

IMPERFECT WATER MARKETS AIMING TO EFFICIENCY*Vanessa Casado-Pérez**

ABSTRACT

Water markets have been envisaged as the solution for the water scarcity crisis that several parts of the globe suffer. This paper is not advocating in any case the abandonment of water markets as management tools, instead it seeks to advance them through a thorough understanding. Water markets are far from the paradigmatic perfect market behind the First Theorem of Welfare Economics. First, water markets, as any other market, require defined property rights. For that reason, the paper starts by delving into the natural characteristics of water resources which make the definition of property rights more difficult. There is also another source of challenges for that definition: the interrelated nature of the different uses of the resources, which is not fully severable from the essence of the resource itself. Regulation of property rights and transactions of these have to adapt to these particularities and usually it has done so by not defining certain elements sharply. The open-ended nature of some of the dimensions of the rights casts doubt in the efficient allocation a market aims to achieve; even more when other water regulations use standards and the market itself is created through political decisions. Second, water markets are presented as the efficient alternative to administrative systems of water management. However, in order to fulfill the requirements to establish a market and to address the related market failures, government has to intervene. Public goods, natural monopoly, externalities, etc. abound in the context of water markets and government regulates the market, is a market agent, facilitates trade lowering transaction costs, etc. Hence, the purported opposition between markets and administrative systems is questioned.

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* JSD Student, NYU School of Law, vc693@nyu.edu.

I. INTRODUCTION

Environmental problems have received different regulatory responses. Market tools have been advocated as a workable answer and even adopted in recent years to deal with a wide range of environmental issues, broadly understood.¹ These include CO2 emissions trading², wetlands mitigation banking³ or agricultural policies production caps.⁴ Interestingly enough, markets have been adopted in different parts of the world⁵ and at different layers of governance, from local – like the individual transferrable quotas to fish geoducks in Washington-⁶ to international level⁷ -such as the European CO2 emissions trading.⁸

¹ See generally RESOURCES FOR THE FUTURE, Discussion Paper No. 01-58, *Experience with Market-Based Environmental Policy Instruments* 5 (2001).

² United Nations Framework Convention on Climate Change, Kyoto Protocol, Dec. 17, 1997, 27 U.N.T.S. 7a. (it establishes three market mechanisms: the Emissions Trading (known as Carbon Market), the Clean Development Mechanism, and Joint Implementation).

³ Wetlands mitigation banking has been part of the Fish and Wildlife Service (FWS) since 1983: Interim Guidance on Mitigation Banking 80 ES Instruction Memorandum (U.S. Fish and Wildlife Service, June 23, 1983). Current implementation of this policy can be found in the federal regulation regarding section 404 of the Clean Water Act.: Compensatory Mitigation for Losses of Aquatic Resources 73 Fed. Reg. 19,594 (US Env't Prot. Agency&US Corps of Eng'rs, Apr. 10, 2008).

⁴ For instance, rights to cultivate vineyards, see Commission Regulation 479/2008, art. 91.5, 2008 O.J. (L 148) (EC). Another example is the Milk Quotas Bank - where dairy farmers can trade their individual quotas of milk production - Spain created to implement European regulations on the common organization of the market in milk and milk products, see R. D. 1540/2006 amending R. D. 347/2003 regulating the management system of milk quotas, and establishing the National Bank of milk quotas (BOE 2006, 44304).

⁵ United States Env't Prot. Agency, The United States Experience with Economic Incentives to Control Environmental Pollution, EPA-230-R-92-001 (Jan. 2001) (acknowledges this trend: "Over the past 20 years, federal, state, and local authorities as well as many foreign nations have enacted a diverse array of environmental incentive mechanisms").

⁶ See, e.g. Christopher J. Costello & Robert T. Deacon, *The Efficiency Gains from Fully Delineating Rights in an ITQ Fishery* 16 (Univ. of Cal., Santa Barbara, Dep't of Econ., Working Paper No. 03'07, 2007) (referring to the auctions of harvest rights on a bed-by-bed Basis in the Geoduck Fishery of Washington State)

⁷ As for an international water market see Ian J. Silverbrand & Keith S. Porter, *An International Water Market: a Proposal* (Cornell Law Sch., Working Papers No. 45 2008) (advocating for an international water exchange in order to achieve a water allocation that not depend on the geographic distribution of it and the political power of the different region. It discusses the obstacles arising from current international law). *But see* EYAL BENVENISTI, SHARING TRANSBOUNDARY RESOURCES 25-31 (Cambridge University Press 2002) (obstacles to the implementation of an international water market in international common pool resources implying that a market will be heavily regulated if adopted due to the difficulties in definition of property rights in water and the high transaction costs involved).

⁸ Initially established by the European Parliament and Council Directive 2003/87, 2003 O.J. (L 275/32) (EC) [later amended by European Parliament and Council Directive 2004/101, 2004 O.J. (L338/18)]. See generally European Union Trading System (EU ETS), (last visited May 23, 2011). An example of an international market for CO2 European Unit Allowances (EUA) and Carbon Credits (CER's) is the secondary market SENDECO2 (Sistema Electrónico de Negociación de Derechos de emisión de dióxido de Carbono), the leading private electronic bourse in the South of Europe. See SENDECO2, <http://www.sendeco2.com/uk/conocenos.asp> (last visited May 23, 2011).

Water has not been an exception. There is trading of water pollution allowances⁹ and for water use rights, which would be the focus of this paper. Water use rights markets have been implemented in New Zealand, South Africa, some US Western States –such as California or Colorado–, Australia,¹⁰ Chile¹¹ or Spain.¹² The goal pursued in markets is allocative efficiency,¹³ embracing the perspective of aggregate economic efficiency, that is, the maximization of the total value of water.¹⁴ Water should be put to the highest value use given the scarcity crises some regions are suffering,¹⁵

Water scarcity is generally defined as the situation where demand exceeds the water resources exploitable under sustainable conditions.¹⁶ Basic economic theory¹⁷ suggests that a good becomes more expensive as it gets scarcer (i.e. more users are competing for it). This is not the case when it comes to water. Water is subsidized almost everywhere not encouraging an efficient consumption.¹⁸ Several explanations might be offered, from equity – household water supply and rural economies should be supported– to public choice explanations –the municipalities and the agricultural sector are powerful lobbies.¹⁹ Be as it may, it is too politically costly to price water at its true value. Hence,

⁹ There are water use rights and markets of pollution allowances. For more information on the later, *see generally* EPA, WATER QUALITY TRADING ASSESSMENT HANDBOOK, http://water.epa.gov/type/watersheds/trading/upload/2005_08_02_handbook_docs_ch4-national-wqt-handbook-2004.pdf (last visited May 23, 2011).

¹⁰ Henning Bjornlund & Jennifer McKay, *Aspects of water markets for developing countries: experiences from Australia, Chile, and the US*, 7 ENV'T AND DEV. ECON. 769, 791 (2002); Henning Bjornlund, *Farmer participation In markets for temporary and permanent water in southeastern Australia*, 63 AGRIC. WATER MGMT 57, 59 (2003).

¹¹ Carl J. Bauer, *Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1976-95*, 25 WORLD DEV. 639, 642 (1997).

¹² Gaspar Ariño Ortiz & Monica Sastre Beceiro, *Water sector regulation and liberalization*, IN WATER POLICY IN SPAIN 97, 100-104 (A.Garrido & M. R. Llamas eds, 2010).

¹³ Howard Chong&David Sunding, *Water Markets and Trading*, 31 ANNU. REV. ENVIRON. RESOUR. 239, 241 (2006) (offer three definition of optimal allocation in water: output maximization by a benevolent social planner, Pareto efficiency-scenario where no one could be made better off without making someone else worse off-, and economic efficiency achieved through the equalization of marginal values across water uses, which seems to be the one embraced in water market scenarios).

¹⁴ RONALD C. GRIFFIN, WATER RESOURCE ECONOMICS 38(2006)

¹⁵ *Id.* 323.

¹⁶ Communication from the Commission to the Council and the European Parliament addressing the challenge of water scarcity and droughts in the European Union, at 2, COM(2007) 414 final (July 18, 2007). For a more broad definition, *see also* FAO water, *Hot issues: water scarcity*, (last visited May 23, 2011). (“Imbalances between availability and demand, the degradation of groundwater and surface water quality, intersectoral competition, interregional and international conflicts, all contributes to water scarcity”).

¹⁷ LIONEL ROBBINS, AN ESSAY ON THE NATURE AND SIGNIFICANCE OF ECONOMIC SCIENCE, 16 (McMillian, 2nd ed., 1945) (economics is the science that studies the allocation of scarce resources).

¹⁸ TERRY L. ANDERSON & PAMELA SNYDER, WATER MARKETS. PRIMING THE INVISIBLE PUMP 7 (Cato Institute, 1997). *Id.* at 10 (inefficient water use is farmers’ rational response to low water prices).

¹⁹ *See* Mateen Thobani, *Tradable Property Rights to Water. How to improve water use and resolve water conflicts*, 34 PUBLIC POLICY FOR THE PRIVATE SECTOR 1, 1 (1995). (“Raising water charges to the long-run marginal cost would result in prices that would bankrupt many farmers –an option that is usually politically and socially unacceptable. A more realistic way to bring about efficient use is to allow water trading”).

the need for a price that reflects the true value of water calls for markets.²⁰ There will be no need to agree on an anew distribution of water,²¹ but on the method to reach it: a market. If a market prices water according to its real value pooling information contingent to time and place without politics having to decide thorny pricing issues,²² low value users (usually thought to be farmers) have incentives to lease or sell to high value users (urban areas, where the growth in demand has taken place) their water rights or the surplus arising from a more efficient use of water when water is scarce.²³ It is important to note that this idea should not translate into a simplification: a type of use should not be considered per se more valuable than another.²⁴ The ideal is the equalization of marginal values given that water will be priced at its true value.

Water markets are not that common. Private property rights are already allocated to part of the resource but they might not be tradable.²⁵ Given the optimal results of markets according to the

²⁰ See Morriss, *Real People, real resources, and real choices: the case for market valuation of water*, 38 TEX. TECH L. REV. 973 (2006).

²¹ The majority of water is allocated to agricultural uses, which were the driver of the economy in the past. Nowadays, urban areas are growing and demanding more water, but regulations still reflect the historical relevance of the agriculture. Stephen E. Draper, *The Unintended Consequences of Tradable Property Rights to Water*, 20 NAT. RESOURCES & ENV'T 49, 49 (2006): "Yet in many jurisdictions, the policies, laws, and regulations that control water use and availability remain rooted in earlier times when water needs and water availability were different.

