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**Law and the New Institutional Economics: Water Markets and Legal
Change in California, 1987-2005**

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Introduction.

New Institutional Economics (NIE) focuses on the interaction between legal (formal and informal) institutions and economic behavior.¹ Both directions of causality concern researchers in the field—how institutions influence economic behavior and how economic factors affect institutional change. As such, the NIE abandons standard neoclassical economics assumptions that individuals have perfect information about the market and important current and future events, as well as the assumption that the transaction costs of exchange are zero. The NIE, then, introduces observed organizations and information costs to neoclassical analysis, providing more analytical richness and power for examining empirical activities. Institutions, such as written contracts, charters, constitutions, and laws, as well as unwritten norms and codes of behavior, are devised to reduce information uncertainty and transaction costs. If effective, these institutions can promote efficiency by encouraging investment, production, and trade. Institutions, especially laws and regulatory arrangements, also can be used to redistribute income or be part of rent-seeking activities. If ineffective, these institutions can result in inefficiencies and reduced investment, production, and trade.² At the same time, individuals engage in collective action to change institutions in response to exogenous

¹ For discussion, see Claude Menard and Mary M. Shirley, eds., *Handbook of the New Institutional Economics*, Dordrecht, The Netherlands: Springer, 2005, 1-18.

² This is not to say that all redistribution is inefficient. Some redistribution can provide more social and political stability for property rights and the overall economy by being viewed as more “fair” or “just.” For discussion of fairness issues, see Alberto Alesina and George-Marios Angeletos: “Fairness and Redistribution,” *American Economic Review*: 95 (4): 2005, 960-80 and Gary D. Libecap, “Distributional Issues in Contracting for Property Rights,” *Journal of Institutional and Theoretical Economics* 145 (1): 1989, 6-24.

changes in relative prices in order to make the institutions more effective in promoting economic activities.³

In the spirit of the NIE, we examine the interactions among regulation, property rights, and water markets in California from 1987-2005. We are interested in whether and how the definition of water rights and the regulation of water transfers have affected observed market activity: the extent and pattern of water trades, their duration, and the nature of the contracts used (short-term leases, long-term leases, and sales).

There is growing pressure to re-allocate fresh water from historical uses in agriculture, where as much as eighty percent of water has been used, to meet greater demands for use in urban areas, recreation (fishing, boating), and environmental requirements (protect endangered species, repair aquatic and riparian habitats). Fresh water supplies are limited with little or no new sources, so meeting new demands necessarily requires re-allocation.

Markets are institutional options for achieving such re-allocation. Land markets, for example, fairly smoothly and routinely shift land resources from one use (farming) to another (housing). But water is a more complicated resource than land. Due to its physical mobility, water cannot be bounded easily or partitioned across claimants and uses, making it more difficult to define and enforce property boundaries and rights. As a result, exclusion is extremely difficult so that numerous parties typically access the same water either simultaneously or sequentially. Because it is difficult to segment water into its various concurrent or chronological uses, often there is a high degree of interaction

³ Not all institutional change, of course, is aimed at efficiency. Some is designed to facilitate rent seeking or redistribution as resource values rise, for example. For discussion of the various motives for institutional change in response to price change, see Gary D. Libecap, *Contracting for Property Rights*, New York: 1989, 16-19.

among water claimants and applicants. For these reasons, water trading among some parties can have important, and negative, effects on others.

For instance, consider an upstream irrigator, who diverts water for farming. Only part of it will be used, with the remainder percolating through the ground back to aquifers, streams, or to ditches for repeated access by other parties in the same watershed or basin. If the first farmer were to sell some or all of her water and ship it out of the basin for urban use, the unconsumed residual or tail water would no longer be available for use by subsequent claimants or environmental uses. They would lose access to water and be harmed by the trading process.

Accordingly, any trades that change the location of water diversion, nature of use, and timing, especially if they are large relative to the stream flow, are restricted by state law and regulated by state agencies. Because of the potential for harm, transfers of surface water rights in western states are predicated on there being “no harm or injury” to downstream rights holders. State water agencies, such as the California State Water Resources Control Agency, typically allow trades that involve changes in diversion and location only for historical consumptive uses (water that would not be available to subsequent users in any event) to minimize these third-party effects.⁴ In contrast, local, short-term water transfers among neighboring users, such as irrigators, typically do not require state approval because the water stays nearby and any changes are of limited duration.

⁴ Johnson, Ronald N., Micha Gisser, and Michael Werner, “The Definition of a Surface Water Right and Transferability,” *Journal of Law and Economics* 24 (2): 1981, 273-88. They describe how specifying a property right in water in terms of consumptive use with options for third party grievances can be an effective method for promoting transfers.

California laws and regulations as defined by the state legislature, courts, and administrative agencies may promote water market transactions if they: (1) strengthen the definition and enforcement of private water rights so that ownership is clear; (2) streamline and make transparent the regulatory process; and (3) limit third-party protests to well-defined criteria and short time periods. Alternatively, California law may retard or change the duration and type of transactions if water rights are weakened and/or the regulatory process is made more complicated. For instance, California law could affect the relative costs and benefits of using particular contracts (leases relative to sales) and the length of transactions (short-term versus long-term or permanent) by the nature of the regulatory process.

In this paper, we examine the water market activities in California between 1987 and 2005 and analyze how the changes in the definition of water rights and regulation have influenced the extent and nature of water trading.

II . The Legal Environment for Water Transfers in California.

California is one of the most important states in the West with respect to water transfers along with Arizona, Colorado, and Texas.⁵ California was not only one of the earliest states to adopt the prior appropriation doctrine, it was also the first state to recognize that water rights could be transferred independently of land.⁶ In turn, Federal

⁵ See Jed Brewer, Robert Glennon, Alan Ker, and Gary Libecap, “Water Markets in the West: Prices, Trading, and Contractual Forms, *Economic Inquiry*, forthcoming for discussion of water transfers by state in the west.

⁶ See Brian E. Gray, *The Shape of Transfers to Come: A Model Water Transfer Act for California*, 4 HASTINGS W-N.W. J. ENVTL. L. & POL’Y 23 (1996) [hereinafter *A Model Water Transfer Act*]; see also *Duckworth v. Pacific Gas & Electric Co.*, 150 Cal. 520, 530-531 (1907); Cal. Code Regs., tit. 23, §775 et. seq.

and state water projects have given California large-scale storage facilities and the infrastructure to move water from one part of the state to another.

For example, the State Water Project (SWP) captures water in the Oroville Reservoir, located on the Feather River in Northern California, and exports water from the Sacramento-San Joaquin Delta to areas both west and south of the delta. Two-thirds of the people in California receive some portion of their water supply from the SWP, including the southern San Francisco Bay area, southern California, and over 700,000 acres of farmland in the Tulare Lake Basin of the San Joaquin Valley.⁷

Additionally, United States Bureau of Reclamation (USBR) operates the Central Valley Project (CVP), perhaps the nation's largest water project, which stretches almost 500 miles from north of Sacramento down to the Kern River in the south.⁸ The CVP consists of twenty dams and reservoirs, eleven power plants, and 500 miles of major canals. Despite these immense water projects, an ever-expanding population required California in the 1970s to come to terms with the reality that it had not only one of the biggest agricultural economies in the world, but also a population of thirty-five million people.

It was within this context that the idea of water marketing seemed a sensible way of making more efficient use of existing water resources.⁹ In 1978, a specially appointed

⁷ See Gerald E. Johns, *Making Water Transfers Work in California*, American Bar Association Section of Environment, Energy, and Resources, 23rd Annual Water Law Conference, February 24-25, 2005, at 32.

