



Understanding the evolution and performance of water markets and allocation policy: A transaction costs analysis framework

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ABSTRACT

Water markets and associated allocation policy reforms have struggled to achieve their intended goals in many water-stressed rivers, in part due to the institutional friction imposed by transition and transaction costs. This paper elaborates a transaction costs analysis framework to examine the evolution and performance of water markets and allocation policy reforms. This analysis rests on three pillars: i) a synthesis of three theoretical traditions of institutional analysis (Williamson, North, and Ostrom) often considered independently; ii) a framework to examine the types and interactions of transaction costs in market-based water allocation over time; and iii) an illustrative analysis of three large river basins – the Colorado, Columbia and Murray–Darling – with varying levels of success in market-based water policy reforms. The resulting framework accounts for water's complexity as an economic good. This framework and the case studies lead to the identification of several policy implications including the need for: a multiphase sequencing of reform, strategic investment in institutional transition costs, and institutional choices that preserve future flexibility to adjust water rights and diversion limits to manage social and environmental externalities.

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1. Introduction

1.1. Water markets and allocation policy reform in river basins under pressure

Australia and the United States have experimented with market-based water-rights trading to enhance flexibility and manage a shared set of challenges: natural aridity, competition for water, climate variability, tradeoffs across multiple jurisdictions and an increasing commitment to balance human and environmental water needs. Market-based water policy reforms involve two linked components: i) imposition of diversion limits (*cap*) to balance production and conservation, including market mechanisms to adjust to lower diversion limits in over-allocated systems (buybacks of water entitlements) and ii) establishment of tradable water rights (*trade*) to allocate water within and across productive sectors.

Market-based water allocation policy reforms have achieved varying levels of success, often leaving the theoretical promise unfulfilled, in part due to the institutional friction imposed by transition and transaction costs. There is increasing empirical research about market-based water policy design and performance in a world of positive transaction costs (e.g. Colby, 1990; Easter et al., 1998; Garrick and Aylward, 2012; Garrick et al., 2013–this issue; McCann and Easter, 2004). However,

longitudinal analysis of transaction costs and institutional change in market-based water allocation has been rare (but see, e.g. Libecap, 2011). Consequently, existing theoretical frameworks and empirical evidence have yet to account for and explain (1) the interplay of transaction costs, institutional change and path dependency in market-based water policy reform, and (2) the transaction costs associated with managing complex water-related economic goods with interdependent private and collective values.

The core contribution of this paper is a transaction-costs analytical framework to examine the evolution and performance of water markets and associated water allocation institutions. This framework shifts from taking institutional constraints as fixed to an analysis of institutional change. It focuses on water as a complex economic good (following Hanemann, 2006) governed by mixed property regimes (public–private–common pool) with pervasive externalities and, hence, relatively high transaction costs.

The paper contains three parts: Section 2 provides a synthesis of concepts and evidence about water rights reform and transaction costs across three theoretical traditions of institutional analysis often examined independently (Williamson, North, and Ostrom). Section 3 presents a transaction-costs analytical framework to understand the evolution and performance of market-based water policy reform. Section 4 offers an illustrative analysis of three large river basins – the Colorado, Columbia and Murray–Darling Rivers – with varying levels of success with market-based water allocation policy reforms. The final section provides concluding remarks and future research priorities.

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2. Transaction Costs and Institutional Change in Market-based Water Allocation Reform

2.1. Water Allocation and Property Rights

Water's mobility and variability pose physical challenges when defining property rights for water access and use (Libecap, 2005). Property rights in water therefore require costly exclusion and collective action at multiple levels to manage interdependent private (e.g. irrigation diversions) and collective (e.g. environmental flows) water-related economic goods. The resulting property regimes and allocation rules governing water have been conceptualised in terms of: i) an "institutional hierarchy" (Challen, 2000) involving nested individual, irrigation group, state and federal rights¹ (see also, Easter and McCann, 2010); and ii) a "bundle of rights": rights to access and withdraw from common-pool water resources, rights to manage use patterns and resource investments, rights to exclude others from accessing and withdrawing, and rights to "alienate" the resource through sale or lease (Schlager and Ostrom, 1992).

Market-based water-allocation reforms aim to establish private, tradable water-access and withdrawal rights separated from land rights (Anderson and Leal, 2001). However, private tradable water rights invariably coexist with state and user rights regimes in practice, particularly in the establishment and revision of cumulative diversion limits and the management of irrigation systems (Bruns and Meinzen-Dick, 2005). Therefore, water's complexity as an economic good requires greater focus on feedback effects, cross-scale interactions, and dynamism at multiple stages of institutional reform: i) the initial assignment of entitlements, ii) reallocation, and iii) adjustment of the initial assignment level and entitlement mix in response to improved information, technology and/or shifting values. As such, water markets are unlikely to fulfil theoretical expectations to become a "self-maintaining [allocation] system" with a single set-up period followed by a period with "very little future need for government involvement" (Challen, 2000: 2).