²² See DONALD R. LEAL & TERRY L. ANDERSON, *FREE MARKET ENVIRONMENTALISM* 17 (2001). James L. Huffman, *Water marketing in western prior appropriation states: a model for the East*. 21 GA. ST. U. L. REV. 429 (2004) [hereinafter, Huffman, *A model for the East*]. ("The invisible hand of the marketplace is demonstrably far more efficient in the allocation of scarce resources, in the sense of maximizing net social welfare, than the invisible hand of politics"); see also generally James L. Huffman, *Markets, Regulation, and Environmental Protection*, 55 MONT. L. REV. 425, 430-434 (1994) [hereinafter, Huffman, *Markets*].

²³ R. Quentin Grafton, Clay Landry, Gary D. Libecap & J.R. O'Brien, *Water Markets: Australia's Murray-Darling Basin and the US Southwest*, 1 (International Centre for Economic Research, Working Paper No. 15, 2009), available at <http://www.icer.it/docs/wp2009/ICERwp15-09.pdf> ("Australia's Murray-Darling Basin (MDB) and the US Southwest offer a 'window to the future' on the growing problem of water scarcity and the potential for water rights and markets to provide information on current consumption patterns and alternative values, incentives for adjustments in use, and smoother reallocation across competing demands") (last visited May 23, 2011).

For the proposition that trade is expected to be from farmers to urban areas, see Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX L. REV 1873, 1888 ("Let's be clear about one thing: we are talking about transfers from rural farming areas to cities. Most of the water that will sustain the expected 15 million additional Californians is going to come from agriculture. It has to.").

²⁴ GRIFFIN, *supra* note 14, 12.

²⁵ The right to alienate a right is one in the bundle of rights that an owner has. Other rightholders may have different positions. Elinor Ostrom, *Private and Common Property Rights*, in *ENCYCLOPEDIA OF LAW AND ECONOMICS* 339-340 (Boudewijn Bouckaert & Gerrit De Gees eds. 2000), available at <http://encyclo.findlaw.com/2000book.pdf> (defines five types of rights -access, withdrawal, management, exclusion and alienation- and up to five position of the rights holder according to what rights she holds - from more to less comprehensive bundle of rights she is entitled to: owner, proprietor, claimant, authorized user, and authorized entrant). Schlager & Ostrom classify the right hold according to these faculties too, see Edla Schlager & Elinor Ostrom, *Property-Rights Regimes and Natural Resources: A Conceptual Analysis*, 68 Land Economics 249, 250-1 (1992).

Since property rights are already allocated, water resources cannot be described as a commons without further qualification and water use is not per se an externality even if it creates some. Hence, water markets not a straightforward application of Hardin's tragedy of the commons [Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968)]. See Harold Demsetz, *The exchange and enforcement of property rights*, 7 J. L.&ECON 11, 25 (1964) (advocating

First Theorem of Welfare Economics,²⁶ they should be established for such a precious good. Markets are supposed to achieve the desirable efficient allocative outcome²⁷ with fewer costs than systems where allocation is decided by an administrative agency.²⁸ Market decentralization purportedly offers, at least theoretically, four advantages: first, it pools information cheaply and factors it into the price;²⁹ second, it enhances innovation;³⁰ third, it provides a framework to mitigate risk given the different levels of risk aversion of the parties;³¹ and, fourth, it overcomes certain political obstacles.³² But to adopt a water market, certain requirements must be met. For a well-functioning market, rights must be carefully defined and transferable, there must be several buyers or sellers, and information must flow.

property rights definition and trade over them as a solution to overexploitation and even depletion of common property natural resources). Scholars working in the field have also proposed other possible approaches such as communal property regimes. For the latter, see generally ELINOR OSTROM, *GOVERNING THE COMMONS* (Cambridge University Press prtg 1998) (adopting an institutional mode of analysis to explain how communities craft their rules to govern the common property resources), the Coase's theorem [Ronald H. Coase, *The Problem of Social Cost*, 3 J. L.&ECON. 1, 17-9 (1960)] or the Demsetz's framework [Demsetz, recognizing the pervasiveness of transaction costs preventing bargaining, emphasized the internalization of the benefits and the harmful effects -pecuniary and non-pecuniary-, making social and private costs coextensive, as one of the main functions of property rights. See Harold Demsetz, *Toward a Theory of Property Rights* 57 Am. Econ. Rev. 347 (1967). Therefore, property rights have also been widely advocated to solve the tragedy of the commons. See also Frank K Uhman, *From Demsetz to Deng: Speculations on the implications of Chinese Growth for Law and Development Theory*, 41 INT'L L&POL. 551, 563 (2009)].

²⁶ GRIFFIN, *supra* note 14, 107-109. HAL VARIAN, *INTERMEDIATE MICROECONOMICS* 577-584 (Norton, 2006). BERNARD SALANIÉ, *MICROECONOMICS OF MARKET FAILURES* 1-8 (2000).

²⁷ See *supra* note 13.

²⁸ For example, in times of scarcity, the agency will decide who should receive less water or whether some new use can obtain a water permit. The Spanish system condensed in 1985 Water Act [L. No. 1985/29 (B.O.E. 1985, 189), now modified, is a good example of an administrative driven system.

²⁹ See LEAL & ANDERSON, *supra* note 22, at 17. See also Morriss, *supra* note 20, at 980. See also, Grafton et al., *supra* note 23, at 1. Draper, *supra* note 21, at 50 ("For supporters of the model, a system of marketable rights to water would allow water users to consider the full opportunity cost of water, including its value for alternative uses"). See also Morriss, *supra* note 20, at 988 ("Market prices respond to events quickly, sending market participants signals about the impact of events on the goods and services sold in markets. As discussed earlier, by monitoring market prices, including future prices, an individual is able to learn a considerable amount about the likely course of events even without studying the underlying information driving the changes in market prices").

³⁰ See Morriss, *supra* note 20, at 991-992 (First, if holders of existing water rights are freed to market their rights, we should discover entrepreneurs investing in new technology to maximize the value of the rights.(...) Second, entrepreneurs will invest in new sources of water. (...)Third, there will be investment in alternatives to water use. (...) [Fourth,] [e]ntrepreneurs who discover reduced cost means of creating and maintaining the infrastructure necessary to produce and deliver clean, safe water can profit from doing so"). See also DRAPER, *supra* note 21, at 50.

³¹ Barton Thompson Jr. *Uncertainty in Water Markets*, 36 MC GEORGE L. REV. 117, 131 (2005) ("While the Governor's Commission focused only on the relevance of uncertainty to water markets, water markets play a pivotal role in reducing the harm from uncertainty (...). Water markets reduce the harm from uncertainty in two principal ways. First, water markets can enable water users to respond more effectively to the events about which they are uncertain. (...) Second, water markets allow water users who face uncertainty to reallocate the uncertainty to individuals or entities that can better bear the risk of the uncertainty"). See also Grafton et al., *supra* note 23, at 5.

³² See ANDERSON & LEAL, *supra* note 22, at 21 (Rent-seeking entails that as result of a regulation benefits could be captured by certain interests groups and costs would be borne by the general public, not by the decision maker). See Morriss, *supra* note 20, at 993.

This paper tries to contest the opposition between administratively-run systems and markets for water management because in both the discretionary decisions and actions of the administrators play a key role.

Usually we identify efficiency with maximization of net social benefits in markets.³³ Efficiency is presented as something that can be calculated objectively,³⁴ but this paper argues that efficiency is a goal we may want to aim at but which cannot be pinned down easily in the water realm, or at least, not without some non-value-free judgments involved, often by public administrations. The reasons why efficiency is a complex concept when applied to water has a lot to do with the physical characteristics of the fugitive resource which merges private, toll, and public goods. Hence, definition of property rights is difficult.³⁵ This is reflected in the regulations defining and allocating the rights and articulating their trade which have open-ended clauses that challenge any objective definition of efficiency. Therefore the first requirement for a market is not perfectly met since trade will be more difficult.

A fine understanding of water markets calls for an assessment of how they met the other requirements for a market to work smoothly and whether there are market failures. It will be shown that water markets and administrative systems are not opposite poles of a spectrum reflecting individual choice and centralization, respectively. In fact, the market, that is, the scope of the efficiency calculation, is also framed by political decisions. Public administrations play important roles in water markets. Failures call for governmental intervention if the medicine is not worse than the disease.³⁶ Non-economic rationales can also be behind government intervention since water is

³³ GRIFFIN, *supra* note 14, at 12-13.

³⁴ STEPHEN BRICHIERI-COLOMBI, THE WORLD WATER CRISIS. THE FAILURES OF RESOURCE MANAGEMENT 126-30, 144 (2009). DEBRA SATZ, WHY CERTAIN THINGS ARE NOT FOR SALE 17-21, 33 (2010).

³⁵ See *infra* note 44 and accompanying text.

³⁶ SATZ, *supra* note 34, 32. Cfr. MORRIS, *supra* note 20, at 994 (Morriss recognizes the existence of market failures, but less relevant that they seem to be for other water markets critics. He suggests that water markets are superior to other systems of allocation and that the solution to the failure may be worse than the disease. "Where there are government actions that impede the free movement of goods and services, we generally demand that the intervention be justified by reference to some market failure and a showing that the alternative, interventionist approach has a superior outcome to the market. In other words, there are institutional failures in government as well as in markets, and a sensible approach is to compare the potential institutions to see which is the least problematic" (footnotes omitted)). See *id.* at 1007 (this author considers that the burden of proof lies on administrative systems. Administrative systems are the ones who have to prove that are superior to markets in a specific setting)

considered a merit good, some might reject its commodification, etc.³⁷ The governmental roles contest the pervasive simplifications offered by the mainstream theory of water markets.

The paper proceeds as follows. Part II fleshes out the complex water realm and how regulation copes with this complexity. This complexity often requires standards instead of rules rejecting in fact the objectivity of any efficiency calculation and increasing transaction costs. Part III describes how markets depend for their establishment and operation on political decisions. Part IV reviews the requirements for water markets and to what extent these are met. This part casts a doubt on the complete opposition between markets and administrative systems that some scholars by discussing to the governmental intervention necessary to address market failures. Part IV concludes.