⁸ See www.usbr.gov/dataweb/html/cvp.html#general

⁹ For recent analysis of water marketing in California, see Barton H. Thompson, Jr., *Institutional Perspectives on Water Policies and Markets*, 81 *Calif. L. Rev.* 673 (1993); Ellen Hanak, *Counties Wrestling Control: Local Responses to California's State Wide Water Market*, 6 *U. Denv. Water L. Rev.* 490 (2003); Ellen Hanak, *Stopping the Drain: Third Party Responses to California's Water Market*, Public Policy Institute of California, Working Paper #2004.11; Ellen Hanak, *Who Should be Allowed to Sell Water in California? Third-party Issues and the Water Market*, Public Policy Institute of California (2003); Ellen Hanak, *California's Water Market, By the Numbers*, Public Policy Institute of California, October 2002;

Governor's Commission recommended statutory changes to create greater incentives for more efficient use of water and to clarify water rights so as to encourage voluntary water transfers.¹⁰ The California legislature enacted these recommendations into law in 1980.¹¹ The legislature mandated that "The growing water needs of the state require the use of water in an efficient manner and that the efficient use of water requires certainty in the definition of property rights to the use of water and transferability of such rights."¹²

In 1982, the legislature directed the California Department of Water Resources (DWR), the State Water Resources Control Board (SWRCB), and other state agencies to "encourage voluntary transfers of water and water rights."¹³ One impediment to water transfers in the West has been the law in some states that provides that conserved water goes to the next junior in the priority system rather than to the person who undertook the conservation effort for either additional irrigation or for sale or lease to a third party.¹⁴ To try to eliminate this disincentive for conservation, the California legislature enacted a series of laws that allowed the transfer of conserved and surplus water to be consistent with beneficial use.¹⁵

Kevin N. O'Brien and Robert R. Gunning, *Water Marketing in California Revisited: The Legacy of the 1987-1992 Drought*, 25 *Pac. L. J.* 1053 (1994).

¹⁰ See *Primer*, *supra* note 6.

¹¹ See CAL. WATER CODE §§109(b), 475, 1010, 1011, 1244; see also California Code of Regulations, tit. 23, ch 3. All the administrative regulations noted throughout the matrix are covered by California Code of Regulations which outlines many of the procedures of the State Water Resources Control Board. The Board's authority is derived from CAL. WATER CODE §1058.

¹² *Id.* at §109(a)

¹³ CAL. WATER CODE §109(b).

¹⁴ *Southeastern Colo. Water Conservancy Dist. V. Shelton Farms*, 187 Colo. 181, 529 P.2d 1321 (1974).

¹⁵ CAL. WATER CODE §§380-87, 1010-11, 1240, 1244; cf. *City of Los Angeles v. City of Glendale*, 142 P.2d 289 (1943); see also *Lindblom v. Round Val. Water Co.*, 173 P. 994 (1918) (discussing difference between abandonment and forfeiture). These code sections are important in understanding the seemingly conflicting provisions of the California Constitution and the Water Code. The natural question of how can surplus water be transferred, yet also be protected from forfeiture or waste is still debatable. §§1010-1011 provide for the sale, lease, exchange, or transfer of reclaimed water, polluted water, and conserved water, but by themselves provide no protection against claims of waste or forfeiture. §1244 specifically states that "[t]he sale, lease, exchange, or transfer of water or water rights, in itself, shall not constitute evidence of waste or unreasonable use." Professor Brian Gray has argued that there is still sufficient uncertainty in this

In 1982, in an attempt to decentralize the water transfer process, the California legislature recognized that “[m]any water management decisions can best be made at a local level, [where] flexibility will maximize efficient state wide use of water supplies.”¹⁶ The legislature allowed local water agencies to sell water outside their boundaries, serve as water brokers, and control the transfer of surplus water.¹⁷ These provisions greatly enhanced the authority of irrigation districts and other water providers to control the transfer of water outside their boundaries. Notwithstanding this authority delegated to local agencies, all transfers in California still are subject to the overarching no-injury provision of the water code.¹⁸ The legislature also created rules that govern water transfers that distinguish between short-term and long-term transfers. It created three categories of short-term transfers: 1) temporary urgency changes,¹⁹ which applies during droughts and emergencies; 2) temporary changes,²⁰ which occur for up to a year; and 3)

area that has prevented wider participation in the water market. *See A Model Water Transfer Act, supra* note 6, at 30.

¹⁶ CAL. WATER CODE §380(c).

¹⁷ *Id.* at §382-83. §383 gives the local water agency a great deal of power over its local member’s ability to transfer water. The consent of the agency is required before an individual will be able to transfer her water rights.

¹⁸ *Id.* at §386. California also distinguishes surface water rights depending on whether they were commenced before or after 1914, in which case water users must obtain a permit from the SWRCB.¹⁸ The pre-1914 rights are not subject to a permitting process. Even though the initial appropriation of these early rights is not subject to SWRCB oversight, the transfers of such rights are still subject to the no-injury rules.

¹⁹ *Id.* at §1435. §1435 provides that a permittee or licensee that has “an urgent need to change a point of diversion, place of use, or purpose of use . . . may petition for . . . a conditional, temporary change order without complying with other procedures or provisions . . .” A temporary urgency change may last for no more than 180 days, but may be renewed by the Board. The Board has oversight of these petitions and approval of a temporary urgency change does not create a vesting of water rights.

²⁰ *Id.* at §§ 1725-1732. §1728 defines a temporary change as “any change of point of diversion, place of use, or purpose of use involving a transfer or exchange of water or water rights for a period of one year or less.” §1725 restricts the transfer of water to that which the transferor would have “consumptively used or stored” prior to the transfer. The 1988 amendments to §1726 removed a provision that previously allowed a transferor to simply notify the Board that it was planning a temporary change. The Board must now be notified and has oversight power as well. Temporary changes may be still seen as beneficial to the transferor because of the potential allowance for expedited approval by the Board (*see Matrix Factor 60*, which was given a “1,” because of the expedited system for water leases and temporary changes). The burden is on the transferor to show that the proposed transfer will meet the traditional no-injury rule.

trial transfers,²¹ which allow for experimental transfers.²² Long-term transfers occur when the period exceeds one year.²³

In 1986, the legislature further clarified the voluntary conservation of water; allowing the transfer of conserved and surplus water. It also allows for the transfer of non-surplus water made available by land fallowing.²⁴ The legislature also put water rights on a more secure basis by recognizing that water transfers are beneficial uses, not subject to the forfeiture rules.²⁵ Because California has the riparian rights doctrine in addition to the prior appropriation rule, the question arose as to whether riparian rights could be transferred. The California legislature attempted to resolve this issue in 1988 by providing that decreed riparian rights may be transferred.²⁶

In 1991, the California legislature took a significant step when it created the Emergency Drought Water Bank. The Bank served to alleviate many drought related problems at the time by allowing for the prompt but temporary transfer of water from one user to another. The agricultural community bought into the water bank idea, in part because their rights were protected, the program involved only short-term transfers, and there were substantial financial rewards to those who participated.²⁷ The water bank was particularly active during a five-year drought cycle in the late 1980s and early 1990s. It can be seen as a necessary catalyst for a sustainable long-term market, in part because the bank was so successful as revealed in the transfer data described below. In 1991, it

²¹ 1980 Cal. Stat. ch. 933, §12.

²² See 1988 Cal. Stat. 1145, §2. This legislation repealed the trial transfer provision in 1988.

²³ See CAL. WATER CODE §§1735-1738.

²⁴ See *id.* at §§ 382, 475, 480, 1011, 1745.02, 1745.05.

²⁵ See *id.* §§ 1024(c), 1244, 1745.05.

²⁶ See CAL. WATER CODE §1740.

²⁷ See David J. Guy, *A Model Water Transfer Act for California: An Agricultural Perspective*, 4 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 75, 77 (1996). [hereinafter *Agricultural Perspective*] Water rights holders were paid \$125 per acre-foot in 1991 and \$50 per acre-foot in 1992.

acquired 820,665 acre-feet of water.²⁸ The major purchasers, were the Metropolitan Water District of Southern California, the Kern County Water Agency, and the San Francisco Water District.²⁹ Notably, as we show below most of the water moved from agricultural to municipal and industrial uses. In 1992, the water bank remained active, though with a smaller number of participants and less water. The primary purchasers that year were farmers, as there was sufficient rainfall for industrial and domestic uses.³⁰

Also in 1992, the California legislature allowed water providers to transfer conserved water by members of water agencies.³¹ In 1999, the legislature further refined the water transfer process and more securely established property rights through the Water Rights Protection and Expedited Short-Term Water Transfer Act, which provided that a transfer or the offer to transfer water would not be a basis for forfeiture, abandonment, or modification of the water right.³² This Act helped allay the fears of many water rights holders who had not entered the market for fear of losing their water rights.³³ The Act also protected rights holders from the actions of a transferee. If a transferee should violates any of the numerous reasonable use provisions in the Water Code, the Act provides for an automatic reversion of the water rights back to the

²⁸ Morris Israel & Jay R. Lund, *Recent California Water Transfers: Implications for Water Management*, 35 NAT. RESOURCES J. 1, 6 (1995).

