

## Results of Chilean water markets: Empirical research since 1990

Carl J. Bauer

Resources for the Future, Washington, DC, USA

Received 3 November 2003; revised 17 February 2004; accepted 27 February 2004; published 7 August 2004.

[1] Chile's free-market Water Code turned 20 years old in October 2001. This anniversary was an important milestone for both Chilean and international debates about water policy because Chile has become the world's leading example of the free-market approach to water law and water resources management, the textbook case of treating water rights not merely as private property but also as a fully marketable commodity. The predominant view outside of Chile is that Chilean water markets and the Chilean model of water management have been a success, and this perception has encouraged other countries to follow Chile's lead in water law reform. Much of the debate about Chilean water markets, however, has been based more on theoretical or political beliefs than on empirical study. This paper reverses that emphasis by reviewing the evolution of empirical research about these markets since 1990, when Chile returned to democratic government after 16 years of military rule. During the period since 1990, understanding of how Chilean water markets have worked in practice has gradually improved. There have been two major trends in this research: first, a gradual shift from exaggerated claims of the markets' success toward more balanced assessments of mixed results and, second, a heavy emphasis on the economics of water rights trading with very little attention given to the Water Code's impacts on social equity, river basin management, environmental protection, or resolution of water conflicts. The analysis in this study is qualitative and interdisciplinary, combining law, economics, and institutions. *INDEX TERMS*: 6319 Policy Sciences: Institutions; 6324 Policy Sciences: Legislation and regulations; 9360 Information Related to Geographic Region: South America; *KEYWORDS*: Chile, Latin America, water law and institutions, water markets, water rights

**Citation:** Bauer, C. J. (2004), Results of Chilean water markets: Empirical research since 1990, *Water Resour. Res.*, 40, W09S06, doi:10.1029/2003WR002838.

### 1. Introduction

[2] Chile's free-market Water Code turned 20 years old in October 2001. This anniversary was an important milestone for both Chilean and international debates about water policy because Chile has become the world's leading example of the free-market approach to water law and water resources management, the textbook case of treating water rights not merely as private property but also as a fully marketable commodity. Other countries have recognized variations of private property rights to water, but none have done so in as unconditional and deregulated a manner as Chile. Because the 1981 Water Code is so paradigmatic an example of free-market reform, some people have praised it as an intellectual and political triumph, while others have criticized it as a social and ideological aberration.

[3] The predominant view outside Chile is that Chilean water markets and the Chilean model of water management have been a success. Many economists and water experts in the World Bank, the Inter-American Development Bank (IDB), and related institutions share this view. Since the early 1990s, these proponents have used their considerable

resources and influence to promote a simplified description of the Chilean model and its results, both elsewhere in Latin America and in the wider international water policy arena. Although they sometimes recognize flaws in the model, their general tendency has been to play down the importance of those flaws and instead to emphasize the model's advantages [e.g., *Briscoe et al.*, 1998; *Rogers and Hall*, 2002]. Other water experts, particularly those associated with United Nations agencies, have been more critical.

[4] Much of the debate about Chilean water markets, however, has been based more on theoretical or political beliefs than on empirical study. This is the case both inside and outside Chile. My goal in this paper is to reverse that emphasis by reviewing the evolution of empirical research about these markets since 1990. In that year, Chile returned to democratic government after 16 years of military rule, and in the period since then, our understanding of how Chilean water markets work in practice has gradually improved.

[5] In section 2 I briefly describe the broader international context, particularly the recent debates about global water problems and the need for major reforms of water law and policy in many countries, in order to show the international significance of the Chilean experience. Next, I summarize the major features of Chile's current water law. The bulk of

the paper then reviews the most important and relevant empirical research that has been published about Chilean water markets through 2003, in Spanish as well as English. I will argue that there have been two major trends in this research: first, a gradual shift from exaggerated claims of the markets' success toward more balanced assessments of mixed results and, second, a heavy emphasis on the economics of water rights trading with very little attention given to the law's impacts on social equity, river basin management, environmental protection, or resolution of water conflicts.

[6] The Chilean model of water markets and water rights trading is different from other countries in at least one essential respect. In other countries that have allowed or encouraged water markets, under varying circumstances, these markets have been a more or less important policy instrument within the broader context of water resources law and management. In Chile this order is reversed: water resources management takes place within the context of water markets. The Chilean Water Code is so *laissez-faire* that the overall legal and institutional framework has been built in the image of the free market, with strong private property rights, broad private economic freedoms, and weak government regulation. As a result, when we look at Chilean water markets, we are also looking at the Chilean model of water management as a whole, to a greater extent than is the case with other countries.

[7] This paper has been condensed from portions of a new book that provides a more comprehensive evaluation of the Chilean experience [Bauer, 2004]. Interested readers should consult the book for more detailed discussion and references about the issues summarized here.

## 2. Significance of Chilean Model in International Debates About Water Policy

[8] In the international context the Chilean model of water law represents one response to what is increasingly recognized as a global "water crisis" [Cosgrove and Rijsberman, 2000; *Global Water Partnership*, 2000a]. Throughout the world, population and economic growth have been increasing the demand for water for a wide variety of uses, including drinking and domestic needs, agriculture, mining and manufacturing, electricity generation, environmental protection, navigation, and recreation, and water resources have become ever scarcer in relation to these growing demands. Greater scarcity has raised water's economic value, intensified the levels of competition and conflict among different water users, and magnified the environmental impacts of water use. Because these trends are interrelated and reinforce each other, they have led to a vicious cycle in many parts of the world. Water scarcity, of course, is often a problem of water quality as well as quantity.

