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Transaction costs, collective action and adaptation in managing complex social–ecological systems

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ABSTRACT

With the escalating uncertainties and surprises faced in responding to environmental and natural resource challenges has come growing recognition of the need to manage such issues as social–ecological systems and value the capacities that enable adaptation to these changes. Adaptations in environmental management often involve complex, including wicked, problems of collective action. Institutions introduced to reduce the transaction costs of solving these problems do not come for free.

A cost effectiveness framework designed to provide a comprehensive and logical structure for economic evaluation of path dependent institutional choices in this context, and a procedure for boundedly rational empirical application of the framework, are proposed and illustrated in this article — including for the choice between water buy-back and infrastructure upgrade programmes for accumulating the 'environmental water' needed to sustain the ecosystems of Australia's Murray–Darling Basin. Also outlined is a research strategy designed to help identify the heuristics needed for application of this procedure.

1. Introduction

Humans have adapted to actual and anticipated changes in our living conditions since our emergence as a species, and the concept of adaptation has long been central to the subject matter of economics. The mainstream economic focus in this area, associated with conventional neoclassical economics, has been on individuals adapting to changes in demand or supply conditions of the markets where they transact with one another in pursuing their self interest. The focus has thus been on adaptation via transactions over private goods. It has been assumed that markets operate mechanistically and thus the consequences of changed conditions for adaptation decisions, or of adaptation decisions themselves, can be accounted for comprehensively using standard decision theory.

The attention paid by policy makers and scholars to understanding human adaptation has escalated over recent decades alongside recognition of the rapidly multiplying and intensifying adaptation challenges to be faced from changes in the behaviour of climate, freshwater and other natural systems. Indeed, some leading scientists have concluded that the Earth has already experienced a transition from the Holocene epoch of around the last 10,000 years, during which human cultures developed within relatively stable natural environments, to a new epoch, the Anthropocene, where 'the impacts of human activities are so pervasive and profound that they could inadvertently alter the Earth System in ways that may prove irreversible and inhospitable to humans' (Biermann et al., 2010 p. 202).

The nature of these adaptation challenges differs in two key ways from the kinds of adaptation on which mainstream economics tends to focus. Firstly, 'the ability of societies to adapt is determined, in part, by the ability to act collectively' (Adger, 2003 p. 387) and steer this action towards adaptation rather than mal-adaptation. Such collective action is required where effective adaptation involves the provision of collective goods (public goods and common-pool resources (Ostrom, 1990)) which, because their benefits cannot be appropriated exclusively by those providing them (Olson, 1965), will not be provided through market transactions. The focus of economists in analysing contemporary adaptation challenges therefore needs to be broadened to encompass adaptation via collective action. Secondly, the dynamics driving many contemporary adaptation challenges in managing natural systems are most appropriately characterised as those of a positive-feedback kind exhibited by complex adaptive systems (Anderies et al., 2004; Marshall, 2010; Ostrom, 1999). The mainstream economic assumption that such dynamics are mechanistic therefore needs to be reconsidered when analysing such adaptation challenges.

The benefits of adaptation invariably come at a cost, and this cost normally comprises both transformation costs (otherwise known as production or abatement costs) and transaction costs. Due to the influence of the new institutional economics which has sought to

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integrate transaction costs within a conventional neoclassical framework, mainstream economics has come to accept the importance of accounting for transaction costs as well as transformation costs in comparing decision options. McCann et al. (2005 p. 527) found that transaction costs can represent a substantial proportion of the overall costs of environmental management initiatives and that these 'nontrivial magnitudes mean that transaction costs will affect the optimal choice and design of policy instruments'. However, they found that 'in practice, transaction costs are not normally included in empirical evaluations of alternative environmental or natural resource policies' and that this 'hinders comparative policy evaluation' (ibid. pp. 528, 538).

Paavola and Adger (2005 pp. 365, 358) 'argue[d] for 'institutional ecological economics' as a promising cross-over between a new institutional economics and ecological economics', while observing that 'the concept of transaction costs contributes to institutional ecological economics by facilitating detailed analysis of policy problems and governance solutions'. The aim in this article is to contribute towards this emerging economic tradition in key ways related to the weaknesses identified above of mainstream economics in analysing contemporary adaptation challenges in managing the environment. These contributions relate to:

- the collective action dimensions of adaptation in managing complex social–ecological systems (SES) (Section 2 below);
- the roles of (adaptive) governance and institutions in dealing with these dimensions (Section 3);
- transaction cost issues in managing these dimensions, including in respect of the path dependencies and surprises often encountered in such efforts (Section 4);
- an appropriate framework and procedure for ex ante evaluation of institutional cost effectiveness in managing complex SES (Section 5); and
- an appropriate research strategy for supporting the application of this framework and procedure (Section 6).