²⁹ *Id.* at 9.

³⁰ *Id.*

³¹ See CAL. WATER CODE §§1745-1745.11.

³² See CAL. WATER CODE §§ 1014, 1240-41, *see also Wood v. Etiwanda Co.*, 81 P. 512, 514 (1905).

³³ See *Agricultural Perspective*, *supra* note 27, at 77. Many of the provisions of the 1999 Act incorporated many of the concerns raised by Guy in the above piece. Securing water rights has long been the major concern of agriculturalists. The ability to participate in short-term transfers that will not jeopardize water rights, it is argued, should bring a number of new rights holders to the market.

transferor.³⁴ The Act sped up the transfer review proceedings by providing that the board must reach a decision within forty-five days.³⁵

The 1999 Act also attempted to confront third-party issues that arise from water transfers. Prior to the Act, agricultural water rights holders could fallow or retire farmland and then transfer the water at will.³⁶ But the Act distinguished between temporary land fallowing and permanent land fallowing.³⁷ Now, only water conserved from temporary fallowing may be transferred.

In California, most water users do not hold the water rights; instead, they have water contracts with supply agencies such as the State Water Project or the U.S. Bureau of Reclamation.³⁸ The complicated nature of water rights in California has meant that there is no single entity with jurisdiction to oversee the process. The SWRCB has general authority over surface water rights in California but, because much of California's water is regulated under contract either with the Bureau of Reclamation or with the Department of Water Resources through the State Water Project, many transfers escape the scrutiny of SWRCB. Indeed most transfers in California have been within the Central Valley Project or the State Water Project. Between 1981 and 1989, some 1,200 informal transfers involving more than three million acre-feet took place just within the CVP.³⁹ The relationship between irrigation districts and their members also complicates

³⁴ See CAL. WATER CODE § 1015.

³⁵ *Id.* at §1726(e), (g)(1)-(2).

³⁶ See 1996 Cal. Legis. Serv. ch. 408, §1, at 96 (amending CAL. WATER CODE § 1011(b)).

³⁷ *Id.* at §§1732, 1745.10, 1745.11.

³⁸ See CAL. WATER CODE §§1745-1745.11; see *Primer, supra* note 6 at 779.

³⁹ See Thompson, *Institutional Perspectives on Water Policy and Markets*, 81 CAL. L. REV. 671, 719 (1993).

the water transfer process in California.⁴⁰ Because most surface water used in California comes from either the Central Valley Project, administered by the U.S. Bureau of Reclamation, or the State Water Project, administered by the Department of Water Resources, there are contractual rights between the state or federal agency and institutions, such as an irrigation district or a conservancy district. Even though the irrigation district typically has a contract with the state or federal agency, its property right is generally considered to be minimal.⁴¹ At the same time, the ability of the actual water users to dispose of “their” water is severely restricted. First, there may be conditions imposed by USBR or DWR in the contract with the irrigation district. Second, the nature of the property right held by the ultimate water user is quite ambiguous, ultimately turning on the relationship between the district and the water users.⁴² Third, state law may place additional restrictions on transfers outside of irrigation districts or even within the district itself.⁴³ Fourth, the internal regulations of various irrigation districts may demand that the proposed transfer receive the approval of the board of directors of the district.⁴⁴

Even though the California Water Code allows an irrigation district, if it determines to be in the best interest of the district, to enter into a contract for the sale or

⁴⁰ See Brian E. Gray, *The Modern Era in California Water Law*, 45 Hastings L.J. 249 (1994), and Reed D. Benson, *Whose Water is it? Private Rights and Public Authority over Reclamation Project Water*, 16 Va. Env'tl. L.J. 363 (1997).

⁴¹ See Truckee-Carson Irrigation District, D. Sec’y of the Dept. of Interior, 742 F.2d 527, 530-31 (9th Cir. 1984).

⁴² See Richard Roos-Collins, *Voluntary Conveyance of a Right to Receive a Water Supply for the U.S. Bureau of Reclamation*, 13 Ecology L.Q. 773, 847 (1987).

⁴³ See Brian E. Gray, *The Modern Era in California Water Law*, at 279-80.

⁴⁴ See e.g. Westlands Water District, Regulations, Article 2: Regulations for the Allocation and Use of Agricultural Water within the Westlands Water District, at <http://www.Westlandswater.org/aboutwwd/regs.#2.htm>. See also Brian E. Gray at 280.

lease of any surplus water,⁴⁵ it is unclear whether individual water users in the district have a right to transfer even water that they have “conserved.”⁴⁶ This uncertainty of water rights and individual user authority is a substantial constraint in water transfers.⁴⁷

In 1992, Congress passed the Central Valley Project Improvement Act (CVPIA), which reallocates Central Valley Project water directly to the environment. CVPIA allocates 800,000 acre-feet to meeting the needs of fish and wildlife in the Sacramento River and the Sacramento/San Joaquin River delta.⁴⁸ The CVPIA also allocates another 400,000 acre-feet for wildlife reserves in the Central Valley.⁴⁹ The CVPIA uses water transfers to generate the water for these environmental objectives. The CVPIA basically allows existing contractors to benefit from selling heavily subsidized USBR water at contemporary market rates.⁵⁰ The Secretary of the Interior must approve all transfers in order to protect the area of origin and to ensure that fish and wildlife habitat are protected. But, in a sharp departure from conventional practice, CVPIA authorizes individual farmers, rather than irrigation districts, to engage in water transfers. If individual farmers propose to transfer less than 20% of the CVPIA water received by the district, the district cannot prohibit the transfers.⁵¹

Another environmental program is the Calfed Environmental Water Account (EWA), which is a collaboration between federal and state agencies to provide protection to at-risk fish species in the Bay/Delta system. Begun in 2001, the EWA program

⁴⁵ See California Water Code § 22259.

⁴⁶ See California Water Code § 1011(a).

⁴⁷ See Paul R. Williams and Steven J. McHugh, *Water Marketing and Instream Flows: The Next Step in Protecting California's Instream Flows*, 9 Stan. Envtl. L. J. 132 (1990).

⁴⁸ For analysis of the CVPIA, see Harrison Dunning, *Confronting the Environmental Legacy of Irrigated Agriculture in the West: The Case of the Central Valley Project*, 23 Envtl. L. 943 (1993).

⁴⁹ See Joseph L. Sax, Barton H. Thompson, Jr., John D. Leishy, and Robert H. Abrams, *Legal Control of Water Resources* (4th ed.) at 778.

⁵⁰ See *id.* 778.

⁵¹ *Id.* at 778.

typically purchases in excess of 200,000 acre-feet of water each year, and uses this water to protect at-risk fish species in the Bay/Delta system.

Judicial decisions also have played a major role in affecting the incentives for water transfers in California. For example, in *Imperial Irrigation District v. State Water Resources Control Board*,⁵² the court held that the state retained the power “to prescribe water use practices, to limit waste, and to sanction water transfers.”⁵³ This ruling created tremendous incentive for the Imperial Irrigation District to modernize its infrastructure to avoid forfeiture of some of its water right.

Administrative rulings by the SWRCB may impact water transfers under application of the of discretionary “public interest” criteria.⁵⁴ The SWRCB has authority to deny outright any application on “public interest” grounds or to approve the transfer subject to various terms and conditions that the board sees fit to employ. The process can be unpredictable and time consuming.⁵⁵ The legislature embellished the common law prohibitions on the no-injury rule to include protection for fish, wildlife, and other instream beneficial uses, as well as protection for third parties from unreasonable harm caused by water transfers.⁵⁶ The SWRCB often has used these provisions to justify

⁵² 225 Cal.App.3d 548, 572 (1990).

⁵³ 225 Cal.App.3d 548, 572 (1990).

⁵⁴ See Brian E. Gray, *The Shape of Transfers to Come: A Model Water Transfer Act for California*, 4 HASTINGS W-N.W. J. ENVTL. L. & POL’Y 23 (1996); see also *McDonald v. Bear River & Auburn Water & Mining Co.*, 13 Cal. 220, 232-33 (1859) (stating that “the ownership of water, as a substantive and valuable property right . . . may be transferred like other property.”).