[9] International recognition of these problems has led to urgent calls for reforming water laws, policies, and management and to substantial debate about what those reforms should accomplish. These debates have taken place at high-profile international conferences, such as the Earth Summit in Rio de Janeiro in 1992 and the Second World Water Forum at The Hague in 2000, and within international development organizations, such as the World Bank, the

United Nations, and many others. Much of this discussion has been part of wider international debates about sustainable development.

[10] There is broad international consensus that water policy reforms should move toward what is called "integrated water resources management" (IWRM). IWRM, like sustainable development, refers to a set of general principles rather than specific policy guidelines, and hence much of the consensus is rhetorical. The basic idea of IWRM is to adopt a comprehensive, interdisciplinary, and holistic approach to dealing with water resource issues, including their social, political, economic, technical, and environmental aspects [e.g., *Global Water Partnership*, 2000b; *World Bank*, 1993]. IWRM focuses on the water cycle as a whole rather than specific water sectors or water uses in isolation and therefore focuses on river basins and watersheds as the most appropriate geographic units for water management. This approach places more emphasis on the relationships between water uses and land uses, between groundwater and surface water, between water quality and water quantity, and between natural sciences and social sciences.

[11] One of the core challenges of IWRM is how to improve water "governance," which has been defined as "the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society" [Rogers and Hall, 2002, p. 4]. As the definition makes clear, water governance is fundamentally a matter of institutional capacity.

[12] Probably the most controversial issue in these international debates has been the proper role for economics in IWRM and, in particular, the role for market instruments and incentives. A more economic approach to water management is often referred to as the argument that water "should be recognized as an economic good," in the phrase made famous by the so-called Dublin Principles of IWRM (named for a conference held in Dublin: see *International Conference on Water and the Environment* [1992]). However, there has been heated debate about what this phrase means and about whether an "economic" approach is the same as a free-market approach [Bauer, 2004].

[13] On one extreme of this debate is the argument that water should be managed as a fully tradable commodity, subject to the forces of supply and demand in an unregulated market, and that water's economic value is the same as its free-market price. On the other extreme is the argument that water should be exempt from market forces because water is so essential to human existence that it belongs in the category of basic human rights and should be managed according to criteria of social equity and justice rather than economic efficiency. An intermediate position is that water should be recognized as a scarce resource, which means that we face difficult choices and trade-offs in how we allocate water to different uses. These trade-offs will be less painful if we can increase the efficiency of water use and allocation, for which market incentives can be powerful instruments as long as they are adequately regulated to safeguard other public interests in addition to economic efficiency.

[14] The essential differences between the free-market and intermediate positions have to do with their views of the appropriate scope of government regulation and the amount of intellectual attention given to the institutional

arrangements that underlie markets. These are matters of disciplinary perspective as well as political ideology. A narrow neoclassical perspective considers legal and political institutions to be outside the realm of “economics”: they are noneconomic factors that must be assumed to be in place in order to do economic analysis, which is typically conceived of as neutral and scientific. When this perspective is combined with a faith in free markets, the result is a notion of markets as mechanisms that work automatically if they are left alone, i.e., if government does not “intervene.” From a more pragmatic and broader disciplinary perspective, in contrast, markets are created and shaped by political decisions, legal rules, and other social factors. In consequence, market-based policies should be thought of as tools that can be more or less effective depending on the circumstances and social objectives, instead of as controlling principles to which we should defer.

[15] This is the context in which Chilean water law has global significance because of its unique and extreme free-market approach to managing water “as an economic good.” For example, a senior water advisor at the World Bank has publicized Chilean water markets as a model of international “good practice” in this area [Briscoe, 1996; Briscoe *et al.*, 1998], and a paper for the Global Water Partnership has described Chile as “a world leader in water governance” for the same reason [Rogers and Hall, 2002, p. 25]. More than 20 years of Chilean experience offer an opportunity to answer two important questions: What have been the concrete results of Chilean water markets? Are they compatible with the broader and long-term goals of integrated water resources management?

### 3. Chile’s 1981 Water Code: Major Features

[16] Chile’s current Water Code is a classic example of what in Latin America is often called the “law of the pendulum”: the historical tendency to swing from one extreme to the other in political and economic affairs, without finding a point of balance somewhere in the middle. In 1967 a reformist Chilean government swung the pendulum toward greatly expanded governmental authority over water use and water management, at the expense of private property rights, by passing a new water law as part of an ambitious agricultural land reform. In 1981 an authoritarian military regime, which had overthrown a socialist government in 1973, swung the pendulum to the opposite, free-market extreme, where it remains to this day. (This section of the paper is summarized from Bauer [1998b] and Bauer [2004].)

[17] The 1981 Water Code strengthened private property rights, increased private autonomy in water use, and favored free markets in water rights to an unprecedented degree. The new code separated water rights from land ownership for the first time in Chilean history and declared them to be freely tradable: they can be bought, sold, mortgaged, inherited, and transferred like any other real estate. As a corollary the code sharply reduced the government’s role in water resources management, regulation, and development. The Water Code’s essential philosophy is *laissez-faire*: it does not directly mandate or establish a market in water rights but instead aims to set up the legal rules and preconditions for such a market

to emerge spontaneously as a result of private initiative. In all these respects, the Water Code closely reflects the legal structure and ideological principles of Chile’s 1980 Constitution, which was also written by the military government and is also still in effect.