II. A COMPLEX NATURAL RESOURCE AND INTRICATE RULES

An example from a lake can illustrate how challenging is to try to define property rights over water for the different uses,³⁸ and consequently, define efficiency by taking all them into account. “Think about the wide variety of uses of many lakes. They can be used for fishing, boating, swimming, and for other recreational activities. Further, lakes can be used as subject matter for artwork, for commerce, for transportation of goods, for waste processing, as a sink for pollution, or as a drinking water source, to name a few. These uses are in addition to the socially valuable role lakes play in supporting a complex ecosystem.”³⁹ The same can be said about rivers: “There is something inherently integrative about rivers. Their uses are, and must be, shared. Upstream uses affect downstream uses. Private uses affect public uses. Human uses affect natural river functions.”⁴⁰

³⁷ Related to these concerns, it is worth noting that there are alternative definitions of efficiency than the mainstream one here used. In particular, there is neutral economic efficiency which does not weight sectors, uses, users by income or market values only, but it is sensitive to alternative entitlements. See GRIFFIN, *supra* note 14, at 12-13; 46-54

³⁸ A standard definition might be: “going as far as possible in the satisfaction of wants within the given resource and technological constraints”, see Stanley Reiter, *Efficient allocation*, THE NEW PALGRAVE DICTIONARY OF ECONOMICS (S. N. Durlauf and L. E. Blume. eds, 2n ed., 2008), available at THE NEW PALGRAVE DICTIONARY OF ECONOMICS ONLINE http://www.dictionaryofeconomics.com/article?id=pde2008_E000049 (last visited May 23, 2011). More suitable for the purposes of this article might be definition of efficiency held by the UK Environmental Protection Agency: “situation where the total value of the end uses, to which the resources are put, is maximized. A consequence is that all resources will be put to their highest value uses” www.environment-agency.gov.uk/static/documents/Research/glossary_777199.doc (last visited May 23, 2011).

³⁹ Brett M. Frischmann, *Environmental Infrastructure*, 35 *ECOLOGY L. Q.* 151, 153 (2008).

⁴⁰ Peter Rogers, Lawrence MacDonnell & Peter Lydon, *Chapter 6 Political decision making: real decisions in real political contexts*, in THE EVOLUTION OF WATER RESOURCE PLANNING AND DECISION MAKING 229, 241 (Russell & Baumann eds. 2009).

These descriptions depict water as a non-standard commodity.⁴¹ It is a fugitive resource which interrelates⁴² more uses and activities than can be realized at first sight and all of them are interdependent, and sometimes simultaneous, with the consequent degree of externalities. Furthermore, these uses imply different degrees of consumption and private control over the resource. Accordingly, the same water can be a private, public, or toll good and different rights to use, access, transfer, etc. may interact.⁴³ In this section, first, the natural complexity of water will be explored analyzing the different types of uses and goods integrated in a watershed. Second, it will be described how this complexity leads to a not fully sharp definition of property rights and norms.⁴⁴

A. *Natural Particularities of water*

The variables to be taken into account to define a particular use of water are almost never-ending: time, place, quantity, quality, etc. Bjornlund & McKay suggest that to maximize the outcome of markets, the following characteristics should identify a property right: “1) Security of supply specified as the probability of receiving the volumetric entitlement (including whether a government has the authority to cancel water rights, (...); 2) Reliability of delivery, specified as the period from ordering to receiving the water; 3) The period during which the water can be used. 4) The constraints on trade, such as spatial constraints, limitations on trade between sectors in the economy, 5) Some indication of the expected quality of the water. 6) The duration of the water right, either indefinite or for a specified period of time”.⁴⁵ Some of the water characteristics reflected in this list can give an idea of why water management is so complex. Water resources complexity has many sources.

⁴¹ Chong& Sunding, *supra* note 13, at 242

⁴² Samuel C. Weil, *Natural Communism: Air, Water, Oil, Sea, and Seashore*, 47 HARV. L. REV. 425 (1934) (arguing that the water realm entails intrinsically natural communism).

⁴³ Ostrom, *Private and Common Property Rights*, *supra* note 25, at 339-340.

⁴⁴ For the proposition that we should expect less defined property rights in fugitive resources such as water, see GARY LIBECAP, *CONTRACTING FOR PROPERTY RIGHTS* 26 (Cambridge University Press 1989); see generally Henry E. Smith, *Governing Water: The Semicommons of Fluid Property Rights*, 50 ARIZ. L. REV. 445 (2008) (building the semi-common model in which public and private exclusionary rights cohabit in water because the nature of the resource has implications for the spectrum of governance).

⁴⁵ Bjornlund & McKay, *supra* note 10, at 791. Michael Warburton, *Toward Greater Certainty in Water Rights? Public Interests Require Inherent "Uncertainty" to Support Constitutional Governance of Our State's Waters*, 36 MC. GEORGE L. REV. 139, 142 (2005). Standardization of property rights is extremely difficult since even if a wide range of dimensions are included in the permit or implicit in a common law right, each right to a stream has certain particularities.

First, water is variable: it entails intrinsic uncertainty due to the climatological variability. Some patterns might be repeated across years (for example, we expect more rainfall in autumn than in mid-summer and, consequently, the river level changes); but climate makes the natural supply of water –either surface water or recharge of groundwater– uncertain. Even more with climate change,⁴⁶ which decreases predictability,⁴⁷ despite the increasingly sophisticated techniques to forecast water availability.⁴⁸ Climatological variability affects both the flow of the river and demand since farmers will not withdraw as much water in wet as in dry years where rainfall drops.⁴⁹ The variability and, even, uncertainty described has serious implications for markets since information might be difficult to gather for private parties whose decisions are central for a market.⁵⁰ To make things worse the measurement of water quantity and quality might not be perfect,⁵¹ for example where delivery is underpressurized.⁵²

Water law has to conform to the natural uncertainty of the resource. It does so with different mechanisms with different impacts on water trading: defining rights as a percentage of the flow,⁵³ granting the authority to decide on an agency, establishing rules of preference in times of scarcity

⁴⁶ ROB WHITE & ALICE CAHILL, CLIMATE CHANGE AND THE INSURANCE INDUSTRY – NO SILVER-BULLET SOLUTION 14(2008), http://www.climaterisk.com.au/ZU10124_Zurich%20Report%20Climate%20Change%20final.pdf (last visited May 23, 2011)

⁴⁷ Jonathan H. Adler, *Water marketing as an adaptive response to the threat of climate change*, 31 HAMLIN L. REV. 729 (2008).

⁴⁸ CalFed Bay Delta Program, *EWA White Paper: The Environmental Water Account: Reducing Conflict Between Fishery Management and Water Supply*, 1 (2003), available at http://calwater.ca.gov/content/Documents/library/FactSheet_EWAWhitePaper_1-22-03.pdf

⁴⁹ Gary D. Libecap, *Water Rights and Markets in the U.S. Semi Arid West: Efficiency and Equity Issues* at 20, presented at The Evolution of Property Rights Related to Land and Natural Resources (Lincoln Institute, Cambridge MA, 2010), on file with the author.

⁵⁰ Cesare Dosi & K. William Easter, *Market Failure and Role of Markets and Privatization in Alleviating Water Scarcity*, 26 INT'L J. OF PUB. ADMIN. 265, 273 (2003).

Glennon & Pearce argue contracts have to be crafted for every specific situation and their completion requires an ongoing relationship to cover agree on all the uncertainties that cannot be predicted at the outset. The achievement of an efficient transaction is therefore tentative, see Robert Glennon & Michael J. Pearce, *Transferring Mainstream Colorado River Water Rights: The Arizona Experience*, 49 ARIZ. L. REV. 235, 245 (2007) (“To accomplish the goal, both buyer and seller must agree to cooperate over a long period of time, and work together to resolve issues that cannot always be foreseen at the initial contract stage. Thus, the contract must include a significant dose of goodwill and reasonableness terminology that can be read, at least at times, as nothing more than an agreement to agree. There are no forms for such contracts idling on law firm shelves: instead, each must be custom drafted to meet the needs of the particular transaction, which can heavily depend on the exact type of water right being transferred.”) Similarly, Emerick & Lueck acknowledge the complexity in water transaction arising from the consideration of third parties impacts which is not usually an important factor in the transactions of other goods and, thus, have received few attentions from the economic organization scholarship, see Kyle Emerick & Dean Lueck, *Economic Organization and the Lease-Ownership Decision in Water* 12 (May, 12 2010) (unpublished working paper, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1605523).

⁵¹ BRICHIERI-COLOMBI, *supra* note 34, at 131-138 (discussing challenges and shortcomings in irrigation water use). GRIFFIN, *supra* note 14, at 119.

⁵² GRIFFIN, *supra* note 14, at 316.

⁵³ Thobani, *supra* note 19, at 3.

between different uses (for example, temporal precedence in prior appropriation systems⁵⁴), etc. These listed rules can be also seen as risk allocation devices, which may burden more in some cases those who value water more but are better equipped to cope with risk.⁵⁵

Second, water is extremely contingent to place, as well as time. A transaction of water from point A –downstream- to point B–upstream- entails a lower flow between the two locations and the quality of water can be different at the two points. Fungibility is, thus, impaired.⁵⁶ Navigation can also illustrate this point. A sharp rule assuming that navigational uses are not rival because they do not consume water is not feasible. Navigation may or not impair or conflict with other uses depending on where it occurs. If it occurs upstream, diversion downstream is not affected, but if it occurs in a lake downstream, the picture looks completely different since upstream uses might affect the quantity of water available for sailing, even more during dry times of the year. Jointness can also be used to describe the scenario where navigation and distribution of water occurs in the same canal without conflict.⁵⁷

Third, different types of uses take place in a water resource. Monitoring and enforcement costs of property rights defined for consumptive use might be prohibitive and standardization⁵⁸ might be too demanding, but definition of property rights is even more difficult, if even possible, for other types of uses that configure water as different type of goods. Water is different from other environmental resources, it embodies not only non-market and public goods⁵⁹ –as it is the case of clean air-, but toll, and private goods;⁶⁰ all involving both human and “nonhuman” users. ⁶¹ The more products a resource is offering, the more costly it will be to define property rights over it.⁶²

⁵⁴ See also Lueck & Emerick, *supra* note 50, at 12.