⁵⁵ See generally Consuelo Bokum, *Implementing the Public Welfare Requirement in New Mexico’s Water Code*, 36 NAT. RESOURCES J. 441, 465-66. Bokum notes that fourteen of eighteen western states have adopted public welfare/interest lists of uses. Six of the fourteen states explicitly list uses in their statutes, including California.

⁵⁶ *A Model Water Transfer Act*, *supra* note 1; see also CAL. WATER CODE §§ 1702, 1706, 1028, 1435(b), 1725, 1736, 1745.10, 1745.11.

additional terms and conditions to water transfer permits in order to protect instream stream flows and other instream uses.⁵⁷

III. Data on Water Transfers in California.

To analyze the interaction between water markets and the law, we collected data on California water transfers from the major water trading journal, the monthly publication *Water Strategist*, from 1987-2005, the period for which such data are available.⁵⁸ In Brewer, Glennon, Ker and Libecap (2007a, 2007b) we describe the data collection methodology in detail so that a brief summary only is provided here.⁵⁹ The *Water Strategist* is self-advertised as “the only source of published information on water transactions in the West.” Each month, the journal publishes a “Transactions” section that lists, by state, each water transfer that occurred. It typically lists: the year of the transfer; the acquirer of the water; the supplier; the amount of water transferred; the proposed use of the water; price; and type of contract. Uses of water include agriculture, urban (municipal & industrial), and environmental. Accordingly, there are nine possible trades: agriculture to agriculture, agriculture to urban, agriculture to environmental, urban to agriculture, urban to urban, urban to environmental, environmental to agriculture, environmental to urban, and environmental to environmental. These data are one of the bases for our analysis of water transactions.

This section provides a brief discussion of the trends in the California water market. On the whole, California has an active water market relative to other states in the

⁵⁷ A *Model Water Transfer Act*, *supra* note 1.

⁵⁸ *Water Strategist*, <http://www.waterstrategist.com/>.

⁵⁹ See Jedidiah Brewer, Robert Glennon, Alan Ker, and Gary Libecap, “Water Markets in the West: Prices, Trading, and Contractual Forms” *Economic Inquiry* forthcoming, 2007a; and Jedidiah Brewer, Robert Glennon, Alan Ker, and Gary Libecap, “Transferring Water in the American West: 1987–2005,” *Michigan Journal of Legal Reform*, 2007, 40 (4): 1021, 1034-37.

West, thus, making it an important market to analyze. This is true for both the number of transfers that have taken place and the amount of water that has been traded. Over the nineteen-year period (1987-2005) in our sample, 493 transfers took place in California which transferred over 11.3 million acre-feet of water. In comparison, in ten of the other eleven states in the West⁶⁰ (excluding Colorado⁶¹) there were 1,047 water transfers totaling about 19.1 million acre-feet. These numbers indicate that California accounts for almost half of the number of transfers and sixty-percent of the amount of water transferred in the West. Therefore, understanding how the legal process affects water markets in California is an important first step to understanding how the legal process may affect water markets more generally in the West.

1. Total California Water Transfers

Figure 1 illustrates water trading in California over the 19-year period. The left axis represents the volume of water transferred as measured by annual flow whereas the right axis represents the number of transfers. We graphed them together so that one can see how the two data series correspond to each other. The correlation coefficient between the number and volume of transfers is 0.76 indicating the two series tend to move together.

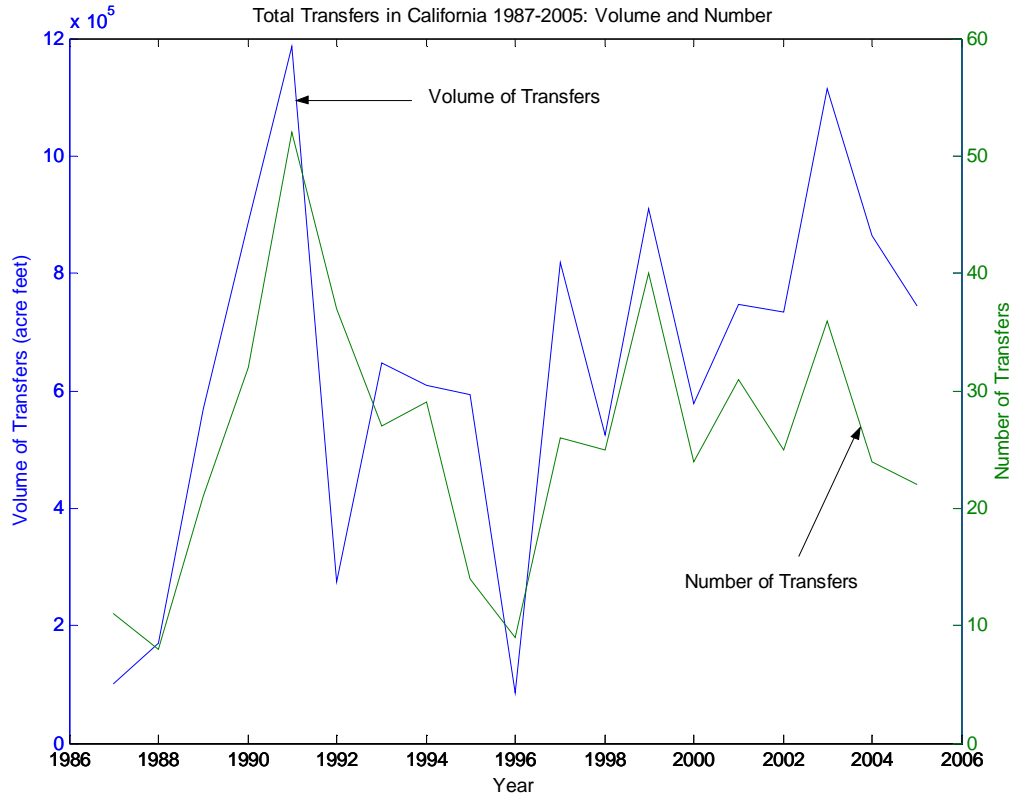
As shown, there is no clear trend in the number of water transfers. The greatest activity occurred in California in 1991 and the least in 1996. The data reveal a general

⁶⁰ In addition to California our dataset includes water transfer information from 11 other states in the West: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Texas, Utah, Washington, and Wyoming.

⁶¹ The state of Colorado has a unique water market system where numerous small transfers occur each year. Over the sample period there were 1,777 transfers in the state with a total of 1,265,560 acre-feet transferred. Thus, each transfer is an average of approximately 700 acre-feet. California's transfers were less in number (493), but much larger (23,000 acre-feet on average), for a total amount of 11,395,892 acre-feet transferred – almost ten times what was transferred in Colorado.

increase in the amount traded, however, with the greatest amounts involved in 1991 and 2003 and the least in 1996.