[18] In formal legal terms the Water Code declares that water resources are inalienably public property and that the national government may grant private rights to use that property. Despite this formal definition, the law strengthens private ownership and control over water rights and weakens government authority in many ways. In the case of new rights, applicants no longer have to specify or justify their intended water uses to the government water rights agency, the General Water Directorate (Dirección General de Aguas, or DGA). The agency is required to grant new rights if there is water physically and legally available, and those rights are granted free of charge. The law does not establish any priorities among different water uses: such determinations are left to private parties and the free market. If there is not enough water to satisfy simultaneous applications for new rights, the DGA has no power to choose among competing applicants and, in theory, must hold a public auction and sell the new rights to the highest bidder (in practice, such auctions have been very uncommon).

[19] Because water rights are treated as real estate once they have been granted, they are included in the general system of real estate title registration and explicitly protected as private property in the constitution. All water rights created or acquired under legislation prior to 1981 enjoy the same protection. The owners of water rights can freely change how they use those rights without notifying the DGA or getting its approval. Unlike other real estate, however, the owners of water rights do not pay any taxes or fees to the government. Moreover, they have no legal obligation to use their water rights, and they face no legal or financial penalty for lack of use. In other words, there is no legal doctrine requiring “beneficial use” (“use it or lose it”). The unconditional nature of private water rights differs from all previous legislation in Chile and also from the water laws of all other countries around the world [Solanes, 1996]. Not surprisingly, these provisions allow unrestricted private speculation in water rights, which has been one of the Water Code’s most controversial aspects.

[20] The DGA has very little authority to regulate private water use and no power to intervene in or adjudicate conflicts between water users. The agency cannot cancel or restrict existing water rights except by expropriation, which requires specific legislation and payment in cash in each case and is extremely rare. Nearly all decisions about water use and management are made by individual water rights owners or by private associations of canal users (in the case of agricultural water use only). The DGA retains some important technical and administrative functions, such as gathering and maintaining hydrologic data, inspecting larger dams and canals, and enforcing the rules about the operation of private canal associations. The agency can prepare studies, reports, and policy recommendations, but these have no regulatory force.

[21] The Water Code’s *laissez-faire* principles are especially evident in the core areas of IWRM: river basin management, coordination of multiple water uses, resolu-

tion of water conflicts, and internalization of externalities. Because the military government's primary concern about water law in the 1970s was irrigation rights, which were crucial to rolling back the land reform, the code says very little about other water uses or how to coordinate them. Dealing with these issues depends on the law's general market principles and institutional framework rather than on specific provisions; in other words, it depends on private bargaining among the owners of water rights. When private bargaining fails, the only alternative is to go to the ordinary civil courts, since the DGA is powerless and Chile has no specialized administrative courts. As noted above, this framework is determined by Chile's Constitution as well as by the Water Code.

[22] The one exception to the Water Code's neglect of nonagricultural water uses was the creation of "nonconsumptive" water rights. This was a new kind of water right that was intended to foster hydroelectric power development in the mountains and foothills upstream from agricultural areas without harming downstream farmers who had preexisting water rights (now called "consumptive" water rights). A nonconsumptive right allows its owner to divert water from a stream, use it to generate electricity (or for some other purpose), and then return the water to its original channel to continue flowing downstream. These new rights, however, were poorly defined. Beyond establishing their existence, the Water Code's rules governing their exercise and their relationship to other water rights are very brief and general, as a series of river basin conflicts between irrigators and hydroelectric companies would show in the 1990s [Bauer, 1998a, 1998b, 2004].

[23] Like most legislation, even legislation adopted by a military government without public discussion, Chile's 1981 Water Code was a product of political negotiation. This was especially important for the specific rules defining property rights and duties, which determined the economic incentives affecting water use and allocation. In most respects, the neoliberal economists who dominated the drafting of the code got what they wanted: a legal framework that favored a free market. They had to yield on one critical point, however, which was the proposed creation of annual water rights taxes. Although the economists argued that such taxes were essential to creating the right incentives and price signals for economic efficiency by giving water rights a real cost, agricultural interests marshaled enough political resistance to block the proposal. Farmers and agricultural landowners refused to pay new taxes regardless of the economic arguments. In Chile these legal rules and economic incentives have been much debated since 1990, but so far, they have been politically impossible to change (as discussed in depth by Bauer [2004]).

#### 4. Research About Chilean Water Markets: Overview

[24] The Water Code defined the legal rules to facilitate the free trading of water rights but did not establish a market directly. The emergence of water markets has therefore depended on private initiative and local conditions. During the first decade after the law's enactment (the 1980s), there was little water market activity and even less research. This was due to both political and economic constraints. In the

first place, Chile's military government remained in power until 1990, which discouraged public policy debates and meant that people had other political concerns more pressing than water issues. In the second place, the national economy was in poor shape until the late 1980s, which reduced demand for water resources. As a result, in this paper I will focus on the period since 1990.

[25] The market for water rights has been the feature of the Chilean Water Code that has attracted by far the most attention. This is especially true in international circles, where the Water Code has been perceived as essentially synonymous with Chilean water markets and water rights trading. Other issues of water management and the current institutional framework, such as managing river basins or resolving conflicts, have been generally overlooked in academic and policy research. In addition, most of the research to date has been done by economists, which helps to explain the heavy emphasis on markets and trading. I return to this point at the end of the paper.