⁵⁵ Current water law is criticized for favoring the agricultural sector: despite ranks disregard specific marginal values, water regulations might rank higher irrigators’ rights not only because norms are historically lagged behind the times, but because farmers suffer from cumulative uncertainty (crop plagues, weather conditions, etc.) which is greater than in other sectors whose subsistence is not impaired by such exogenous factors. Thompson *supra* note 31, at 127. In Spain, the Water act establish a rank of uses to inform the decision of granting an administrative permit to use water, see art. 60.3 Consolidated Water Act [Texto Refundido de la Ley de Aguas – R.C.L. No. 1 (B.O.E. 2001, 176).

⁵⁶ For a discussion on the role that non-fungibility plays in the design and operation of environmental markets, see James Salzman & J. B. Ruhl, *Currencies and Commodification of Environmental Law*, 53 STAN. L. REV. 607 (2000).

⁵⁷ K. William Easter & Gershon Feder, 16. *Water Institutions, Incentives, and Markets*, in DECENTRALIZATION AND COORDINATION OF WATER RESOURCE MANAGEMENT 263 (D.D. Parker & Y. Tsur eds., 1997)

⁵⁸ Regarding standardization, see generally Thomas W. Merrill & Henry E. Smith, *Optimal Standardization in the Law of Property: The Numerus Clausus Principle*, 110 YALE L.J 1 (2000).

⁵⁹ The two main definitional characteristics of public goods are non-excludability and non-rivalry in consumption, see Agnar Sandmo, *Public Goods*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, *supra* note 38, available at http://www.dictionaryofeconomics.com/article?id=pde2008_P000245 (last visited May 23, 2011).

⁶⁰ “Toll goods are nonrival but users can be excluded at a relatively low cost. If there are concerns with equitable access to users, market power, scarcity of substitutes, or optimal provision of the good or service, public regulation

Consumptive use is intuitively related to a private good consumed out of the stream. But consumptive use is not that easy to define⁶³ if we take into account its quantity, quality and temporal dimensions. Roughly, in water we might think that an irrigator consumes part of his entitlement and that the other goes back to the stream in form of return flow. But the evaporated water and the water that filters are missing in this first approximation. A great part of all this water may enter the production function of several other users. Besides, diverting pollution into the river is consuming the water, at least in its qualitative dimension. The mapping of potential uses is still incomplete; the sequence of uses should be further explored to account for the temporal dimension. For example, we have to consider the implication of hydropower generation which needs to store water for a period of time and, even if it does not consume it, it is unavailable for other uses which might be on need.⁶⁴

Non-consumptive uses connect with toll goods when congestion arises. For example, the river might hold recreational activities –commercial and non-commercial- such as fishing. In some places, these uses are carried out under license –which provides a sort of exclusion regarding fish capture- but the permit is not directly tied to a right to the river’s water. Kayakers, fishermen, swimmers, etc. do not conflict unless certain stretch of the river is overcrowded.

Finally, water in a river can also provide public goods, such as environmental quality. Environmental quality is a prior for certain instream, non-consumptive uses such as fish life. All of us enjoy, and may remotely care about, a crystalline river. Some might have stronger preferences over this public good, such as environmentalists. How to address the regulation of these public goods will be discussed in the next section.

Consumption cannot be oversimplified just focusing on quantity. The picture sketched shows that in water management rivalry is the defining characteristic. Interestingly enough, the word rival comes from the Latin *rivus* which refers to those who compete for the water of a stream.

will be needed regarding property rights, conditions for competition, and quality and pricing of services. When the services are strongly nonrival, public financing mechanism (for example through benefit taxes such as land taxes) might be necessary to supplement direct user charges. Conventional sewage and navigation are good examples of toll goods.”, see Dosi & Easter, *supra* note 50, at 272.

⁶¹ Frischmann, *supra* note 39, at 174.

⁶² Jean-Marie Baland & Jean-Philippe Platteau, *Economics of Common Property Management Regimes*, in I HANDBOOK OF ENVIRONMENTAL ECONOMICS, 136-37(Karl-Göran Mäler, Jeffrey R. Vincent (eds.) 2003).

⁶³ §1725 Cal. Water Code (West 2009): “(...)”consumptively used” means the amount of water which has been consumed through use by evapotranspiration, has percolated underground, or has been otherwise removed from use in the downstream water supply as a result of direct diversion”. See also Chong& Sunding, *supra* note 13, at 241:“A California definition of “consumptive use” is applied water that cannot be put to further use by downstream users, which includes water that drains to a saltwater body”.

⁶⁴ GRIFFIN, *supra* note 14, at 193.

Rivalrousness is not binomial, but a question of degree.⁶⁵ In the case of water, rivalrousness is very contingent to users, season (as a proxy for quantity of water available) and place. Another good example to analyze rivalry are the already mentioned recreational uses. They are not rival among them until it congestion arises.⁶⁶ Hence, instead of rules based on presumptions and sharp defined property rights for all types of uses, several regulations adopt standards that the administrator applies. These standards might be more desirable despite the uncertainty they imprint.

B. Challenges addressed and arising from regulation

The complexity of water is reflected in the numerous dimensions that describe a right to use water. It is important to note that the definition of property rights is usually a governmental function and it can have a very important impact in the market.⁶⁷ A right of an irrigator from the Ebro River Region (Spain) can illustrate it. A farmer has an administrative permit for 75 years to use water from Araquil River in the Basque Country. The use, which is a proxy for quality, is fixed (irrigation) and his plot identified and measured. The quantity he can divert is expressed in daily average (in litres per second) and annual maximum (in cubic meters). He can use it daily or with interruptions during the month of July.⁶⁸ This right has defined characteristics, but it might be too strict to adapt to changing circumstances. In contrast, other areas of water law are sources of uncertainty given the less defined regulation in them.

In order to illustrate the indefiniteness -which does not pretend to carry a negative connotation- of some water regulations, which has inevitably an impact on transactions, this section will, first,

⁶⁵ See in general, Frischmann, *supra* note 39.

⁶⁶ GRIFFIN, *supra* note 14, at 46.

⁶⁷ There can be *governmentally* granted rights or common law rights, see Bruce Yandle & Andrew P. Morriss, *The technologies of property rights: choice among alternative solutions to tragedies of the commons*, 28 *ECOLOGY L.Q.* 123, 124 (2001). See Morriss, *supra* note 20, at 1008.

The issues regarding grandfathering or modification of the current allocation of rights when setting up a market which define who the market agents can be will not be discussed here. Instead, this section focus on how regulations address the complexity of water described in the previous part.

Property rights definition has the features of a public good which entails, usually, governmental provision. Glicksman & Levy [ROBERT L. GLICKSMAN & RICHARD E. LEVY, *ADMINISTRATIVE LAW: AGENCY ACTION IN LEGAL CONTEXT* 15-16 (2010)] include here standardization of the product (here, the property right to use water) as a public good, while Tinggaard [GERT TINGGAARD, *PUBLIC CHOICE AND ENVIRONMENTAL REGULATION* 49 (1998)] enumerates it as an independent rationale in his list based on the CO₂ permit market, where he does not include any reference to public goods.

⁶⁸ This is a real example taken from the "Registro de Aguas de la Confederación Hidrográfica del Ebro" -Public Water Registry from the Ebro Basin Authority (Section A, Volume 30, page 26), available at <http://iber.chebro.es/webche/regVistaPrevia.aspx?id=0> (last visited May 23, 2011).

briefly comment on certain standards which are open-ended and potentially subject to a discretionary decision, and, second, on why standards have been preferred over property rights to regulate public goods in water. The latter exemplifies the tradeoff between sharp-definition of rules and the costs of monitoring and control, with certain overtone of non-economic rationales since it is still uncomfortable to conceive water as a standard commodity and society may prefer to entrust a public authority to protect it. People react differently to the privatization, trade, or commodification of water than they do of other good, without the need to fully embrace Sagoff's views against monetization of all environmental goods.⁶⁹

In some jurisdictions, the decision to grant a water right depends on standards. For example, §1243 California Water Act (CWA) establishes that "in determining the amount of water available for appropriation for other beneficial uses, the board shall take into account, whenever it is in the public interest, the amounts of water required for recreation and the preservation and enhancement of fish and wildlife resources". Doctrines as "reasonable use" or "beneficial use" or vague standards such as "public interest"⁷⁰ to be weighed when granting a permit for water withdrawal are far from predictable bright-line rules. The evolution of the concept beneficial use, which now includes environmental flow,⁷¹ illustrates how open the concept is. Uncertainty also increases when water rights are subjected to external regulations, such as the Endangered Species Act.⁷² California's petition for long-term transfers have to include reference to the measures required by the Fish and Wildlife Service regarding the mitigation of the transfer's effect.⁷³

Protecting in-stream flow, a public good pre-requisite for certain non-consumptive uses, entails protecting the quantity of water in rivers and streams. The quality of that water is regulated through other means, such as federal and state water quality standards.⁷⁴ There are two main ways

⁶⁹ See generally MARK SAGOFF, *THE ECONOMY OF THE EARTH: PHILOSOPHY, LAW, AND THE ENVIRONMENT* (Cambridge University Press, 2008) (advocating for a social compromise on these issues).

⁷⁰ Cal. Water Code § 1255 (West 2009): "The board shall reject an application when in its judgment the proposed appropriation would not best conserve the public interest".

⁷¹ For an analysis of the evolution of "beneficial use", see Libecap, *supra* note 49 at 21.

⁷² For a discussion, see Thompson *supra* note 31, at 124 (arguing that uncertainty imprinted by Endangered Species Act is exogenous to the law).

⁷³ Application for long-term transfer to State of California Water Resources Control Board -Division of Water Rights, (Cal. Water Code §1735). For a more elaborated description of the complex institutional structure managing water resources and the potential anticommons problem that it entails, see *infra* notes 88-93 and accompanying text.

http://www.waterboards.ca.gov/waterrights/publications_forms/forms/docs/trans_long_petition.pdf (last visited May 23, 2011). See, for example, California Water Code §1727b(2) (West 2009): "(b) The board shall approve a temporary change if it determines that a preponderance of the evidence shows both of the following(...): (2) The proposed temporary change would not unreasonably affect fish, wildlife, or other instream beneficial uses".

⁷⁴ Water Quality standards can be either numeric or narrative, being the later much less defined. For an explanation of the different criteria, see Minnesota Pollution Control Agency, Water Quality standards,

government can provide for in-stream flow protection: regulation and property rights⁷⁵ which rank differently regarding uncertainty.