Figure 1



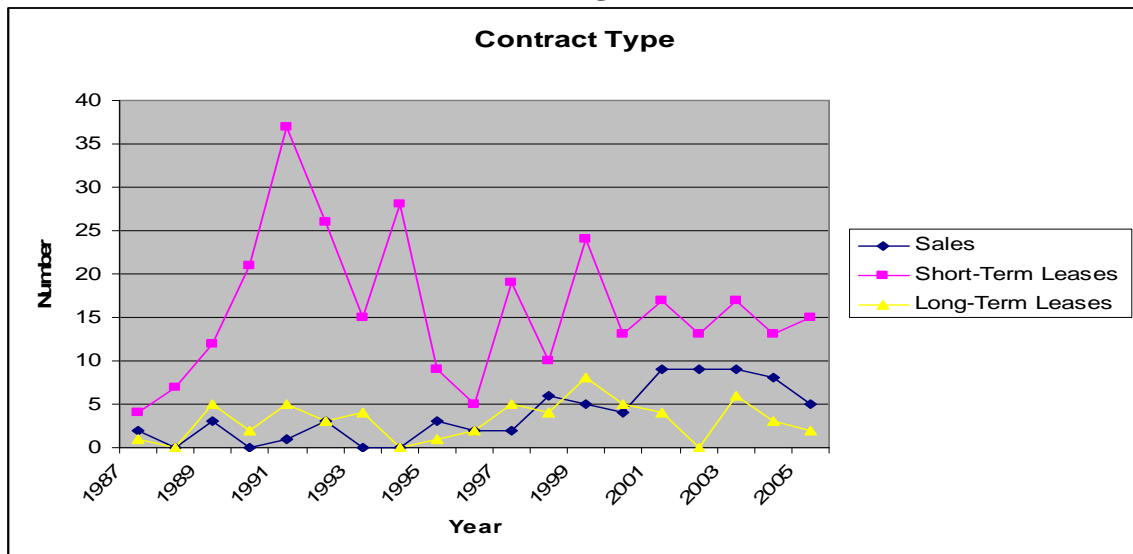
In our empirical analysis in section V, we model both the volume and number of transfers because while related, they represent different metrics of market activity. For example, if the transactions costs for a transfer are primarily fixed, that is the costs are similar whether hundred acre feet are being transferred or 10,000 acre feet are being transferred, the volume of water transferred would be a poor metric for identifying factors that promote or hinder market activity. In that situation, modeling the number of transfers rather than the volume of transfers will better identify which factors promote or hinder market activity. If, on the other hand, the transaction costs for a transfer are primarily variable, that is the costs increase with the volume of water transferred, then the volume

rather than the number of transfers would be the appropriate metric to identify which factors promote or hinder market activity. With respect to water transfers in California, transactions costs are comprised of both fixed and variable costs, so we have modeled both.

2. California Water Market Contracts

Figure 2 describes the contract type used in California water markets. The data in the figure demonstrate the dominance of short-term (one-year) leases in California. As the figure shows, there is no clear trend in either short or long-term leasing, but sales of water rights are increasing. The predominate use of short-term sales in California is of special note in comparison with other states in the West. In total, 62 percent (305 out of 493) of all transfers in California were short-term leases for one year or less. This sharply contrasts to the rest of the West where only 39 percent of all transfers (excluding Colorado) were short-term leases.⁶²

Figure 2

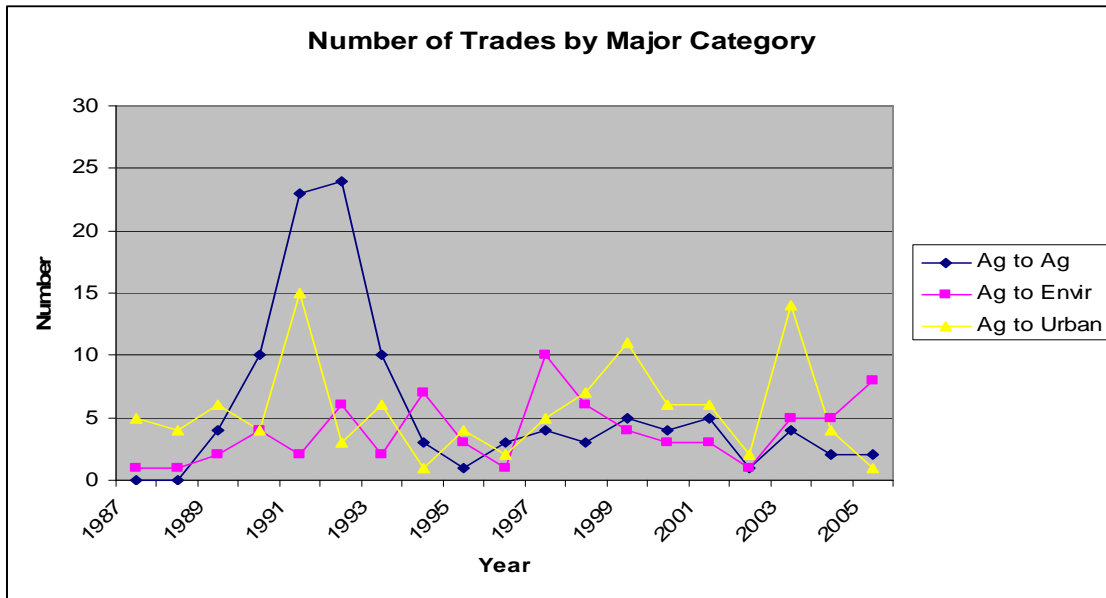


⁶² Including Colorado only magnifies the difference. If Colorado is included only 17% of all transfers were short-term leases in the rest of the West.

3. Water Market Transaction Types

Figure 3 outlines the number of transactions by major category of trading in California: agriculture-to-agriculture, agriculture-to-urban, and agriculture-to-environmental. As shown, there was a spike in agriculture-to-agriculture and agriculture-to-urban trading in 1991. There is a slight declining trend in agriculture-to-agriculture trades; no clear trend in agriculture-to-urban; and a slight increase in agriculture-to-environmental trades over the 19-year period.

Figure 3



4. Quantities Traded

Figure 4 examines quantities traded for the same categories. The quantity patterns tend to mirror those shown in Figure 3, with spikes for agriculture-to-agriculture and agriculture-to-urban trades in the early 1990s and increases in agriculture-to-environmental trades by 2003. Moreover, slight increases also were seen in amounts traded from agriculture-to-urban.

Figure 4

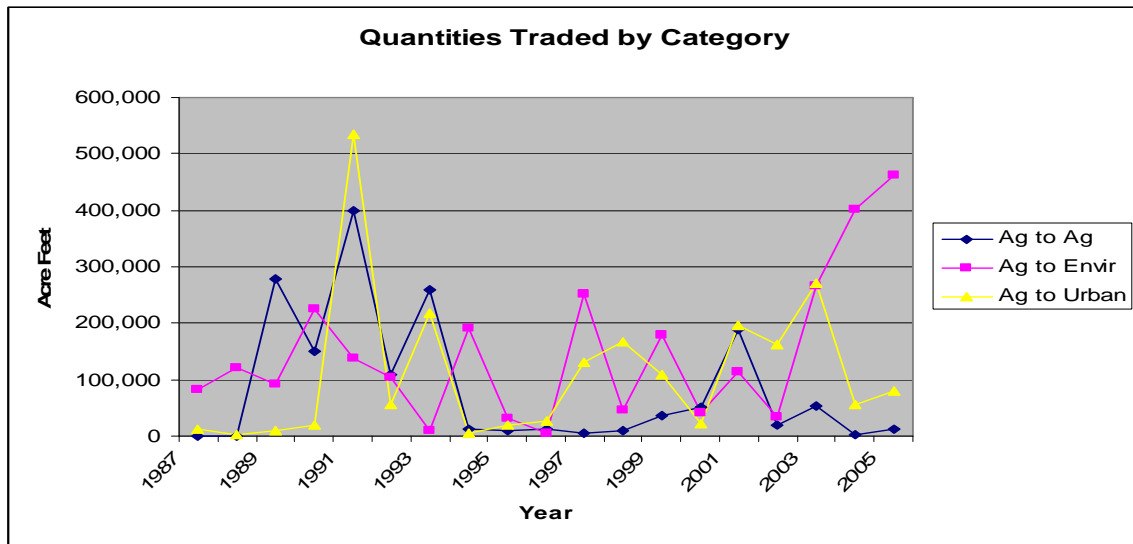


Table 1 illustrates trades within California and compares market activities within the state with other states in the West in terms of the number of transfers and the amount of water exchanged. The table shows that California is fairly balanced between agriculture-to-agriculture, agriculture-to-urban, and agriculture-to-environmental transfers. Within-agriculture trades account for 22 percent of the number, but only 14 percent of the amount. Agriculture-to-urban transactions reveal a similar pattern, but agriculture-to-environmental transfers are larger on average, involving 15 percent of the trades, but 24 percent of the volume.

Most notably though, the table displays key comparisons with other states. For one, California tends to engage in more agriculture-to-agriculture transfers than do other states, but the average size of each exchange is less. The opposite is true for agriculture-to-urban transfers. California engages in relatively fewer agriculture-to-urban transfers (as a percent of total transfers), but move more water from agriculture to urban uses. This means that agriculture-to-urban transfers in California are generally larger than

elsewhere. Additionally, agriculture-to-environmental transfers are more important in California than in other western states.