[26] The performance and results of Chilean water markets have been highly politicized topics both inside and outside Chile. This is not surprising: the Water Code is so pure a symbol of free-market theory and ideology that both proponents and critics have had a lot at stake in whether or not the resulting markets are considered to be a success. In the international water policy arena the issue has been politicized since the World Bank and the IDB began to publicize the Chilean model as an example of successful reform in the early 1990s. This provoked a strong critical reaction from water experts at other international organizations, who were more concerned about the flaws of the Chilean model. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC), which is located in Santiago, Chile, was especially active in mobilizing such opposition.

[27] Within Chile, empirical research and analysis about water markets have been overshadowed by the heated political debate about whether to reform the Water Code. Since the country's return to democracy in 1990, all three elected governments have proposed legislative reforms aimed at reducing the Code's laissez-faire emphasis (i.e., swinging the pendulum back toward an intermediate position). These proposals have generated strong public disagreement that has tended to be ideologically polarized, which has inevitably affected people's assertions about how well or how poorly water markets have worked in practice, a factor that outsiders to Chile have rarely understood. As of early 2004, after more than 13 years of debate and a steady narrowing of the scope of reform, the government's proposals continue to be blocked by opposition from conservative political parties and private sector interest groups [Bauer, 2004].

[28] Because of the lag in empirical research much of the discussion about Chilean water markets has been long on theoretical or ideological argument and short on reliable information. This was especially true in the first half of the 1990s. The amount of research increased slowly throughout the 1990s, however, and the level of empirical knowledge gradually improved. By the second half of the decade, there was a good deal of consensus about how to describe the main characteristics of Chilean water markets, at least among people who were well informed. Nevertheless,

political disagreements have continued about how to interpret that description or what the policy implications should be.

## 5. Evolving Assessments Through the 1990s: From Boosters to Balance

[29] The tone and content of published accounts about Chilean water markets changed notably from the early 1990s to the late 1990s. The overall trend was from exaggerated claims of remarkable success toward more moderate and credible assessments of mixed results.

[30] During the first half of the decade, published accounts tended to be highly enthusiastic. These accounts' ideological bias and lack of empirical foundation were indicated by their sweeping assertions of success on all counts: water markets had supposedly resulted in active trading of water rights, greater efficiency of water use and allocation, social and economic benefits for poor farmers, and fewer water conflicts. No significant problems or difficulties were recognized. Strictly speaking, these publications were theoretical arguments or opinion pieces rather than empirical research, but they were not clearly identified as such and they influenced many people's impressions of the Chilean case.

[31] Nearly all of these early publications were by economists associated with the World Bank, whether as staff members or consultants. It is important not to oversimplify the World Bank's position on these issues since the World Bank is not a monolithic organization and it includes people with a certain range of viewpoints. With respect to Chilean water markets the quality of the World Bank's analyses and publications varies a good deal: some are reasonable and well supported, while others are misleading or simply wrong. Unfortunately, it is often hard for readers to tell the difference, particularly because most of these publications share a tone of confident assertion whether or not they provide any supporting evidence. In any event, whatever the variations among these World Bank publications, their overall assessment of the Chilean model is always positive, even in the later 1990s.

[32] Several examples of the early wave of exaggerated claims were published in 1994. One was a World Bank report about water management and irrigation development in Peru, written by World Bank economist M. Thobani [*World Bank*, 1994]. The report discussed a new draft water law for Peru that had been modeled on the Chilean Water Code and that both the World Bank and the Inter-American Development Bank were urging the Peruvian government to adopt. (The draft was apparently written by Chilean consultants who had helped write the Chilean law in the late 1970s and who were firmly convinced of its benefits.) According to Thobani, the Chilean water law "has successfully improved water delivery and use, stimulated private investment, and reduced water conflicts," in addition to increasing the value of water, reducing environmental damage, and benefiting poor farmers at the expense of "politically influential water users" [*World Bank*, 1994, pp. ii–iii]. He did not provide or cite any evidence to support these assertions.

[33] Another example was a widely cited paper by Mark Rosegrant, an economist at the International Food Policy Research Institute in Washington, and Hans Binswanger, an

economist at the World Bank [*Rosegrant and Binswanger*, 1994]. Rosegrant and Binswanger present a comprehensive argument in favor of markets in tradable water rights in developing countries, and they refer repeatedly to Chile to support their argument. In Chile, they assert, such markets "have been operating effectively with relatively unsophisticated conveyance technology" and have "greatly reduced the number of water conflicts reaching courts." They also use the example of Chile to dismiss concerns about social inequity. Although some people have worried that if water rights are made fully tradable, differences in wealth or power might favor large nonagricultural water users and harm small farmers, "evidence from Chile, where active markets exist...shows that this has not happened." Rosegrant and Binswanger also refer to concerns raised about the influence of market power in the initial assignment of water rights but argue that this was not an issue in Chile because water rights were assigned as part of the military government's reversal of the land reform, which "was seen as an improvement in equity" [*Rosegrant and Binswanger*, 1994, pp. 1618–1619, 1622]. (This last assertion is simply mistaken since the great majority of water rights in Chile were not, in fact, assigned as part of the end of land reform. This error, however, has been repeated routinely in later publications and has become one of the common myths about the Chilean case. The suggestion that the military's redistribution of land and water rights in the 1970s improved social equity is debatable at best [see *Jarvis*, 1988; *Bauer*, 2004].)

[34] In short, *Rosegrant and Binswanger's* [1994] description of Chilean water markets is uniformly rosy. This reflects their principal source of information: they rely heavily on the work of Renato Gazmuri, a Chilean economist and politician who is knowledgeable but not an impartial observer. Gazmuri was a high-level civilian official in the military government's Ministry of Agriculture after 1973. He was a leading member of the neoliberal team that reversed the land reform, liberalized the agricultural sector, and designed the 1981 Water Code. In the early 1990s, Gazmuri worked as an international water policy consultant in a number of countries, when he joined Rosegrant to publish several papers that spread the word about the Chilean "success story" [e.g., *Gazmuri and Rosegrant*, 1994].