Government can protect in-stream flows by imposing regulatory duties on private parties. Regulation can take the form of rules or standards. A rule can establish minimum flow requirements.⁷⁶ The establishment of these requirements may be contentious in over-allocated streams since the requirements could necessitate curtailing the amount of water that can be withdrawn under existing water rights. To enforce in-stream flow requirements, governments may review market transactions to ensure that the in-stream flow requirements still would be satisfied after the transactions. If the government has not established in-stream flow requirements, it still could attempt to protect in-stream flow by reviewing market transactions on the basis of whether they accord with the public interest, as is currently done in certain jurisdictions.⁷⁷

Another way to protect in-stream flow in water markets is to sharply define non-consumptive property rights to the flow.⁷⁸ Once the rights are defined and allocated – perhaps by purchasing rights to the flow from existing water rights holders–, market transactions would have to respect the property rights in-stream flow just like they must respect consumptive rights. Protecting in-stream flow through property rights might facilitate market transactions, similarly to minimum flow requirements, compared with ex post review of transactions under a public interest standard. According to the free-market environmentalist view, fishing clubs or environmental NGO should hold in-stream flow rights, avoiding governmental capture and arbitrariness.⁷⁹ But given the public good nature of environmental protection, government might be entrusted with its provision due to

<http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/water-quality-and-pollutants/water-quality-standards.html> (last visited May 23rd, 2011).

⁷⁵ See in general David M. Gillilan & Thomas C. Brown, *INSTREAM FLOW PROTECTION: SEEKING A BALANCE IN WESTERN WATER USE* (Island Press, 1997).

⁷⁶ This is similar to the controversy regarding the Delta smelt; cutbacks were placed in certain areas by a Federal court based on the Endangered Species Act. See Joel K. Bourne, Jr., *California's pipe dream*, *NAT'L GEOGRAPHIC*, Apr. 2010, at 132 & 144.

⁷⁷ Cal. Water Code § 1255 (West 2009): "The board shall reject an application when in its judgment the proposed appropriation would not best conserve the public interest". Even though if the policy of California seems to suggest that public trust, public interest and the environment are separate rationales. http://www.waterboards.ca.gov/waterrights/water_issues/programs/instream_flows/docs/ab2121_0210/adopted050410instreamflowpolicy.pdf (last visited May 23, 2011).

California's petition for long-term transfers have to include reference to the measures required by the Department of Fish and Game regarding the mitigation of the transfer's effect, see http://www.waterboards.ca.gov/waterrights/publications_forms/forms/docs/trans_long_petition.pdf (Cal. Water Code §1735) (last visited May 23, 2011). §1243 CWA establishes that "in determining the amount of water available for appropriation for other beneficial uses, the board shall take into account, whenever it is in the public interest, the amounts of water required for recreation and the preservation and enhancement of fish and wildlife resources".

⁷⁸ Huffman, *Markets*, *supra* note 22, at 430-434.

⁷⁹ LEAL & ANDERSON, *supra* note 22, at 99.

the risk of underprovision as result of free-riding.⁸⁰ This governmental role might also be justified from a non-economic approach which conceives water as a resource with community ties. This explanation might be behind the declaration of waters as public properties in many jurisdictions even if it is residual because water use rights are granted.⁸¹ Given the difficulties of measuring the societal value of public goods in the administrative process,⁸² government may prefer to channel protection through standards over any other strategy that requires exact valuation of the good a priori.

Given how contingent rights, goods, and uses related to water are, regulations are not always clear-cut rules. Instead, standards to be applied to the particular circumstances of each case are preferred. Despite its costs in terms of administration and uncertainty, standards adapt to the local characteristics and to the changes across time easily. But this lack of ex-ante full predictability, not only may impose costs in private parties, but it may blur any calculation of efficiency -outcome to

⁸⁰ Even though the main critique of this proposal is free-riding effect may crowd out these initiatives as the very definition of public goods show, there have been experiences in the US that may offer support for the free market environmentalist argument such as the Oregon Water Fund [Janet C. Neuman & Cheyenne Chapman, *Wading Into the Water Market: The First Five Years of the Oregon Water Trust*, 14 J. ENVTL. L. & LITIG. 135 (1999).] or the BEF Water Restoration Certificate (WRC) commercialized by the Bonneville Environmental Foundation (BEF) which enables buyers to take responsibility for their water consumption -water footprint- by returning back water to the environment, see BEF, at <http://www.b-e-f.org/water/cert> (last visited May 23, 2011). For more successful examples, LEAL & ANDERSON, *supra* note 22, at 99-101. For a comprehensive review of the experiences until 1998, see Clay J. Landry, *Saving Our Stream Through Water Markets: A Practical Guide* (Political Economy Research Center, 2008) (In particular, in page 8 he reports that 2,364,020 acre-feet had been acquired in the Western US from 1990 to 1997)].

⁸¹ Examples abound. For California, see §102 California Water Code: "102. All water within the State is the property of the people of the State, but the right to the use of water may be acquired by appropriation in the manner provided by law." For Spain, see art. 1 Consolidated Water Act [Texto Refundido de la Ley de Aguas - R.C.L. No. 1 (B.O.E. 2001, 176)].

⁸² Measuring the social valuation is a very complex enterprise and the results are always contentious. Market does not always offer a measure of how much recreational fishermen value certain level of in stream water, but it is desirable to come up with an objective way to quantify them. However, non-market valuation methods either based on hedonic pricing, travel-cost -which could be used for example to analyze how much recreational fisherman are willing to travel to catch fishes in a certain stream- or survey methods, such as contingent valuation, do not offer non-contestable results. However, the complexity of the enterprise might explain why this approach has not been taken regulation remains the preferred option to provide public goods. But regulation imposing duties to third parties, such as not to erode the soil of the river or not to pollute, should suffer from the same flaws since a cost-benefit analysis should be done. For an analysis of these valuations, see John B. Loomis, *Use of non-market valuation studies in water resource management assessments*, 109 WATER RESOURCES UPDATE 3 (1997), available at http://www.ucowr.siu.edu/updates/pdf/V109_A2.pdf (last visited May 23, 2011). See also, GRIFFIN, *supra* note 14, at 297-304 (non-market valuation techniques are covered: contingent valuation, hedonic pricing, and travel costs. The author states that "Of these three techniques, contingent valuation has the best capacity to produce the functional information needed to conduct policy or project analysis"). For non-market valuation of leisure activities, see in general, Daniel J. Phaneuf & V. Kerry Smith, *Ch. 15: Recreation Demand Models*, en II HANDBOOK OF ENVIRONMENTAL ECONOMICS, 671 (Karl-Göran Mäler, Jeffrey R. Vincent (eds.) 2005).

be achieved through market transactions- which becomes at best aspirational and depends heavily on several governmental decisions, often discretionary.⁸³

III. MARKET (POLITICAL) EFFICIENCY

Markets are aimed to efficiency, that is, goods have to end up allocated to those users who value it the most. But markets themselves also pose challenges to efficiency since they depend on political decisions.

It is usually overlooked that the scope of the water market defines the analysis and its scale is usually set by a governmental decision. The unit of efficiency analysis is, thus, endogenous and might be dictated by the territorial jurisdiction of the body setting the market⁸⁴ or the existence of infrastructure,⁸⁵ and it cannot be affirmed without doubt that these are sound grounds. The standard account that assumes that a market will achieve efficiency within their scope begs the question of why this should be the scope that matters. For example, in ecological terms, basin is the sound division. A public agency could be entrusted with water management for that basin,⁸⁶ but social and economic dimensions might not respond to this setting.⁸⁷ Or there might be an interjurisdictional basin where any board has been set to manage the resources under cooperation and, instead, two separate jurisdictions might adopt not integrated markets. The scope has repercussions on the

⁸³ Glennon&Pearce, *supra* note 50, at 245 (considering Colorado River Water Rights more like privileges than rights given the discretionary powers the administration holds. Underlying all of the bureaucracy involved in effecting the transfer is the notion that the "right" to use Colorado River contract water is more a privilege than a right, allocated by both state and federal governments, to deserving citizens who will put the water to beneficial use. Selling this privilege involves, for better or worse, the exercise of discretion by both the state and federal entities in determining whether the new use is consistent with both state and federal water management policy) (considering Colorado River Water Rights more like privileges than rights given the discretionary powers the administration holds. Underlying all of the bureaucracy involved in effecting the transfer is the notion that the "right" to use Colorado River contract water is more a privilege than a right, allocated by both state and federal governments, to deserving citizens who will put the water to beneficial use. Selling this privilege involves, for better or worse, the exercise of discretion by both the state and federal entities in determining whether the new use is consistent with both state and federal water management policy). Chong& Sunding, *supra* note 13, at 242 (recognizing the subjective character of efficiency).

⁸⁴Victor Brajer, Al Church, Ronald Cummings & Phillip Ronald, *The Strengths and Weaknesses of Water Markets as They Affect Water Scarcity and Sovereignty Interests in the West*, 29 NAT. RESOURCES J. 489, 495-497 (1989).

⁸⁵ Easter & Feder, *supra* note 57, at ***.

⁸⁶ Bert Bolin, *Geophysical and geochemical aspects of environmental degradation*, in I HANDBOOK, *supra* note 67, at 7, 33.

⁸⁷ *Id.*: "People do not always live where there is water". See also *National Geographic, Water. Our thirsty world* 144 (April 2010) (San Joaquin Valley in California is an arid area where they are cultivating cantaloupe melons). See also Katie Paul, *Dying on the vine*, NEWSWEEK, 24.08.2009, disponible en <http://www.newsweek.com/2009/08/23/dying-on-the-vine.html> (last visited May 23, 2011): it quotes the historian Kenneth Starr who describes San Joaquin Valley as "the most productive unnatural environment on Earth".

analysis of secondary effects because usually only those in the jurisdiction affected will be taken into account.