Table 1

Percent of Transfers (Number)					
	Ag-to-Ag	Ag-to-Urban	Ag-to-Envir	Other	Total
California	22%	22%	15%	42%	100%
Other Western States	13%	61%	6%	21%	100%
Other Western States (Excluding Colorado)	17%	37%	13%	33%	100%
Percent of Water Transferred (Acre-feet)					
	Ag-to-Ag	Ag-to-Urban	Ag-to-Envir	Other	Total
California	14%	18%	24%	43%	100%
Other Western States	27%	17%	16%	40%	100%
Other Western States (Excluding Colorado)	28%	16%	16%	40%	100%

In sum, the data in the above figures and table reveal a steady number of trades and an increase in amounts involved over the nineteen years in California. Within those aggregates, agriculture-to-urban and environmental transactions are increasing, and the importance of water sales is rising relative to short-term and long-term leases, even though short-term leasing remains the dominant type of transaction. California differs distinctly from other states in the West as it relies more heavily on short-term transactions. California also transfers less water within-agriculture and more water out-of-agriculture (relative to all water transferred within the state) than do the other western states. The issues to be explored throughout the rest of the paper are a). the nature of water transactions in California; b). the patterns of legal change involving statutes, court rulings, and administrative agency decisions; and c). the roles of changes in the legal

property rights and regulatory systems in California in explaining changes in the annual number of water transfers and amounts transacted in the state, controlling for other factors.

IV. Data on Legal Change in California.

1. Methodology

The manner in which the law defines water rights and the operation of the regulatory process can importantly affect water transfers. In order to more precisely examine the impact of legal changes on water marketing, we coded water law in California between 1980 and 2005 with respect to twenty-one legal variables that might encourage or retard the transfer of water from agriculture to municipal and environmental uses. We partitioned the twenty-one legal variables into those that strengthened water rights and promoted water transfers, and those that weakened water rights and limited or raised the transaction costs of water trades. The breakdown is provided in Table 2.

**Table 2
Legal Factors**

Factors that Strengthened Property Rights and Lowered the Transaction Costs of Trading	Factor Number*
--Does the law make the water right more definite or precise?	1
– Does the law specifically define what uses qualify as beneficial uses?	2
– Does the law allow for the sale of the land without the water right or the water right without the land?	3
– Does the law allow someone to profit from the sale, transfer, or exchange of his water right to another?	4
– Does the law allow someone to transfer ownership of his water right?	5
– Does the law allow someone to lease his water right to someone else?	6
– Does the law allow temporary transfer of water rights on an emergency basis, in times of need?	7
– Does the law allow someone to exchange his water right?	8
– Does the law add a mechanism for enforcing water rights?	9
– Does the law require or encourage water conservation?	10

– Does the law encourage water conservation and then allow the owner of the right to sell or transfer some or all of that conserved water?	11
– Does the law provide for water banking mechanisms?	12
– Does the law provide an expedited process for short-term transfers or transfer of water rights during times of great need, like droughts?	13
– Does the law allow the use of canals, reservoirs, water support facilities, or streambeds to transport water as part of a water transfer?	14
Factors that Weaken Property Rights and Raise the Transaction Costs of Trading	
--Does the law authorize water districts, irrigation districts, or other member institutions to regulate use and transfer of water by their members?	15
– Does the law limit water use based on environmental concerns or restrictions?	16
– Does the law limit the transfer of water rights to protect the rights of other water users?	17
– Does the law restrict the transfer of water rights to protect the environment?	18
– Does the law require a third party to be compensated for damage to his water right or when he sells or transfers his water right?	19
– Does the law provide for or require notice of proposed water transfers?	20
– Are third parties allowed to protest water transfers, and what is the mechanism for those protests?	21

. * These factor numbers are used to identify the changes in the law illustrated in Figures 6 and 7.

We analyzed each state’s law across the twenty-one water rights variables with respect to three types of legal rules: judicial case law, legislative or statutory law, and administrative regulations. The research involved examining all statutes and cases using Westlaw and Lexis-Nexis legal databases and search engines, using keywords, and tables of content for each state’s statutes. We accessed administrative regulations separately through legal databases for each state. Treatises, law review articles, and other periodicals also guided the analysis.⁶³ The analysis began with 1980 in order to have a full understanding of the process of legal change, even though our statistical analysis begins in 1987, due to data limitations.

⁶³ Research was undertaken by a team of eight law students, with a senior law student supervisor and Robert Glennon as the ultimate supervisor and arbiter.

The coding proceeded in two stages. The first stage recorded if any one of the twenty-one factors was present in a state in the year 1980. The presence of the factor would result in that factor being coded “1”, and the absence would result in the factor being coded “0”. We coded a variable as a “1” if it involved a “significant” change in the law, that is, a substantive or procedural change in the law that had a marked alteration in how the law operated. For example, considering the factor whether the law makes the water right more definite or precise, a change in law that shifted a state’s groundwater law from the reasonable use doctrine to an allocation of three acre-feet per-acre per-year was coded as a “1”, while a change that renamed the state’s water agency from the Department of Water Resources to the Department of Ecology was coded as a “0”. In other words, purely formal or stylistic changes were coded “0’s”, but significant substantive or procedural changes were coded as “1’s”.⁶⁴ Court decisions often refer to a statute or an earlier judicial precedent, but merely referring to that precedent may not change the law. Cases or statutes referred to this way are known to lawyers as “dicta” that is, a discussion that is not germane to the holding of the case. We codified dicta as “0”. Finally, students researched administrative regulations in each state.

In a year when a particular legal variable was significantly changed, a “1” was assigned and it remained in subsequent years. Significant changes in the same law during

⁶⁴ The first step in the coding process required the law students to examine the entire statutory code of each state. Depending on the state and the complexities of its water code, this task may have entailed reading several hundred statutes. This process was necessary in order to establish a base line for the year 1980. After that, web-based research engines became very helpful and efficient because, once a statute was identified, the annotations would lead the researcher to the associated case law. The primary technique used to identify case law was to search using either a known statute or key words that related to each of the factors being researched. Even then, the inexact functionality of search engines sometimes required the law students to read through many cases in order to determine whether the *holding* of the case actually changed or supplemented the law in any way.

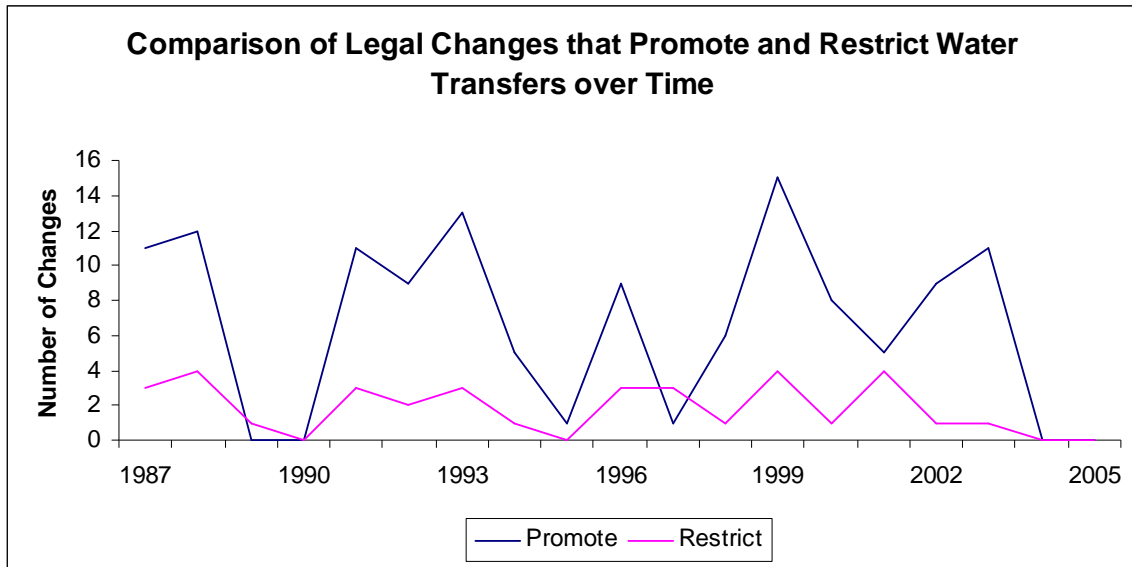
another year would also be coded a “1” and thereafter.⁶⁵ Given the number of legal variables across the three categories, many are perfectly correlated. In our empirical analysis we can not differentiate between those variables in terms of their impact on water transfers, as discussed below. But the summary of changes in the legal environment in California provides insights for explaining the results of the statistical analysis.