[35] The viewpoints summarized above were the first to be published in English, and in international circles they dominated the initial terms of debate. They soon began to unravel, however, as more careful empirical studies were completed. From 1995 on, growing evidence from both Chilean and foreign researchers, including some who were funded by the World Bank, led to more balanced assessments of the limitations as well as the benefits of Chilean water markets.

[36] The first area where the conventional wisdom shifted was the question of whether Chilean water markets were as active as their early proponents claimed. The first empirical study to challenge that description was a paper that I published in late 1993, which discussed the results of 2 years of field research in central and south central Chile [*Bauer*, 1993]. (The fact that this paper was published in Chile and in Spanish limited its circulation outside of Latin America. The research became available in English in 1995 and was published in expanded and updated form by *Bauer* [1997,

1998a, 1998b.) In these publications I argued that the available evidence, both quantitative and qualitative, showed that water rights transactions were, in fact, quite uncommon in most parts of Chile, and therefore, as a general rule, Chilean water markets were relatively inactive. Moreover, the great majority of water rights transactions took place within the agricultural sector and did not involve nonagricultural water uses.

[37] These were empirical observations rather than a criticism of the water market, and much of the analysis sought to explain the markets' observed inactivity by discussing the many factors that limited water rights transactions. These limiting factors included (in no particular order of importance) (1) constraints imposed by physical geography (Chilean rivers are short and steep and interbasin transfers are expensive) and by rigid or inadequate infrastructure (i.e., canals with fixed flow dividers and very few storage reservoirs), (2) legal and administrative complications, particularly the uncertainty and confusion about water rights titles and record keeping, (3) cultural and psychological resistance to treating water as a commodity, especially from the viewpoint of farmers, and (4) inconsistent and variable price signals about the real scarcity and economic value of water (e.g., water rights owners are rarely willing to sell, even if their rights are unused, and until recently, groundwater has been an untapped alternative). The first two factors in particular, problems of infrastructure and legal titles, have been common themes in all subsequent analyses of Chilean water markets, as discussed below.

[38] The activity of water markets, in terms of the number or frequency of water rights sales, was only one way to assess the Water Code's results and not necessarily the most important. A more critical issue was the effectiveness of the law's market incentives at increasing the efficiency of water use and allocation, specifically by encouraging investment in water conservation in order to sell the water saved. This was the main economic argument in favor of the new Water Code back in the late 1970s [Bauer, 1998b, 2004]. Here the evidence showed that market incentives had been almost entirely ineffective in practice. Water rights owners in Chile rarely sell any unused or supposedly "surplus" rights; instead, they hold onto such rights to protect themselves from occasional drought years or because they know that the value of those rights will increase over time. Even where farmers have invested in more efficient water use, their motive has been to improve their agricultural yield or to expand their irrigated acreage, and they have not sold any resulting surplus water. Indeed, since 1985, the Chilean government has had to revert to subsidizing private investment in irrigation in an implicit recognition that the water market has not provided sufficient incentives to replace public subsidies, contrary to the objectives of the economists who wrote the Water Code. The ineffectiveness of these incentives, of course, was partly due to the absence of any taxes on water rights or other costs of ownership, for which the government's economists had argued to no avail in the late 1970s.

[39] This research gained a reputation for being "anti-market," particularly in Chile, but this reflected the politicized nature of the debate rather than the research itself. In fact, my criticisms were aimed not at Chilean water markets but rather at the exaggerated claims that were being made

about their success. I agreed that the markets had the advantage of allowing flexible reallocation of water resources, even if this advantage was still more potential than real in the mid-1990s. I predicted that water markets would become more active over time and in certain regions of Chile as water demands and relative water scarcity increased enough to overcome the obstacles and transaction costs listed above. In short, I concluded that the most important economic benefits of the Water Code have not come from water rights trading or market incentives but instead from the greater legal security of property rights, which has encouraged private investment in water use [Bauer, 1997, 1998b].

[40] The next empirical research was done by Robert Hearne in 1993, who studied four areas in central and northern Chile that were selected precisely because they were expected to have active water markets [Hearne and Easter, 1995]. In each case the climate was arid, water was scarce, and irrigated agriculture was well developed and commercially profitable (the southernmost of the four cases included part of the metropolitan area of Santiago). In spite of the expectations, however, Hearne's research showed that there was very little trading of water rights in three of the four study areas. The principal explanation for these results was that the rigid canal infrastructure made it costly to change water distribution, particularly among farmers. The one exception was the Limarí River Basin in north central Chile, which I discuss further below since it has become widely known as "the" example of Chilean water markets.

[41] Hearne argued that water markets had led to economic benefits in some areas, including greater efficiency due to transfers to higher value water uses: i.e., from agriculture to cities. (Many of these transfers, however, involved paper titles to water rights that had been long unused, rather than a physical reallocation of water resources.) On the whole, he favored the Chilean model, while recognizing some of its limitations. Nonetheless, his empirical work helped to confirm the view that water rights sales and transactions were the exception rather than the rule in most of Chile. His conclusion carried added weight because the World Bank had financed his research and he himself was a World Bank consultant at the time.

