. The magnitude of intertemporal costs depends upon the range of possible future states that could be revealed by learning, and the future transition costs that would need to be incurred in making appropriate institutional responses to learning. In the absence of any potential transition costs in the future, an institutional structure is perfectly flexible and the value of learning about an uncertain future (the quasi-option value) is at a maximum. As potential transition costs in the future increase, institutional structures become increasingly inflexible and unable to be changed in response to learning: quasi-option values decrease. The quasi-option value of an institutional structure thus provides an inverse measure of the intertemporal costs associated with that institutional structure.

Taking into account both the static and dynamic transaction costs, the overall policy problem is to select an institutional structure that minimises a sum of the static transaction costs, the transition costs of moving from the institutional *status quo* to the new institutional structure,

and the negative of the quasi-option value of the new institutional structure (an inverse measure of intertemporal cost):

$$\min_{I_i} \; C = c_i\{I_i\} + d_i\{I_0, I_i\} - q_i\{I_i\} \qquad\qquad (3)$$

where:

$I_0 =$ the existing institutional structure, possibly comprising a vector of institutional characteristics such as distributions of property rights, entitlement systems, and allocation mechanisms;

$I_i =$ alternative institutional structures ($i = 1 \dots m$);

$c_i\{I_i\} =$ static transaction costs associated with institutional structure I_i, measured as the difference in economic benefits from the resource system with zero static transaction costs and the economic benefits with the static transaction costs incurred under I_i ;

$d_i\{I_0, I_i\} =$ transition costs of institutional change from I_0 to I_i ; and

$q_i\{I_i\} =$ quasi-option value of institutional structure I_i, measured as the expected net-present-value of learning under institutional structure I_i, taking into account the potential future transition costs in changing I_i in response to learning.

To illustrate this formulation of the policy problem, consider the situation in the Murray Darling Basin where state governments determine the extent to which private property rights will be granted in water entitlements. Property rights reside initially with the state governments, and these governments need to decide whether to: (i) devolve property rights down the institutional hierarchy to create and strengthen private rights to the point where security of private water entitlements is guaranteed and any changes in water allocation would need to be accomplished through market transactions with private water users; or (ii) retain some state property rights allowing state governments to unilaterally make allocation decisions that affect private water entitlements.

Using notation similar to that adopted by Horn (1995) in formulating a similar problem, let the level of delegation of property rights equal Z with a range [0,1], where $Z = 0$ corresponds to property rights being retained fully by the state government (the institutional *status quo*) and $Z = 1$ corresponds to property rights being fully delegated to private water users.

Let the static transaction costs for private allocation be a function of the level of delegation $\alpha\{Z\}$. The static transaction costs are the costs of making allocation decisions measured by the extent to which the resultant allocation falls short of the efficient allocation that would occur in a world of zero transaction costs. For allocation decisions by a state government, these transaction costs may arise through lack of information and inflexible or time-consuming decision-making processes. For allocation decisions by private water users, transaction costs may arise through market imperfections, such as imperfect information in relation to trading of water entitlements.

Let the transition cost in the current period be denoted by the function $\beta\{Z\}$, which reflects path dependency constraints imposed by the pre-existing institutional structure ($Z = 0$). The impact of a current decision on the flexibility of the institutional structure and the future costs

of institutional change made in response to learning is captured by the quasi-option value associated with any selected level of delegation. Let the quasi-option value associated with any given level of delegation be denoted by the function $\gamma\{Z\}$. The quasi-option value is determined from considering several parameters: the range of possible future states that may be revealed by learning; the subjective probabilities of these states; the possible changes to the institutional structure Z that would be desirable under alternative states; and the effect of the current institutional structure Z on the costs of achieving different institutional structures in the future.

The policy problem faced by a social planner is, for a given objective in resource allocation:

$$\min_{Z}\ V = \alpha\{Z\} + \beta\{Z\} - \gamma\{Z\} \quad \text{for } 0 \leq Z \leq 1 \tag{4}$$

where V is the sum of static and dynamic transaction costs associated with a new institutional structure.

Some comment can be made on the signs of the different cost components within the context of the problem being addressed. The static transaction costs $\alpha\{Z\}$ and the variation in these costs would be situation specific. For example, if the problem is one of allocation of water between farms and irrigation activities within an irrigation region with a very large number of farms and no major constraints on spatial patterns of water use, then the static transaction costs associated with strong private rights and market allocation would likely be low, and indeed possibly much lower than for allocation by a government agency. In other circumstances the static transaction costs for market allocations may be relatively high. For example if the allocation problem involves 'public-good' uses of water and there are many constraints on allocations, then the information and bargaining costs associated with private property rights and market allocations may be relatively high and allocation decisions may be made at lower transaction cost by a central state agency. Such a situation may exist where a water resource must be allocated across diverse uses such as irrigation farmers, recreational water users, environmentalists and hydro-electricity generators, and constraints on water allocation arise from capacities of river channels and spatial externalities in water use. Static transaction costs of allocation would be minimised by a lower level of delegation and the state retaining some property rights.