2. Trends in Legal Change in California

Figure 5 plots legal change across time in California with respect to the twenty-one legal variables as partitioned into those that promoted relative to those that restricted water transfers. As indicated, the most active years for legal change to support water markets were 1987, 1988, 1991, 1993, 1999, and 2003, whereas most changes to limit markets occurred in 1988, 1999, and 2001. Most changes occurred through legislation and those that promoted trading tended to cluster during the time periods described above.

⁶⁵ For the coding to be meaningful, it was imperative that the law students be consistent in determining whether a factor was present or not. This was not a particularly challenging task for the factors that were particularly precise and concrete, but more difficult when the factors were phrased in general terms. If the case law made the water rights more complicated or nuanced, the water right would not substantively be more definite or precise. Law students only coded a case as making a right more definite or precise if the holding of the decision in fact did so. The statutory and administrative coding presented some of the same challenges but it was not as difficult a process for two reasons. First, state statutes and administrative regulations typically address one specific area of law or policy. It generally is clear what a statute or administrative regulation is attempting to achieve. To the extent that any ambiguity remained after the student had read the statute, there was often legislative history that was helpful in determining a statute’s meaning. To resolve ambiguous issues, the team of law students worked closely together with the supervising senior student and the law professor to resolve how to handle ambiguities. As a final check on objectivity, all of the states were coded separately by at least two law students, and a final review was performed by a third law student.

Figure 5



Figures 6 and 7 break out the pattern of change by variable. The most active factors in support of markets were making the water right more precise: defining beneficial use to include trading activities, allowing for the transfer of water rights, separating water from the land for trading, and those defining conservation and the trading of conserved water. The most active factors limiting water markets were restrictions on transfers to protect other water users, restrictions to protect the environment, requiring third-party compensation, requiring notice of transfers, and allowing for third-parties to protest and challenge proposed transfers. In the following section we statistically analyze how these legal changes may have affected observed water transfers by identifying when they took place and thereby changed the legal environment in which water transactions took place.

Figure 6

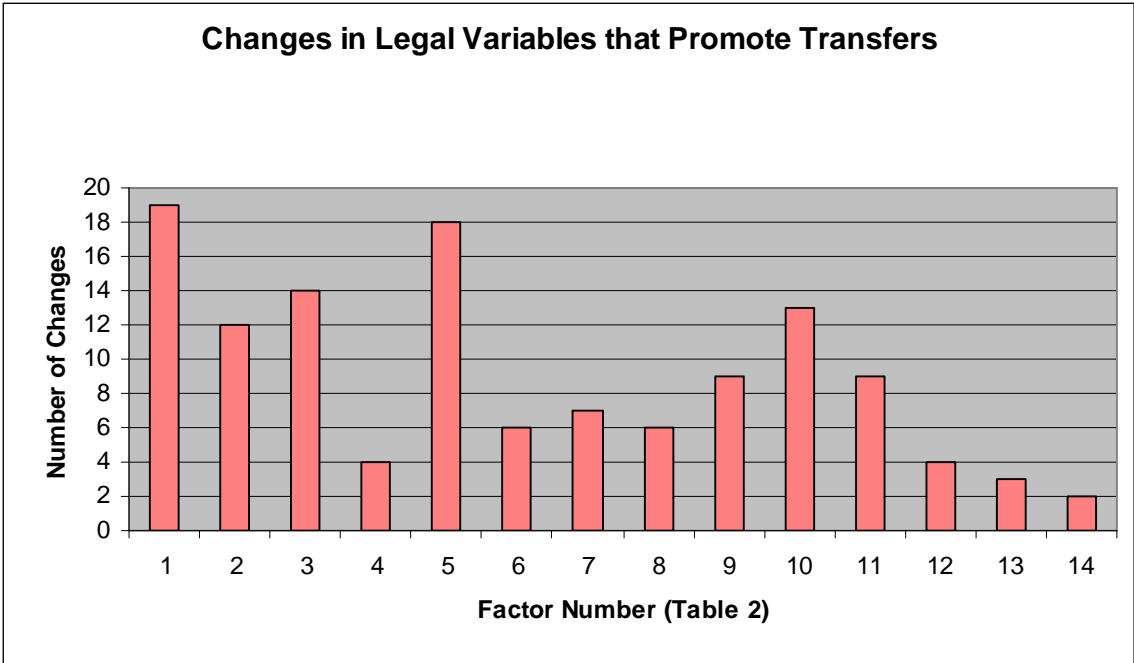
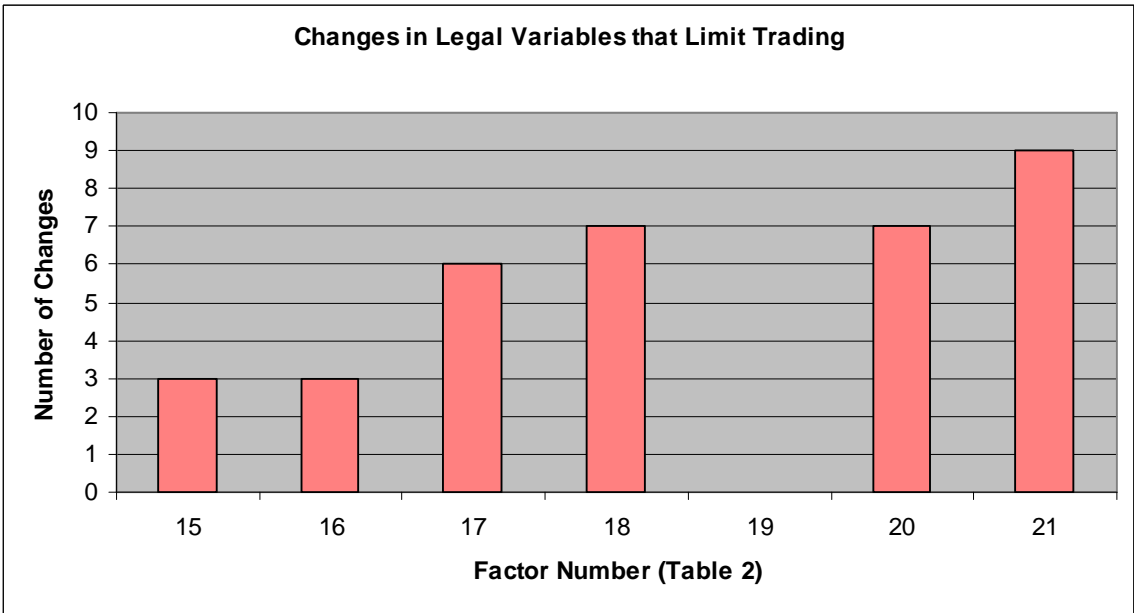


Figure 7



V. Statistical Analysis

In this section, we empirically model the water transfer process -- both the annual number and volume of transfers -- as a function of economic and legal institutional variables. As discussed in the previous section, we reviewed the legal institutions that govern water transfers in the California. This appraisal resulted in a number of legal variables that were perfectly collinear in that they changed in the same year. For example, with respect to legislative or statutory law there were changes in 1988 with respect to the following three factors: does the law allow someone to lease his water right to someone else; does the law allow temporary transfer of water rights on an emergency basis, in times of need; and does the law restrict the transfer of water rights to protect the environment. As a result, the three dummy variables representing these three factors were identical because they had the value of '0' in 1987 and a '1' thereafter and thus were empirically indistinguishable from each other. There were many instances of this. Accordingly, we were forced to undertake the modeling process using yearly dummy variables rather than institutional-specific dummy variables.

These yearly dummies are such that once they change from a zero to a one, they remain a one, representing a permanent change in the legal institutional environment. Specifically, dummy variable 1991 is a zero from 1987-1990 and a one from 1991-2005 and by necessity, encapsulates the effect of the institutional (legal) variables that changed significantly in 1990 and 1991. We say both 1990 and 1991 because legislation may be passed in the latter part of 1990 which may not have any effect on 1990 water transfers but could begin affecting water transfers in 1991. Similarly, legislation may be passed in the early part of 1991 that could affect water transfers in that year.