[42] This conclusion soon became part of the conventional wisdom about Chilean water markets. It forced the Water Code's proponents, both Chilean and foreign, to change their arguments about the code's success. From 1995 on, many of these proponents no longer argued that the water market was active; instead, they argued that even though the market was inactive, it was nonetheless efficient. In fact, they said, the lack of water rights transactions showed that the existing allocation of water resources was already efficient (presumably thanks to the military government's assignment of water rights as part of its rollback of the land reform).

[43] Chilean economists Mónica Ríos and Jorge Quiroz repeated this argument in another World Bank publication in 1995, in which they reviewed the major issues raised by Chile's market in water rights [Ríos and Quiroz, 1995]. Ríos and Quiroz did not conduct any new empirical research: their review is based on interviews and on the existing research summarized above. They question the significance of the fact that water rights sales have been so infrequent,

for the reasons given above, and they argue instead that the water market has been active in temporary rentals. This assertion is probably accurate, although they offer no evidence, since temporary and informal exchanges of water rights among farmers, particularly among members of the same local canal associations, have been a long historical tradition in Chile. There is no reason to attribute these rentals to the current Water Code, however, at least until empirical research shows otherwise.

[44] *Ríos and Quiroz* [1995] describe a number of problems, including the vague definition of nonconsumptive water rights, which has caused conflicts with consumptive rights, and the “transaction costs arising from incomplete legalization of water titles, lack of infrastructure, and free rider problems.” Overall, however, they conclude that “the system in Chile has worked reasonably well” and that the problems identified should be addressed through “fine tuning” of the system rather than drastic reform.” Among the “minor amendments” they recommend is to impose a user fee on all water rights (in 1995 the political difficulty of such a “minor” change in Chile had not yet been demonstrated) [*Ríos and Quiroz*, 1995, pp. 28–29, 15, vii].

[45] The Chilean government responded differently to the change in conventional wisdom. By the mid-1990s the government argued that the inactivity of water markets was one of the major reasons for reforming the Water Code: the laissez-faire and unconditional definition of water rights had distorted price signals and economic incentives, and this in turn had made markets static and inefficient. The DGA conducted internal studies of water rights transactions to confirm these arguments about market performance but did not publish additional empirical evidence for years [*Dirección General de Aguas*, 1999; *Alegría et al.*, 2001].

[46] In international circles the conventional wisdom about Chile was also affected by the counteroffensive led by ECLAC in the mid-1990s. Water experts at ECLAC and other international organizations were deeply concerned about the way the World Bank and IDB were pushing the Chilean model on other developing countries. These experts, who included some skeptics at the banks, were familiar with economic arguments and favored the appropriate use of market incentives, but they did not share the more dogmatic views of many of the proponents of the Chilean model. ECLAC staffers Miguel Solanes, an Argentine water lawyer, and Axel Dourojeanni, a Peruvian engineer and specialist in river basin management, did little new empirical research, but they assembled the available information to highlight the flaws and excesses of the Chilean water law and to urge other countries to take a more balanced approach. Solanes was particularly insistent that private water rights had to be subject to some requirement of socially beneficial use that could be enforced by government authority; otherwise, public interests in water management would be harmed by monopoly power, unfair competition, speculation, hoarding, and environmental damage [*Solanes*, 1996].

[47] After 1995 no new empirical research became available until the end of the decade, although some of the previous work was published in updated form [*Bauer*, 1997, 1998a, 1998b; *Hearne*, 1998]. In the meantime, with the description of the markets’ inactivity widely accepted, researchers in Chile began to develop more sophisticated

diagnoses of the reasons for that inactivity and the range of problems needing attention.

## 6. Recent Chilean Syntheses: Toward a Shared Diagnosis

[48] Several important syntheses and overviews about Chilean water markets have been published in Chile since 1997. These publications are available only in Spanish and are largely unknown outside of Chile. They represent the state of knowledge of the best informed local experts. Their analyses confirm most of the critiques that had been made in the previous years, although some of these experts are declared supporters of the Water Code and opponents of the government’s proposed reforms.

[49] In 1997–1998, Chile’s leading academic expert on water law, Alejandro Vergara, published several articles that examined the functioning of Chilean water markets. (These articles were later compiled by *Vergara* [1998].) Vergara is a law professor as well as a water lawyer in private practice, and his analysis was based on a thorough review of the existing literature and on his own professional experience. His point of departure is that Chile has already adopted water rights legislation that favors the free market rather than government planning, and he does not question or criticize that decision. Instead, his purpose is to raise issues about how water markets have actually worked so far and to suggest the legal improvements needed for them to work better in the future.

[50] *Vergara*’s [1998, p. 504] initial observation is that “the free market was established but not all of the prior institutional arrangements were made that are necessary for the market to function adequately.” The gist of his argument is that water rights in Chile are not, in fact, clearly defined, despite the Water Code’s general principle in favor of private and tradable property rights. In both legal and physical terms, water rights are much more fuzzy than they seem on the surface. He identifies the following problems.

[51] 1. The Water Code does not mention how to deal with the externalities caused by water rights transactions, either environmental impacts or third-party effects on other water users. Indeed, both Vergara and other defenders of the Water Code have argued that externalities have not yet been a problem in Chile precisely because water markets have been so inactive.

[52] 2. There is a great deal of legal confusion about the rights to return flows from upstream irrigators. According to the Water Code, downstream users do not have any rights to those flows, despite many decades of customary practice to the contrary.