Relatedly, it is important to connect the definition of efficiency in water with the concept of public interest. Markets fulfill the public interest, which is normatively squared with efficiency in its framework, by achieving an allocation that maximizes water value. Public interest is a term whose content might vary⁸⁸ since the different scales in public interest are dictated by the multiple interests at stake and the scope of them. The multi-faceted nature of water translates into a complex administrative structure where several agencies, even from different levels of government, might enact regulations affecting the resource.⁸⁹ Communication and coordination among them despite desirable might be difficult to achieve given their specific subject-matters, the different scale of their interests and their different constituencies.⁹⁰ The piece-meal intervention of all these agencies entails, among other things, the presence of numerous veto points in water rights transaction reviews.⁹¹

Public interest has been blamed for triggering the anticommons tragedy in what water markets are concerned. Different administrative agencies in charge of some aspects water management may have veto power grounded on the ethereal public interest to prevent a transaction between lower value users and high value users from happening or delay it increasing exponentially its transaction costs in administrative review procedures in place to ensure that other users are not damaged where they participate.⁹² But public interest and participatory dialogue⁹³ might be the best way to account

⁸⁸ Stephen N. Bretsen & Peter J. Hill, *Water Markets as a tragedy of the Anticommons*, 33 WM. & MARY ENVTL. L. & POL'Y REV. 723, 749-50 (2008) ("First, the often undefined term "public interest" or "public welfare" raises a number of questions in the context of water markets. "Is 'public welfare' or the 'public interest' simply the sum of individual's well being" in accordance with utilitarian standards? Is the public interest defined as the interests of all the people in the state in a particular transfer or just the communities or watersheds directly affected? 6 ° How is the public interest measured in a public policy balancing against private interests, especially when a transfer of water rights from agricultural uses to urban uses represents an economic gain?" (Footnotes omitted)).

⁸⁹ See DANTE A. CAPONERA, PRINCIPLES OF WATER LAW AND ADMINISTRATION (2007).

It is not coincidence that "pork barrel" laws was coined for the Rivers and Harbors Act of 1899, Peter P. Rogers, *Water governance, water security, and water sustainability*, in WATER CRISIS: MYTH OR REALITY? 3, 26 (P. P. Rogers, M. R. Llamas & L. Martínez-Cortina, 2006).

⁹⁰ Rogers *et al.*, *supra* note 40, at 248; "All types of governance systems have a concern for a public interest –albeit for smaller publics (...). There are instead guardians of separate 'national' interests that involve the manner in which water is used. The interests historically were promotion of commerce and economic development utilizing river resources. Today such interests are more fractionalized and are pursued by a mix of federal agencies")

⁹¹ Katrina M. Wyman, *From fur to fish*, 80 N.Y.U. L. Rev 117, 176 (arguing how the presence of different political institutions in a decisional process implies higher costs).

⁹² See in general Bretsen & Hill, *supra* note 88.

⁹³ For an account of a flexible coordination model of governance for cases where different agencies with not always concurrent interests and serving different constituencies interact, see Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L. J. 795 (2005). See *id.* at 837-856 for a case study on the Cal-Fed Delta Bay Program.

for externalities that could not be narrowed down into the definition of property rights over public goods, between partially rival users, etc.

One reason behind these undefined extremes and the participation of many agencies is, once again, the fact that government is entrusted with the guardianship of public goods and societal goals, mixing economic arguments with non-economic ones. Sometimes this communal dimension⁹⁴ has taints of parochialism, such as it might be the case in interbasin transaction in which the communities where water is originated are reluctant to such a trade. It can be argued that to prevent parochialism the decision making body and, thus, the accounting stance should be broader.⁹⁵

Be as it may, the current scenario is one of a puzzle of agencies whose interests are obviously crafted according to different territorial and subject-matter scopes, and thus, efficiency might have different components for each of these agencies. Therefore, the achievement of an efficient allocation through a market is not exempt of political influence, neither at the outset nor in its operation.

IV. WATER MARKETS: REQUISITES AND FAILURES

This section, building on some ideas already pointed out, portrays the requirements that water markets do not meet or what are the imperfections or market failures present in order to challenge those who advocate markets as the paradigmatic solution to all the flaws administrative water management systems present. Markets and administrative systems have more in common that water market advocates recognize.⁹⁶

Free-market environmentalists are the strongest advocates for market solutions to environmental problems not only in the case of water, but also for other resources. Books by

⁹⁴ For example, Oregon requires legislative approval for water transfers out of the state: O.R.S. §537.830; §537.801-810 (West 2009). Another example can be found at Grafton *et al.*, *supra* note 23, at 11 (“Other restrictions have been introduced over concerns that ‘trade out’ of water entitlements will erode the economic base of irrigation communities. For instance, the State of Victoria imposes a 4 % limit on the annual trade of water entitlements out of an irrigation district and a requirement that a maximum of 10 % of the volume of water entitlements be held by parties separate to the land”).

⁹⁵ A higher level dilutes some negative externalities, though: jobs lost in one area where water is sold might be offset by increased economic activity in the area receiving water, so the effects cancel out. See Griffin, *supra* note 14, at 166-170.

⁹⁶ For a critique of the purported decentralization of markets, see in general Joseph W. Dellapenna, *The importance of getting Names Right: The Myth of Markets for Water*, 25 WM. & MARY ENT. L. & POL’Y REV. 317 (2000)

ANDERSON & HILL⁹⁷ and ANDERSON & SNYDER⁹⁸ pin down the application free-market environmentalist ideas to water. World Bank policy proposals for water markets can be inscribed in this group, too.⁹⁹ They present the market as an alternative to government.¹⁰⁰ As Krier points out:

“They –free-market environmentalists– hope to rely on the market more or less entirely and side-step the government just altogether.”¹⁰¹

In fact, it may be more accurate to say that they envision a minimization of the governmental role,¹⁰² and limit government intervention to enforcement of private parties’ agreements once property rights are defined. This section contests these assumptions highlighting the instances of governmental intervention with few strokes of a brush. Functioning water markets require a deeper and more varied governmental intervention than markets for other goods as the analysis of requisites and failures will unveil.

Water markets should be the realization of the First Theorem of Welfare Economics:¹⁰³ water markets should be set to achieve the attractive Pareto efficient outcome that will maximize the value of scarce water use. There are some implicit requirements in the theorem such as: a) competition – there should be numerous buyers and sellers–; b) agents must always prefer more of the good than less; and c) agents do not care about another’s consumption.¹⁰⁴ This list connects with theories of regulation based on market failures which justify governmental interventions; failures are the side coins of these requirements.¹⁰⁵ If public goods, natural monopolies, externalities or imperfect

⁹⁷ WATER MARKETING. THE NEXT GENERATION 32 (Terry L. Anderson & Peter J. Hill eds., 1997).

⁹⁸ ANDERSON & SNYDER, *supra* note 18, at 7. Other authors in this trend might be cited, among others, *see also* Huffman, *A Model for the East*, *supra* note 22; Morriss, *supra* note 20; R. Smith, *TRADING WATER: AN ECONOMIC AND LEGAL FRAMEWORK FOR WATER MARKETING* (1988); Thobani, *supra* note 19, at 1.

⁹⁹ *Id.*

¹⁰⁰ For a free-market environmentalists’ vision of government, *see* LEAL & ANDERSON, *supra* note 22, at 3, 71, 115, 124-125, 129.

¹⁰¹ James Krier, *Tragedy of the Commons part two*, 15 HARV. J. L. & PUB. POL’Y 327, 328 (1992). *See also id.* at 338, Krier arguing that Hardin in the celebrated *Science’s* article just take government for granted without analyzing how it is compelled to take action.

¹⁰² *See* LEAL & ANDERSON, *supra* note 22.

¹⁰³ *See supra* note 26. But the First Theorem must not be easy to apply in the water realm since markets are not blooming all across, GRIFFIN, *supra* note 14, at 108.

¹⁰⁴ VARIAN, *supra* note 26, at 585.

¹⁰⁵ Despite this common basis, there is not a single enumeration of market failures though. The enumeration offered compiles the four rationales enumerated by Cooter & Ullen [ROBERT COOTER & THOMAS ULLEN, *LAW & ECONOMICS* 43-47 (5th ed. 2007)] and Glicksman & Levy [GLICKSMAN & LEVY, *supra* note 67, at 15-19] which identify four conditions that might impeding perfect competition in a market (and consequently the desirable outcome of general equilibrium) and thus requiring corrective public policies: monopoly and market power –which I narrow down to natural monopoly since it is what has a more direct connection to water–, externalities, public goods and informational asymmetries. Levi-Faur [David Levi-Faur’s, *Market failures*, available at <http://poli.haifa.ac.il/~levi/failure.htm>] includes –apart from public goods, information asymmetries, and

information are present, governmental intervention is required. For example, if for a water market we need multiple buyers and sellers, the administration may need to regulate the natural monopoly characteristics of the conveyance and distribution of water. Some authors also include transaction costs in this list.¹⁰⁶

To these economic justifications, non-economic ones are added. Water has been considered a merit good,¹⁰⁷ that is, it should be provided to everyone regardless of his or her income. This has been seen as a non-economic argument tied to human rights or distributive questions, but it could have been connected to the preferences of each consumer. We may care that all others have water, defying the third requirement and, we may request government to provide for the minimum water needs,¹⁰⁸ either directly or imposing duties on companies.

In order to explore some of the governmental roles played in water markets, the requirements specifically pinned down for water markets by Brajer et al., and not the general ones listed above, will be used. These requirements are:¹⁰⁹ 1) well-defined property rights over the goods; 2) mobile resources; 3) many buyers and sellers; 4) correct flows of information. From the previous explanation about the nature of the resource and about the different goods it comprises, it can be inferred that some of the assumptions and requirements are, at best, partially met.

externalities- natural monopoly –which might be embodied in distortions of competition from the previous list-, transaction costs (which has been analyzed under imperfect contracts in a similar fashion as a market failures by Cooter&Ulllen[COOTER & ULLEN, *supra*, at 225]) or moral hazard. Finally, it is worth mentioning the classification of market failures related to an environmental market –CO₂ offered by Gert Tinggaard [TINGGAARD, *supra* note 67, at 48-49] which lists political interference and differentiated products, which can be understood as a governmental failure and as a public good respectively. GRIFFIN, *supra* note 14, at 107-113, includes also overdiscounting –that is private discount rate is higher than the social desirable one- as a type of market failure. It gives incentives to underconserve water depletable resources.

¹⁰⁶ Transaction costs are“(a) the costs of locating and attracting potential trading partners and of pre-sale inspection; (b) contracting and fulfillment costs; (c) policing and enforcement costs”, see M. Klaes, *History of transaction costs*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, *supra* note 38, available at http://www.dictionaryofeconomics.com/article?id=pde2008_T000239 (last visited May 23, 2011). See also BARRY C. FIELD, ENVIRONMENTAL ECONOMICS. AN INTRODUCTION 193 (1994).