In addition to the institutional variables, a number of economic variables representing supply and demand factors likely influencing water transfers were also included as control variables. These included precipitation measures, drought indexes, electricity rates (water pumping and transport costs), gross state product (economic activity and growth), annual state population measures, per capita income, percent in poverty, agricultural gross state product measures (agricultural water supply), lands in farms, planted acres, harvested acres, farm cash receipts, and government agricultural payments.

Table 3 below summarizes our statistical analysis of the yearly number of water transfers in California from 1987 to 2005 using the annual legal change dummies and control variables. Because the dependent variable is a count, the number of water transfers, we use a Poisson model and likelihood methods rather than ordinary least squares (OLS). The Poisson distribution is generally used to model numerical data of this form and is defined as

$$\Pr(Y=y|\lambda)=(e^{-\lambda}\lambda^y)/y!$$

Hence the corresponding log likelihood function for the regression model is

$$\text{Log } L(\beta)=\sum\{y_i\log(\mu_i)-\mu_i\}$$

$$\text{where } \log(\mu_i)=X_i\beta.$$

The dependent variable was number of water transfers, and the independent variables were the annual dummies representing legal change and the supply and demand for water transfer control variables. We report only the coefficients that were statistically significant.

Table 3
Determinants of the Number of Water Transfers

Variable	Estimate	Standard Error	Chi-Square	p-value
Intercept	1.5156	0.4337	12.21	0.0005
Lagged Population Change	0.1821	0.0389	21.94	0.0001
Precipitation	-0.0277	0.0104	7.16	0.0075
Dummy 1989	0.8372	0.2693	9.66	0.0019
Dummy 1991	0.8436	0.1822	21.44	0.0001
Dummy 2000	-0.2911	0.1303	4.99	0.0254
Dummy 2003	0.2335	0.1598	2.14	0.1438

The statistical analysis is quite revealing. On the demand side, we find that among the control variables, increases in California’s population (lagged to control for potential endogeneity) result in an increased number of water transfers, all else equal. This is as predicted. On the supply side, we find that decreases in precipitation lead to an increased number of water transfers.⁶⁶ This result too is consistent with predicted effects. In terms of institutional effects, we find the dummy variables associated with legal changes 1989, 1991, and 2000 have a significant impact on the number of water transfers. We include the dummy for 2003 to be consistent with the regression for the volume of water transferred. The dummy for 1989 reflects the effects of 1988 legislation providing that decreed riparian rights may be transferred, and as such, it has a positive effect on the

⁶⁶ Precipitation data was provided on an annualized basis from Michael Anderson, State Climatologist, California Department of Water Resources Division of Flood Management. We also collected other climate related supply variables. One was the Sacramento River 40-30-30 Index (SIR) from the California Department of Water Resources. It measures the amount of water-year flow in the Sacramento River. We used the precipitation data as opposed to the SIR for two primary reasons. First, the SIR is calculated as a weighted-moving-average of the current year’s water flow and the past year’s water flow. However, the current year’s water flow is based on a water-year (October-September), while our water transfer data we are predicting is based on a calendar-year (January-December). Both the weighted-moving average and the water-year aspect of the SIR make it a more difficult variable to predict water transfers. Secondly, the SIR measures the water flow only in the Sacramento River. In our dataset water transfers occur throughout the state of California and we needed a more comprehensive measure. A second climate related supply variable that we collected was the Palmer Drought Severity Index (PDSI) for the state of California. The drought measure did not perform as well in predicting water transfers as did the precipitation variable.

number of water transfers once the law was operational. The dummy for 1991 reflects the important effect of the creation of the Emergency Drought Water Bank by the state legislature in 1991 that promoted short-term exchanges from agriculture to urban uses, as well as the likely effects of 1992 changes in legislation that allowed water providers to transfer water conserved by their members. Also in 1992, the federal Central Valley Project Improvement Act was enacted that smoothed the process for the transfer of water provided by the Bureau of Reclamation, a major water supply institution in the state, by individual farmers. The discussion in Section II provides more detail as to why these institutional changes should have a positive effect on the number of water transfers in California. Finally, we find that the dummy for 2000 is significant and negative. In 2000 and 2001 there were judicial rulings that limited water transactions if there were potential environmental damages, and in 2001, the California Legislature approved statutes that required increased third-party notice of proposed transfers and facilitated third-party protests of such actions. These legal changes appear to have reduced the number of transfers, all else equal.

We also empirically modeled the quantity of water transferred as measured by annual flow. Specifically, we estimate the linear model

$$Y=X\beta$$

where X represents the vector of economic and institutional variables discussed above. Table 4 presents the results of our statistical analysis of the determinants of the annual quantity of water transferred, as measured by the annual flow of water among the parties as stipulated by the contract. This is a standard way of reporting water transactions as reported in the *Water Strategist*.

Table 4
Determinants of the Volume of Water Transferred

Variable	Estimate	Standard Error	Chi-Square	p-value
Intercept	-1.6270	4.4744	-0.36	0.7225
Lagged Population Change	0.8889	0.4625	1.92	0.0787
Precipitation	-0.1698	0.1069	-1.59	0.1381
Dummy 1989	4.8988	2.1335	2.3	0.0405
Dummy 1991	3.4696	2.1492	1.61	0.1324
Dummy 2000	-1.0059	1.4880	-0.68	0.5119
Dummy 2003	3.4214	1.7602	1.94	0.0757

As shown, the coefficient signs are the same as reported for the analysis of water transfers, but the statistical significance has changed in some cases. This is not surprising in that the two dependent variables, although similar, do differ importantly in some years (see Figure 1). We find that the population change coefficient remains positive and the precipitation coefficient remains negative, although the statistical significance for both variables has been reduced. We also find that the 1989 dummy and 2003 dummy are statistically significant and positive. Again, the dummy for 1989 likely represents the 1988 legislation providing that decreed riparian rights may be transferred and as such it has a positive effect on the volume of water transfers. The positive coefficient for the 2003 dummy reflects the effects of important 2003 legislation that strengthened water rights in California by defining them more clearly, including what constituted beneficial use and allowing for sale or lease of conserved water. A 2003 court ruling also strengthened water rights. Although as shown in Table 3 the 2003 dummy is not significant for the number of transfers, it does have a statistically-significant effect on the volume traded. Accordingly, the 2003 legislative changes may have facilitated larger water transactions.

VI. Conclusion

Scholars such as Ronald Coase, Douglass North, and Oliver Williamson have emphasized the importance of institutions, institutional change, and transaction costs in molding economic behavior. Legal institutions, especially as they relate to property rights and regulation of markets, critically influence trading activity. At the same time, the need to facilitate trade provides political and economic pressure for the modification of existing or the introduction of new laws and regulations to support market exchange. How completely the institutional environment responds will determine how quickly and effectively market activity can respond to exogenous changes in prices.

In this paper we examined the interaction between legal change and market activity regarding water in California in the spirit of the New Institutional Economics. Our approach suggests that quantifying otherwise qualitative measures of legal change and statistically analyzing their impact on observed market behavior can be a useful mechanism for analysis within the New Institutional Economics to better understand the interplay between economic factors and the law.

With a rapidly growing population, increased demand for recreation and environmental quality, and a semi-arid climate, more and more water must be transferred from historical uses in agriculture, where eighty percent of it has been devoted, to urban and environmental uses. The development of water markets for voluntary exchange of water through leases of water and sales of water rights are an important institutional reaction. Water market institutions require changes in water rights and regulations to allow for increased water transfers from traditional uses and originating watersheds.

These legal changes take place in legislatures, courts, and administrative agencies, and we have chronicled those changes from 1980 through 2005. Many of these changes, for example, are spurred by drought, which often has stretched California's already tight water supply/demand conditions. At the same time, the institutional structure of California water rights and water supply organizations determine that much more water trading occurs through one-year leases in the state than elsewhere in the West, where water rights sales and long-term leases are more prevalent. As climate change occurs and precipitation patterns become even more variable, and as California's urban population continues to grow along with increased demand for recreation and environmental water uses, there will be additional pressure for legal change to reallocate water in a smooth and cost-efficient manner.