[53] 3. The record keeping and legal registration of water rights titles are widely recognized to be completely inadequate. The great majority of water rights in Chile are not formally registered: instead, they predate the 1981 Water Code and are based on past legislation or on customary practice. Although these rights often lack any documentary support, they enjoy full constitutional protection as property rights. Unregistered rights cannot be bought or sold, however, which is another obstacle to water markets.

[54] 4. Many water rights that do have formal legal titles nonetheless have a substantive content that is disputed in

practice. For example, they may be defined as “permanent” rights when, in fact, the water is not available all year.

[55] 5. The existing infrastructure of canals and reservoirs is inadequate to allow many transfers of water from one place to another.

[56] Vergara [1998] argues that until these problems are addressed, water markets will remain restricted and flawed and their potential will not be realized.

[57] Guillermo Donoso is the leading Chilean academic economist in the field of water markets. Like Vergara, he supports the general principles of the Water Code and shares the goal of making existing water markets work better. At a 1998 conference, Donoso presented an overview of how water markets have worked in Chile and identified the problems they have encountered, based on a review of the academic literature and various consultants’ reports [Donoso, 1999]. He begins by summarizing the conflicting views about how active Chilean water markets have been, concluding that although there is some room for debate, it is clear that the markets exist to some degree but vary greatly by river basin and geographic region: water rights trading is more active in areas where water is scarcer and during periods of drought.

[58] The bulk of Donoso’s [1999] study discusses the various problems and distortions that have affected Chilean water markets. Like Vergara, he argues that the biggest problem is the inadequate definition of water rights, which has caused negative externalities when rights have been sold or transferred. These externalities include the loss of or interference with return flows, degradation of water quality, and overextraction of groundwater. He also describes the transaction costs caused by the need to build or modify physical infrastructure in order to redistribute water.

[59] Another major problem is the lack of adequate legal, economic, and hydrological information about water rights. Although this would also be a problem for nonmarket systems of allocation, Donoso [1999] argues that it is a more acute problem for a market because a decentralized system relies more heavily on good and widely available information. Other related problems are the gap between nominal rights (i.e., paper rights) and real rights (“wet water”) and the conflicts caused by transactions involving or affecting the many thousands of unregistered customary rights. Finally, he discusses speculation and hoarding of both consumptive and nonconsumptive rights, which he concludes are only minor issues. (In a later work, Donoso *et al.* [2001] present quantitative data about water rights transactions in two important river basins, the Maipo and the Limarí, which were two of the four basins studied by Hearn and Easter [1995]. While this work does not contain arguments or results that challenge what is already generally known in Chile, it is unusual simply for its basic empirical description and analysis.)

[60] In 1999, two water experts at ECLAC published a comprehensive analysis of the Chilean Water Code, suggestively subtitled “between ideology and reality” [Dourojeanni and Jouravlev, 1999]. Dourojeanni and Jouravlev argue that too many other countries in Latin America have looked to Chile as the model of water law and policy reform without being aware of the problems that the Water Code has caused or the controversies within Chile about how to solve these problems. They attempt to rectify this

lack of knowledge in a lengthy paper that is aimed primarily at Latin American readers outside of Chile.

[61] First, Dourojeanni and Jouravlev [1999] describe the problems with the original allocation of water rights: speculation, accumulation and hoarding, and excessive monopoly power. They argue that these problems are serious in the case of nonconsumptive rights and the electric sector and relatively unimportant in the case of consumptive rights and agriculture. They also describe the Chilean government’s proposed Water Code reforms that have been aimed at correcting these problems. Second, they analyze the various factors that explain why water markets have been so inactive in Chile and why water rights transactions have been so uncommon. Here they repeat the analyses of the previous works already discussed.

[62] Third, they examine the problems caused by the Water Code’s inadequate regulation of externalities, both in the government’s original granting of water rights and in the subsequent transfers of water rights. Their discussion includes several different kinds of externalities: (1) externalities involving return flows, i.e., the relations between upstream and downstream water uses and water rights; (2) externalities involving in-stream effects, including in-stream flow protection for environmental purposes as well as the coordination of extractive and in-stream water uses (i.e., consumptive and nonconsumptive uses); and (3) externalities involving the impacts on “areas of origin,” meaning areas whose water supplies are sold or exported (here their concern is mainly for rural farming communities and indigenous communities).

[63] In this context, Dourojeanni and Jouravlev [1999] also describe the weaknesses of existing institutional procedures for reviewing third-party effects and resolving conflicts. Finally, they conclude with a brief summary of the Water Code’s economic achievements. The authors’ main purpose, however, is to counter the generally positive images that have dominated most descriptions of the Chilean experience, and in this they differ from Vergara and Donoso, who support the Water Code even as they recognize some of its problems.

[64] The government’s National Water Policy is another important document, although not a research publication, that shares the general diagnoses summarized above [Dirección General de Aguas, 1999].

## 7. Limarí River Basin: Poster Child for Chilean Water Markets

[65] One particular river basin in north central Chile has attracted ever more national and international attention through the 1990s: the Limarí River and its tributaries. The Limarí River Basin is the one example that is widely agreed to have an active and successful agricultural water market, including both temporary rentals and permanent sales, and even local real estate agents who broker and facilitate water rights trading. The Limarí Basin is the place that foreign economists come to study and that the Water Code’s boosters prefer to talk about [Bauer, 2004].