2. Adaptation and Collective Action in Environmental and Natural Resources Management

Smit and Wandel (2006 p. 282) found that definitions of 'adaptation' in the human context usually refer 'to a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity'. This concept refers both to the building of adaptive capacity, which strengthens the ability of individuals, associations, organisations, governments and other enterprises to adapt to changes, as well as to the conversion of that capacity to action by way of implementing adaptation decisions (Adger et al., 2005). Adaptive capacity is dynamic, influenced by interplay between multiple factors including: natural, economic and human resources; infrastructure; social capital; institutions; governance; human resources; technology; and levels of societal equity (Adger et al., 2005). Bridging barriers to implementation of adaptation options can be an important way of building adaptive capacity. Such barriers can arise from natural, technological, financial, cognitive and behavioural, social, or cultural constraints, as well as from market failures (e.g., collective goods and imperfect information) and policy and regulatory failures.

Whether as implementation of adaptation decisions or building adaptive capacity, adaptation in response to environmental changes often involves collective action (McCann, 2013-this issue). This is the case when the benefits arising from adaptation efforts by individual enterprises (individuals, households, firms, organisations, government agencies, governments, etc.) constitute collective goods that cannot be captured exclusively by those enterprises.

Consider implementation of a farmer's decision to adapt to an expected decline in surface water availability for irrigation by reducing her pumping of groundwater in order to increase the volume of such water remaining available when access to surface water does decline. If the aquifer holding the groundwater is a common-pool resource shared by neighbouring landholders, this farmer will not be able to exclude these other landholders from sharing in the benefits from her implementation efforts of the additional groundwater remaining in the aquifer. Anticipating this problem with her adaptation plans, she may explore the option of strengthening her adaptive capacity in implementing those plans by lobbying the relevant government agency to develop a system of individualised groundwater property rights that would help overcome the excludability problem she faces. Again, however, she would not be able to exclude her neighbours from sharing in any benefits arising from these efforts to build her adaptive capacity. Their capacities to adapt to anticipated declines in surface water availability by individually 'storing' groundwater to be used in this eventuality would also be strengthened.

Successful adaptation does not always involve collective action. Another way for the farmer in our example to adapt to declining surface water availability for irrigation would be to adopt technologies (e.g., tailwater recycling systems) that increase her water-use efficiency. Increasing her adaptive capacity in respect of adopting such technologies might involve commissioning consultants to advise how they would best be applied in her context, or else attending field days where relevant information is provided. The benefits from each of these adaptation efforts constitute private goods for this farmer in so far as they can be captured exclusively by her.

Nevertheless, societal capacities to adapt to environmental changes are normally influenced significantly by their abilities to act collectively (Adger, 2003). Many of the fundamentals of adaptive capacity in this sphere – including social capital, institutions, governance arrangements, national economic wealth, research and development programmes, public awareness and education programmes, and monitoring and evaluation systems – are collective goods. Governments are themselves exercises in collective action. It is important then to understand the collective action dimensions of human adaptation to environmental changes.

3. Collective Action, Governance and Institutions

3.1. Trust, Reciprocity and Collective Action

The externality problem in providing collective goods becomes greater the larger the group of members who would benefit from the good. The larger the group, the smaller the proportion that individual members capture from the benefits of their respective contributions towards provision, and thus the less motivated each will be to contribute (Olson, 1965). The term 'group' as used here refers to social entities comprising multiple members who share some interests; e.g. communities, voluntary associations, organisations and nations.

Olson (ibid.) observed that individuals with a greater interest in seeing a collective good provided typically contribute disproportionately to provision efforts. The expression 'free riding' was coined to describe the situation where individuals stint in their own provision efforts in the expectation that others with greater interest will contribute sufficiently that the collective good gets provided. Olson (ibid. p. 62) predicted that free riding would rule in groups large enough that 'each member … is so small in relation to the total that his action will not matter much one way or the other', thus making it irrational for individual members to incur the costs of monitoring and punishing each other's free riding.

The free-rider problem became interpreted as one of assurance, where obstacles to collective action arise from the challenges group members face in assuring each other that they can be trusted to reciprocate one another's contributions. Key insights into how such