¹⁰⁷ For a broad conception of water’s economic value, see J. PERRY, MICHAEL ROCK AND D. SCKLER, WATER AS AN ECONOMIC GOOD: A SOLUTION OR A PROBLEM? v (1997): “ is a basic need, a merit good, and a social, economic, financial, and environmental resource. See William M. Hanemann, *The economic conception of water*, in n WATER CRISIS: MYTH OR REALITY? 61-91 (Peter P. Rogers, M. Ramón Llamas eds., 2006).

A definition of merit good can be found at Richard Musgrave, *Merit goods*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, *supra* note 38, available at http://www.dictionaryofeconomics.com/article?id=pde2008_M000152 (last visited May 23, 2011) (this author also understands community rights as a limit constraining individual choice).

¹⁰⁸ Gleick offers this calculation based on the water needed to drink, cook, hygiene, and cleaning, see Peter.H. Gleick, *Basic water requirements for human activities: Meeting basic needs*, 21 WATER INT’L 83-92 (1996). The minimum standards are around 20 litres but between 50 and 100 is what should be ensured for every human being, see European Water Initiative, *Water and Sanitation as Human Rights*, http://www.euwi.net/files/FAQ_Right_to_water-sanitation_0.pdf (last visit May 23, 2011).

¹⁰⁹ Brajer et al., *supra* note 84, at 495-497.

The first prong embodies the idea that the sharper the definition of property rights, the more transfers will occur.¹¹⁰ Property rights should be defined in terms of ownership, transferable, enforceable, and specified to avoid conflicts with other right holders or users.¹¹¹ From the characteristics of the resource already described, the first prong is clearly difficult to fulfill: property rights are difficult to define for the physical intricacies of water and we may prefer to leave some extremes open.¹¹²

The second requisite, the mobility of resources is a question of degree. Brajer et al. link mobility to low transaction costs imposed by regulation.¹¹³ But it can also be conceived physically. The market in water seems to be physically limited by either natural connections or the existence of man-made infrastructure. Water is expensive to transport, more than gas or power.¹¹⁴ In addition, the commerce of water in bulk transfers has not taken off given the high costs.¹¹⁵ Water infrastructure – dams, channels, and other structures necessary for distribution – are natural monopolies, a rationale analyzed under the third prong.¹¹⁶

Connected to these first two requirements, the pervasive problem of externalities arises. Since property rights are not fully defined, externalities abound and need to be accounted for. If two parties trade their rights, not only it is difficult to agree into a contract, but multiple changes in the

¹¹⁰ Grafton et al., *supra* note 23, at 4 (arguing that more defined property rights brought more transactions in the US West).

¹¹¹ Brajer et al., *supra* note 84, at 495.

¹¹² See *supra* section II.A

¹¹³ Brajer et al., *supra* note 84, at 495-496

¹¹⁴ The costs of transporting water 100km represent about 50 % of the wholesale cost of water [¹¹⁴ while the equivalent is 2.5% for natural gas and 5% for electricity. Alexander Gee, *Competition and the water sector*, 2 ANITRUST 38, 39 (2004), available at http://ec.europa.eu/competition/publications/cpn/2004_2_38.pdf]. Hence, connections may not exist on a vast scale due to the cost of pipelines and of the energy needed to pump water long distances. See Vicky Waye & Christina Son, *Regulating the Australian Water Market*, 22 J. ENV'T L. 431, 458 (2010). See also Jon Stern, *Introducing Competition into England and Wales water industry: Lessons from the UK and EU energy market liberalization*, 18 UTILITY POL'Y 120, 124 (2010). Raw water usually is not priced as the fees and levies we pay monthly show, they only reflect the price of canalization, purification, and treatment of waste, while it does not happen in other commodities such as gas where the product itself is priced, see Tony Balance, *A view from the industry* in TONY BALANCE, IAN BYATT, MARTIN CAVE, RONAN PALMER & ALAN SUTHERLAND, *INNOVATION, INCENTIVES AND COMPETITION; A NEW DEAL FOR THE WATER INDUSTRY* 19, 20 (2009).

Water is much more local than other commodities; the “Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors” recognizes this singularity of water: (26, in fine) “procurement rules of the type proposed for supplies of goods are inappropriate for purchases of water, given the need to procure water from sources near the area in which it will be used. But it can be applied to the hydraulic projects”. It can be also local for the different standard imposed as the German municipal water utilities regulation shows, see WRC/Ecologic, *Study on the Application of the Competition Rules to the Water Sector in the European Community*, 46(2002), available at: http://ec.europa.eu/competition/publications/studies/water_sector_report.pdf (last visited May 23, 2011).

¹¹⁵ Jeneen Interlandi, *The New Oil*, NEWSWEEK, Oct. 18, 2010, at 46.

¹¹⁶ See *infra* pp. 23-24.

dimensions that might delineate a right may occur with a new use which might potentially affect other users given the interdependencies. The simplest example illustrates it: if A sells his right to B who is an upstream user, the water that will flow after the transaction between the point where B diverts it and A used to will be reduced. But A and B may not be fully sure what are the parties affected or what are the actual effects which may impair their transaction. It might be envisioned, of course, a more complex scenario where these two parties enter into a contract with C- an intermediate user, but this implies increased transaction costs. Usually there is an administrative or judicial review procedure in place to prevent undesirable effects on other users and uses. Or other administrative schemes, such a compensation fund need to be established.¹¹⁷ Many of these schemes entail administrative decision-making power.

When considering how the potential externalities from transactions are handled, it is important to note that the review instead of being inspired by a Kaldor-Hicks criterion,¹¹⁸ seems to embrace a Pareto efficiency criterion.¹¹⁹ Some review procedures bar any transaction negatively affecting a third party.¹²⁰ Any Coasean bargaining has to occur outside the process. Given how demanding it is for any transaction not to affect negatively any third party, it has been proposed that instead of injury without further qualifications, only substantial injury should be the standard adopted. A similar rationale might be behind the different depth of the review procedures for short-term and long-term transactions.¹²¹ It should be discussed whether the protection of third parties' interests and society in general would not be better channeled through a liability rule, which allows compensation ex post, than through a property rule that in absence of ex-ante agreement blocks the

¹¹⁷ A sort of compensatory fund was adopted in the California Model Water Transfer Act §§505-506 (14 HASTINGS W.-N.W. J. ENV. L. & POL'Y 591, 606 (2008)). The fund is set with the security deposits the person who files a transfer has to pay. The amount of the security deposit is calculated by a fee per acre foot of water (§505.a). Compensation is limited to that amount. The funds remained after paying the judgment, if any, entered by an independent arbitrator would be returned to the transferor (§505.1).

¹¹⁸ Robert N. Stavins, *Environmental economics*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, *supra* note 48, available at http://www.dictionaryofeconomics.com/article?id=pde2008_E000096&edition=current&q=stavins&topicid=&result_number=2 (last visited May 23, 2011).

¹¹⁹ Louis Kaplow, *Pareto principle and competing principles*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, *supra* note 38, available at http://www.dictionaryofeconomics.com/article?id=pde2008_P000315&edition=current&q=Pareto&topicid=&result_number=2 (last visited May 23, 2011).

¹²⁰ A good example is again the regulation of temporary –up to 2 years- transfers (Cal. Water Code §1725 (West 2009)):“(b) The board shall approve a temporary change if it determines that a preponderance of the evidence shows both of the following(...): (2) The proposed temporary change would not unreasonably affect fish, wildlife, or other instream beneficial uses”.

¹²¹ Compare the short and long term transfer applications, the latter being more demanding, *see* http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/ (last visited May 23, 2011).

transaction if the environment or third parties are affected.¹²² The framework envisioned in the California Model Water Transfer Act¹²³ can serve as an example. According to it, transfers of conserved water are subject to a less demanding procedure. For example, the period for approval is shorter and they cannot be protested. Instead, third parties can claim compensation in front of an arbitrator. But even in this more streamlined scheme, government plays a decisive role.

The third prong, that is, the existence of many buyers and sellers –or, in other words, the absence of market power– is linked to the natural monopoly.¹²⁴ Due to its cost structure; duplication of water infrastructure is not desirable. Governmental intervention can take the form of regulation, that is natural monopolies can be managed by private companies regulated by public agencies, but it is pretty common that these projects and their management are carried out by public entities.¹²⁵ Supply mains and water distribution imply both a monopsony and a monopoly in the water use rights market. Household, in general, do not hold water rights; they are supplied by companies or public entities.¹²⁶ In contrast with other utilities, there has not been liberalization in the urban water sector even though all utilities present natural monopoly characteristics over infrastructure but not over the product itself. In general, only one water company supplies a municipality which implies a lower number of agents in the market. A great majority of these municipal suppliers are public which entails that public administrations will be agents in the market.¹²⁷ In the supply side, there are

¹²² For the theoretical framework, see Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

¹²³ Current regulation differentiates between short and long term transactions to establish different level thoroughness of the review procedure (compare §§1725-1732 with §§1735-1737), but the California Model of Transfer Act differentiates between whether water transferred is conserved water or not since conserved water should imply lower level of external effects. California Model Water Transfer Act §506.b (14 HASTINGS W.-N.W. J. ENV. L. & POL'Y 591, 597-609 (2008)).

¹²⁴ "A situation that occurs when one firm in an industry can serve the entire market at a lower cost than would be possible if the industry were composed of many smaller firms. Gas and water utilities are two classic examples of natural monopolies. These monopolies must not be left to operate freely; if they are, they can increase prices and profits by restricting their output. Governments prevent such a scenario by regulating utility monopolies or providing utility services themselves.", Tatyana Soubbotina, BEYOND ECONOMIC GROWTH AN INTRODUCTION TO SUSTAINABLE DEVELOPMENT SECOND EDITION 140 (2004).

¹²⁵ See EUREAU, STATISTICS OVERVIEW ON WATER AND WASTEWATER IN EUROPE 87 (2008), http://www.aeas.es/aeas/docs/EUREAU_Water_and_Wastewater_in_Europe_2008.pdf. ("Over 70% of the total population in EUREAU member countries [27 EU member countries except Latvia and Slovenia; 3 EFTA countries - Iceland, Norway and Switzerland-, and Croatia] are served by a public or a public-private operator for drinking water services, the figure being 80% in the case of wastewater services"). In the US, by 2000, only 15% of the provision was private. PETER GLEICK GARY WOLFF, ELIZABETH L. CHALECKI&RACHEL REYES, THE NEW ECONOMY OF WATER: THE RISKS AND BENEFITS OF GLOBALIZATION AND PRIVATIZATION OF FRESH WATER 23 (2002).