2.2. The Problem of High Transaction Costs: Definitions and Conceptual Issues

A primary cause of transaction costs in water allocation is the high cost and impracticality of perfectly defining private tradable water rights for a socially and physically interconnected resource, as outlined in Section 2.1 (see also Meinzen-Dick, 2007). Pressure for more adaptive or flexible water allocation systems is countered by institutional frictions (Baumgartner et al., 2009) that stem from the contentious – and hence costly – political economy of water reallocation. The politics of water allocation involve tradeoffs between economic efficiency and other policy goals, such as equity and robustness (Colby, 1990).

2.2.1. Definitions

Accounting for transaction costs in market-based water policy analysis requires defining, measuring and explaining them. Definitions of transaction costs have proliferated since Coase urged analysts into a world of positive transaction costs (Krutilla and Krause, 2010; McCann et al., 2005). This study draws from three definitions that combine to provide a rounded set of defining elements for a transaction costs framework attentive to collective action and institutional change.

In this context, transaction costs refer to the resources required to:

- i) address collective action challenges of exclusion and coordination in natural resource management (Cole, 2002). This definition focuses expressly on the collective action challenges tied to downstream externalities, public goods and free riding in the provision and

maintenance of water infrastructure and freshwater ecosystem services.

- ii) "define, establish, maintain, use and change institutions and organisations and define the problems that these institutions and organisations are intended to solve" (Marshall, 2013-this issue). This definition explicitly encompasses institutional change and adaptation in a context of path dependency and irreversibility.
- iii) "define, establish, transfer and maintain property rights" (McCann et al., 2005: 530). This definition explicitly addresses property rights, which have significant theoretical and policy relevance for water allocation due to the exclusion and coordination challenges that render water rights so costly and contentious to define and adjust.

Saleth and Dinar (1999: 4) apply institutional economic theory to formalise the proposition that water reform will occur when transaction costs are less than the opportunity costs (i.e. foregone benefits) of maintaining the status quo. Competition for water raises the value of water and can increase the opportunity costs of misallocation to tip the balance in favour of market-based water policy reform, particularly in concert with innovations in technologies and institutions that reduce transaction costs. This calculus presumes institutional change is driven by efficiency; however, rent-seeking by vested interests (e.g. by irrigation lobbies or environmental groups) and the contested political economy of water reallocation may inhibit otherwise efficiency enhancing institutional reforms.²

2.2.2. Transaction versus Transformation Costs of Water Allocation

North (1994: 360) emphasises that "institutions and the technology employed determine the transaction and transformation costs" that influence economic performance over time. The design and evaluation of market-based water allocation policy should consider transaction costs in relation to transformation costs (production and abatement costs)³ and the full range of market and non-market benefits. McCann and Easter (1999) and Marshall (2005) advocate a choice criterion that minimises the total costs – both transaction and transformation – of reaching a given policy target.

Transaction and transformation costs interact in water markets. In theory, tradable water rights establish price signals that incentivise decentralised decision-making to allocate water rights to their highest valued economic use (Grafton et al., 2011). However, political economic factors may lead to the adoption of a more costly option in terms of transaction and transformation costs. This is particularly the case when vested water user groups receive the concentrated benefits of supply side measures (e.g. irrigation efficiency enhancements) while the costs might be distributed more broadly among taxpayers. The comparison of infrastructure-driven (transformation-costs intensive) versus market-based (transaction-costs intensive) policy options illustrates how transformation and transaction costs interact with the political economy of water allocation to influence the outcome of reforms.

There are conceptual and accounting challenges of distinguishing transaction costs from transformation costs. Krutilla and Krause (2010: 272) acknowledge that "transaction costs and production costs can range from mutually exclusive to overlapping" but urge the analyst to treat them as mutually exclusive. In market-based water-allocation reforms, water infrastructure and market buybacks of water entitlements for the environment are two common sources of confusion. Some authors consider water storage and distribution to be a form of transaction costs;⁴ others classify them as transformation costs because these costs are not used to define property rights

¹ Institutional hierarchies may be more properly viewed as a polycentric governance system (Ostrom et al., 1961) with multiple formally independent centres operating in cooperation, competition, contract and/or conflict with one another.

² McCann et al (2005) identify lobbying activity as a form of transaction costs. A full treatment of the political economy of transaction costs in water reform is an important future research opportunity.

³ See Marshall (2013-this issue) for a discussion and definition of transformation costs.

⁴ Hearne and Easter (1997: 188) include "the cost of the physical infrastructure needed to measure and transport water" as a form of transaction costs.

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