The transition costs for institutional change, $\beta\{Z\}$, arise both in the form of the direct costs of decision making and implementing institutional change, as well as the indirect political costs or benefits to decision makers. It is conceivable that for some institutional changes, political benefits may accrue from the change that over-ride the direct transition costs and $\beta\{Z\}$ may be a net benefit to the decision makers. For example, with delegation of property rights from a state to private water users, it is likely that there would actually be a benefit, or negative cost, to the decision maker as the rights are being transferred down an institutional hierarchy from a large, diffuse group (the state population) to a small, concentrated group (the private water users). Whilst costs may be incurred in drafting and establishing the systems of private property rights, the political benefits of such an institutional change may exceed these costs and cause a net 'transition benefit' to the political decision-makers.

The quasi-option value, $\gamma\{Z\}$, is always non-negative (Challen and Schilizzi, 1998). The magnitude would depend on the level of uncertainty in relation to future states of the world; the future decisions that may need to be made for resource allocation; the optimal distribution

of property rights for these decisions in terms of minimising static transaction costs; and the extent to which delegation of property rights is characterised by irreversibility. For example, consider a situation where the potential environmental impacts of irrigation are largely unknown but could be greatly influenced by the spatial distribution of water use. If the static transaction costs of allocation under private property rights were too high to provide for an efficient allocation of water to balance productive use and environmental quality, an efficient allocation under an adverse future outcome may require an administrative allocation of water and therefore require the state governments to hold the property rights. If a delegation of property rights to private users is costly to reverse, such a delegation would reduce flexibility to respond to learning about the environmental impacts of irrigation and the quasi-option value, $\gamma\{Z\}$, would be decreasing in Z. Situations of proposed institutional change can also be envisaged where the quasi-option value would be increased. An institutional change involving a state government resuming private rights (a redistribution of property rights up an institutional hierarchy) could reduce the costs to government of making future institutional changes in response to learning, and result in an increase in quasi-option value.

Given ranges of the different transaction-cost parameters as $\alpha\{Z\} \geq 0$, $\beta\{Z\} \geq$ or < 0, and $\gamma\{Z\} \geq 0$, the value of V may be $\geq$ or < 0. A positive value of V indicates that for the given institutional structure, the sum of static transaction costs and transition costs exceeds the quasi-option value. This may be the case where there is little uncertainty about the future or minimal flexibility costs associated with the relevant institutions, both contributing to a small quasi-option value. A negative value of V indicates that the quasi option value exceeds the sum of static transaction costs and transition costs. This may be the case where there is substantial uncertainty about the future and strong irreversibilities in institutional change that contribute to a high quasi-option value. The sign of V does not in itself determine whether institutional change will or will not occur. What matters is whether an institutional change will result in a net reduction in V over the institutional *status quo*. Recalling that the institutional *status quo* is represented by $Z = 0$, the sum of transaction costs for this institutional structure can be represented as:

$$V\{0\} = \alpha\{0\} - \gamma\{0\} . \tag{5}$$

For the institutional *status quo*, the transition costs of $\beta\{Z\}$ are, of course, equal to zero as there is no institutional change.

As a general statement, institutional change to a new structure Z' is desirable where:

$$V\{Z'\} < V\{0\} \text{ for } 0 < Z' \leq 1. \tag{6}$$

This formulation of the policy problem for institutional change indicates that the decision-maker may have to consider a trade-off between current benefits (reduced static transaction costs), transition costs, and quasi-option values associated with flexibility in future institutional change. The need to make policy decisions involving trade-offs between minimising current allocation costs and maintaining flexibility in the face of uncertainty has been previously recognised (for example Segerson, 1992) but not expressed a part of a cohesive framework for policy analysis.

PRACTICAL APPLICATION

Rigorous practical application of the transaction cost framework for institutional choice is impeded by a lack of techniques and methodology for *ex ante* estimation of transaction costs. Existing literature indicates that some effort has been given to estimation of static transaction costs, but these are predominantly for *ex post* analyses of institutions. Transition costs have received more attention in *ex ante* studies because of their importance to political decision-makers. Quasi-option values represent probably the greatest challenge in estimation, particularly where there are multiple options or a continuum of options for institutional change, and multiple possible future states of the world that affect the relative benefits of alternative institutional arrangements. Some conceptual similarity exists between the options associated with flexibility of an institutional structure and financial call options, but in-principle differences prevent direct adoption of valuation methods from finance theory[2].