¹²⁶ When water supply in urban areas is short, the companies or the entities in charge of the distribution will be the ones trading in the market. Brajer et al., *supra* note 84, at 499 (analyzing the influence the City of Albuquerque has in the New Mexico's market).

¹²⁷ See EUREAU, STATISTICS OVERVIEW ON WATER AND WASTEWATER IN EUROPE 87 (2008), http://www.aeas.es/aeas/docs/EUREAU_Water_and_Wastewater_in_Europe_2008.pdf. ("Over 70% of the total population in EUREAU member countries [27 EU member countries except Latvia and Slovenia; 3 EFTA countries -

also fewer agents than it can be intuitively thought. Farmers usually do not hold their rights. They receive water from irrigation organizations that hold the water use rights.¹²⁸ Some of these organizations are also public.¹²⁹ Government could increase the number of buyers and sellers by opening up municipal markets and by declaring farmers' individual entitlements tradable. In any case, public entities will be agents with important market power.

Finally, information is a contentious point. According to basic microeconomics theory, "[b]uyers and sellers will only make exchanges that maximize their interests if they have good information".¹³⁰ Markets are supposed to aggregate atomized private information¹³¹ better than the regulator.¹³² But, in water markets the situation might not be as ideal and potential contracting parties might be unable to locate potential partners. A sort of a broker could centralize information about willing buyers and sellers. Information about past transactions and clearing prices¹³³ is particularly relevant in a water market because it may allow the potential parties to forecast and plan their decisions accordingly.

The broker might well be a public or private agency. In fact, this is the role played by government in water banks¹³⁴ or clearinghouses.¹³⁵ Public entities might have a comparative

Iceland, Norway and Switzerland-, and Croatia] are served by a public or a public-private operator for drinking water services, the figure being 80% in the case of wastewater services") (last visited May 23, 2011). In the US, by 2000, only 15% of the provision was private. PETER GLEICK GARY WOLFF, ELIZABETH L. CHALECKI&RACHEL REYES, *THE NEW ECONOMY OF WATER: THE RISKS AND BENEFITS OF GLOBALIZATION AND PRIVATIZATION OF FRESH WATER* 23 (2002).

¹²⁸ In the US, in 1978, 56,1% of the irrigation water was self-supplied or provided by unincorporated mutuals, 16% by incorporated mutuals, and 24.8% by irrigation districts (a sort of political subdivision of state government), see Bretsen&Hill, *Irrigation Institutions in the American West*, 25 *UCLA J. ENVTL. L. & POL'Y* 283, 292 (2006-2007).

¹²⁹ Barton Thompson Jr, *Institutional perspectives on water policy and markets*, 81 *CAL. L. REV.* 671, 678 (1993) (the main water suppliers for the agricultural sector are water mutuals -companies- and water districts -public entities- and these are the sellers in ag-urban transactions).

¹³⁰ For an analysis of the role of information flows in financial markets, see Ronald J. Gilson & Reinier H. Kraakman, *The Mechanisms of Market Efficiency*, 70 *VA. L. REV.* 549 (1984).

¹³¹ See also Grafton et al., *supra* note 23, at 1 ("[...]potential for water rights and markets to provide information on current consumption patterns and alternative values, incentives for adjustments in use, and smoother reallocation across competing demands") (last visited 30.10.2010).

¹³² Cameron Hepburn, *Environmental policy, government, and the market*, 26 *OXFORD REV. OF ECON. POL'Y* 117, 121 (2010). However, when ranking the different degrees of governmental involvement, ranks second -just after free market- the provision of certain information by government (mainly about externalities).

¹³³ The relevance of such a function was praised by the officials of the Catalan Water Agency (conversation with the Catalan Water Agency officials). Furthermore, there are examples from the beginning of the XXth Century in irrigation communities holding auctions in the Tibi Dam in Alicante -Spain- where one of the complementary activities the organization was posting the prices, quantities, etc. of previous transactions, see OSTROM, *GOVERNING THE COMMONS*, *supra* note 25, at 79.

¹³⁴ Water banks can be defined as "[A] mechanism designed to facilitate the transfer of water use entitlements from one location or use to another. A water bank functions like an intermediary, or broker, similar in some ways to a financial bank that acts as a broker or clearinghouse between savers and borrowers. In the case of water banks -- and unlike some brokers -- there is some kind of public sanction for its activities.", *Agriculture and Resource Economics*,

advantage¹³⁶ because they control water registers and maybe infrastructure. Despite technological change is not likely to revolution water distribution as wireless technology did with telecom markets,¹³⁷ internet and computer software are new platforms for water markets.¹³⁸ Incipient examples have been tested in California, such as the on-line clearinghouse system “WaterLink” put forward by CALFED in 1996¹³⁹ or webpages that contain electronic bulletin boards or databases where buyers and sellers can list their needs.¹⁴⁰ These new technologies might help the entry of private companies as water market intermediaries.¹⁴¹ However, in Australia the first experiences suggest that private brokers lack good knowledge of the system which suggests an initial, at least, comparative advantage of the administration.¹⁴²

To sum up, water markets require governmental intervention to address some of the shortcomings imposed by the special nature of the resource and by, perhaps, its social value.

Oregon State University, Public Policy & Economics, Water, Frequently Asked Questions, available at <http://arec.oregonstate.edu/jaeger/water/FAQ1.html> (last visited May 23, 2011)

¹³⁵ Sarah Hollinstead, *Water is Not Liquid: Securitization, Transaction Costs, and California's Water Market*, 33 COLUM. J. ENVTL. L. 323, 365 (2008) “provides information on the price, quantity, and location of water available for sale without purchasing that water or arranging for delivery offers a final option”.

¹³⁶ *Id.* at 353 (the author grounds its position in favor of government intervention to securitize water based on the comparative advantage public entities have at least during the first stages).

¹³⁷ Lidia Ceriani, Raffaele Doronzo & Massimo Florio, *Privatization, Unbundling, and Liberalization of Network Industries: a discussion of the dominant policy paradigm in the EU* (2009, preliminary draft 5-6 (2009), available at –march 2009- http://www.economia.unimi.it/uploads/wp/Deas2009_09wp.pdf (last visited May 23, 2011)) (“In the last twenty years the perception that new technologies could weaken the traditional case for natural monopoly has increased”).

¹³⁸ Donald F. Santa Jr & Clifford S. Sikora, *Open access an transition costs: will the electric industry transition track natural gas industry restructuring?*, 25 ENERGY L.J. 113, 156, 157 (2004) (recognizing the relevance of software to implement a Poolco model).

¹³⁹ Hollinstead, *supra* note 135, at 365 (Online clearinghouse by CALFED). ERIN SCHILLER & ELIZABETH FOWLER, *Executive Summary: ENDING CALIFORNIA'S WATER CRISIS: A MARKET SOLUTION TO THE POLITICS OF WATER* 27 (Pacific Institute, 1999) (“WaterLink enables water users to buy and sell water from their home computers. They can post and read bids and asks, access weekly and seasonal statistics on average prices and trading volumes, negotiate deals, and record trades.”).

¹⁴⁰ Clay Landry, *The evolution of e-water markets*,1 GLOBAL WATER INTELLIGENCE (November 2000), available at <http://www.globalwaterintel.com/archive/1/11/market-insight/the-evolution-of-e-water-markets.html> (last visited May 23, 2011).

¹⁴¹In Australia there are several companies which act as water brokers. See e.g. Waterfind, <http://www.waterfind.com.au/> (last visited May 23, 2011). Brokers imply that new payoff function, theirs, enters into the picture, reducing - holding all things constant- the gains from trade. Thus, these agents acting as filters between the buyer and the seller are only economically justified if they reduce other transaction costs. For example, in a market where private actors face asymmetric information the expertise of a broker can match successfully different high value parties and low value parties, allowing more tailored contracts. However, water brokers in Australia have not been extremely successful in the first stages of markets. For example, they have not warranted that their suppliers had enough water to cover the transaction requirements.

¹⁴² Vicky Waye & Christina Son, *Regulating the Australian Water Market*, 22 J. ENV'T L. 431, 456 (2010) (brokers' misconduct was not widespread but they lack knowledge and familiarity with the system. They did not warrant that the supplier had enough water to cover the transaction).

V. CONCLUSIONS

On the one hand, this paper has provided a description of the natural, technical and legal complexities in the water realm which cast a doubt on the possibility of calculating an efficient optimum in any water regulation, including markets. Property rights and water regulations are not fully determined. Sometimes because it is too costly to do so; other because there are non-economic arguments that advice against completely defined rules. On the other, it has presented how requirements for a well-functioning market squeak when applied to markets. It has also explored many political decisions and governmental roles involved in the establishment and operation of markets.

The aim has been to offer a more realistic account that the simplifications asserted by free-market environmentalists. These scholars trust the magic of the market to reallocate water assigning to government just the initial definition and allocation of rights, contractual enforcement, and, sometimes, review for externalities.¹⁴³ These crude arguments are usually the benchmark for the public debate.¹⁴⁴ Hence, it is worth understanding the real operation of water markets, which are far from free markets,¹⁴⁵ and the fact that the efficiency where these markets are grounded might be uncertain in the water realm.¹⁴⁶ Water markets are not opposed to an administrative system, but a tool in the agencies' kit to manage water.

¹⁴³ See e.g. Richard A. Epstein, *Why restrain alienation?*, 85 COLUM. L. REV. 970, 970 (1985). ("This Article first seeks to explain why the right of alienation is a normal incident of private ownership. Thereafter it seeks to examine the principled reasons for limiting the right. These justifications in turn fall into two main groups. The first set is concerned with the practical control of externalities. These may take the form of aggression against third parties, the overexploitation of the common pool, or the exploitation of infants and insane persons. Alternatively, restraints on alienation may be used to redress some asserted distributional weakness within the present allocation of rights. My central thesis is that the first justification is sound, but that the second is not").

¹⁴⁴ Carl J. Bauer, *Slippery Property Rights: Multiple Water Uses and the Neoliberal Model in Chile*, 38 NAT. RESOURCES J. 109, 110 (1998).

¹⁴⁵ Janet C. Neuman, *Beneficial Use, Waste, and Forfeiture: the Inefficient Search for Efficiency in Western Water*, 28 ENV'T L. 919, 992 (1998).

¹⁴⁶ Michael C. Blumm, *The Fallacies of Free Market Environmentalism*, 15 HARV. J. L. & PUB. POL'Y 371, 389 (arguing that markets should be tools to implement water policy but they should not dictate it).