Notwithstanding problems of practical application, the formulation of the problem of institutional choice provides a useful conceptual framework for considering alternative institutional structures and the costs and benefits of institutional change. Indeed, the formulation provides a cohesive structure for some existing *ad hoc* procedures of policy analysis that seem to give implicit attention to all three types of transaction costs included in the problem formulation.

Given these difficulties in measurement of the different parameters of the institutional choice problem, there may perhaps be some criticism of this formulation. In the words of Lancaster (1966) the formulation may be thought to "*run the danger of adding to the economist's extensive collection of non-operational concepts*". Other researchers applying the concepts of transaction costs to problems of institutional choice have been pessimistic about empirical application. Griffin (1991), for example, stated that "*because a proper analysis incorporating transaction costs has never been performed to investigate the global efficiency of a prospective institution, the applicability of* …[the terms externality correction, resolution and internalisation] … *is highly questionable in all but conceptual work. Moreover, the empirical difficulties to be encountered in such a rich analysis imply that the chances of ever satisfying this requirement are quite remote.*"

Despite the problems of quantifying and predicting transaction costs, particularly flexibility costs as measured by quasi-option value, there is considered to be value in the formulation of the problem of institutional change as one of minimising a sum of transaction costs. Regardless of the problems of measurement, this formulation of the problem of institutional choice provides a useful conceptual framework for considering alternative institutional structures and the costs and benefits of institutional change. Indeed, the formulation provides a cohesive structure for some existing *ad hoc* procedures of policy analysis that seem to give implicit attention to all three types of transaction costs included in the problem formulation.

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[2] Although the quasi-option value associated with flexibility in future institutional change has conceptual similarities to the value of a financial call option, the pricing formulae for financial call options are inappropriate for estimating quasi-option values. There are two significant departures from the financial model of valuing a call option: the value of the stock and the exercise price are endogenous to any consideration of the value of an option or a decision to secure an option. Furthermore, there are measurement difficulties for parameters of the value of the stock and the variability in this value which are critical parameters in estimating the value of an option over the stock. It is possible that the models for valuing financial call options could be developed to handle endogeneity of the stock price and exercise price, and hence provide greater insight into measurability of quasi-option values. This, however, remains a difficult problem that is yet to be solved, if it can be.

Examples of instances where implicit attention is given to the three types of transaction costs are as follows.

In regard to static transaction costs, attention to markets as a means of improving allocation efficiency of resources can be interpreted as an often unwitting search for allocative institutions with lower transaction costs than existing institutions of administrative allocation. Most economists have been educated to consider markets as being free of transaction costs while acknowledging the transaction costs of government decision making arising from imperfect information. It is therefore not surprising that so many models of zero-transaction cost markets have been put forward as a panacea for problems of resource allocation and have formed the basis for many initiatives in institutional change away from government decision-making. These policy analysts are on the right track, but perhaps not fully aware of the diversity of institutional options for allocation of natural resources and the different implications for transaction costs and efficiency of allocative decisions.

Transition costs are often given explicit recognition in policy analysis for institutional reform, particularly as the subset of costs arising from the social and economic dislocation of the people affected by proposed institutional changes.

Recognition of quasi-option values is implicit in many policy decisions based on the precautionary principle. An underlying presumption of the precautionary principle is that under conditions of uncertainty and irreversibility, it may be better to take a cautious stance in resource allocation for the time being with the possibility of revising the stance at some later date as new information becomes available. A preservation of quasi-option value is implicit in preferences for gradual institutional change. As indicated by Dorfman (1981): "*one motivation, surely, for the prevalence of introducing regulations or dismantling them by graduated steps is uncertainty about the consequences of the regulatory change. It is felt to be desirable to be able to watch the adjustments as they evolve and to be able to make mid-course corrections as they are needed*". Quasi-option values have also been implicitly recognised in reform of institutions of water allocation. In Western Australia for example, the following statement was recently made by the relevant regulatory agency in regard to institutional reform for water licences. "*Long term licences will be issued where it can be shown that there is little risk to the resource or other users. In other areas, where the risk is high, licences will be issued for shorter periods to allow periodic review*" (Water and Rivers Commission, 1998). Maintaining options for government decision making over resource allocation is implicit in a reluctance to grant long-term licences where the future state of the resource system is 'risky' and where reducing licence terms at some future time would be politically difficult.

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