[66] The Limarí River Basin has three factors in its favor that are not combined anywhere else in Chile. First and most important, the basin has adequate water storage capacity, thanks to three reservoirs built by the national government

between the 1930s and 1970s that are still operated and maintained by the Ministry of Public Works. These reservoirs are for irrigation purposes only. Second, the local water users' associations are, for the most part, well organized, and their canal infrastructure is well maintained. Third, the local climate is sunny, hot, and dry, making excellent conditions for growing high-value fruit crops for export. For all these reasons the water rights market is dynamic. It is important to keep in mind, however, that irrigation is by far the most important water use and that the agricultural sector overwhelmingly dominates water rights trading.

[67] The most careful and sophisticated study of the Limarí water market was completed by *Hadjigeorgalis* [1999]. Her study illustrates the intricacies of defining water rights in practice, as described above, and presents a rich and detailed description of a complex system of three reservoirs and their associated canals, known as the "Paloma system" after the name of the largest reservoir. She examines both short-term transactions (the "spot water market") and permanent water rights sales. Her empirical analysis is obviously based on intensive fieldwork of a kind far too rare in Chilean water issues.

[68] In discussing the water rights in the Paloma system, *Hadjigeorgalis* [1999] makes a crucial distinction between their physical location and their legal source: for a given water right, different reservoirs may be involved. This is because the Paloma reservoir, the largest as well as the last of the three reservoirs to be built, was built to increase the irrigation security of the valley by unifying and integrating the preexisting water distribution systems. The result was that a large number of water rights that formerly were supposed to be delivered via rivers or stored in the two smaller reservoirs were relocated to the Paloma reservoir (in other words, the water corresponding to those rights was physically transferred). The distinction between the physical and legal sources of water rights leads *Hadjigeorgalis* to distinguish between physical and institutional constraints on water rights trading. Institutional constraints are defined as those imposed by local canal associations to prevent third-party impacts.

[69] Short-term trading is allowed between farmers within the same physical sector of the system, that is, between those who share the same reservoir, regardless of the legal sources of the water rights involved. In the permanent water rights market, in contrast, "the universe of possible trades is determined by both the physical and legal location of the water right." This is because physical constraints prevent transferring rights between different reservoirs, while institutional constraints prevent trading rights "that are stored within the same reservoir, but that have different legal locations" [*Hadjigeorgalis*, 1999, p. 28]. *Hadjigeorgalis* then presents a range of data about the nature of water rights transactions and price behavior, describing and comparing the spot markets and permanent markets in the different sectors of the overall reservoir system.

[70] *Hadjigeorgalis* concludes that the Limarí water market has operated efficiently and has had important benefits for both buyers and sellers. There is abundant evidence that water has been frequently reallocated to higher-value uses within the reservoir system. In addition, the market has provided farmers with the flexibility to manage some of the risks caused by uncertainties in water supplies and in

agricultural markets. Poor farmers, for example, have been able to lease their water rights to other farmers during drought years, when water prices are high and income from irrigation is uncertain.

[71] As *Hadjigeorgalis* herself points out, however, her study looks only at the water market within agriculture and only at the country's most unusual case. In this sense, the very success of the Limarí water market seems to be the exception that proves the rule. Readers of publications about Chilean water markets should be alert to the common and misleading tendency of many authors to discuss the Limarí example as if it were representative of the rest of the country [e.g., *Briscoe*, 1996, p. 21; *Instituto Libertad y Desarrollo*, 2003].

## 8. Issues Missing From Research About Chilean Water Markets

[72] The work summarized above indicates fairly broad agreement about the empirical description of Chilean water markets, at least among people who are knowledgeable about them. This consensus is striking given that these authors have different theoretical and disciplinary perspectives and different positions on the Water Code in general. The consensus about how these markets have worked does not extend to the policy implications, such as what reforms might be advisable, but the gradual accumulation of research in this area has sorted out the confusion caused by conflicting accounts about the basic facts in the first half of the 1990s.

[73] What is equally striking, however, especially to the outside observer, is what has been missing from research about Chilean water markets, namely, the impacts on social equity, environmental sustainability, river basin management, coordination of multiple water uses, and resolution of water conflicts. These issues are often mentioned in political debates, albeit in general or rhetorical terms, and they are sometimes mentioned in passing in academic and policy research, but rarely have they been studied. Researchers have paid so much attention to the economic and legal aspects of water rights trading that they have virtually ignored these other issues of water management and institutions.

[74] For example, some of the World Bank publications about Chilean water markets have recognized the absence of effective river basin institutions and the flaws of existing arrangements for coordinating multiple water uses and resolving water conflicts. Nevertheless, the authors describe such problems either as pending challenges for the Chilean government or as issues for future study but which, in any case, are secondary matters in relation to their overall positive assessment of the Chilean experience [*Briscoe et al.*, 1998, pp. 6–8; *Hearne and Easter*, 1995, pp. 40–41].

[75] Furthermore, nearly all of the research on Chilean water markets has focused only on consumptive water rights: i.e., those used for irrigation or urban consumption. Nonconsumptive rights have presented serious problems of private speculation and monopoly power and have generated serious conflicts between farmers and hydroelectric companies over how to manage dams, reservoirs, and river basins, but because these rights have rarely been traded in markets, they have been left out of most empirical

studies. The problems posed by nonconsumptive rights point to the deeper flaws of the current legal and institutional framework, determined by Chile's Constitution as well as the Water Code, such as the weakness of the DGA and the erratic and legalistic behavior of the courts. These flaws have shown the framework's inadequacy in core matters of regulatory governance, including resolution of conflicts, definition and enforcement of property rights, and internalization of externalities. (Limits of space prevent further discussion of these issues here [see *Bauer*, 1998a, 1998b, 2004].)

[76] The absence of research on these social, environmental, and institutional issues is critical for two reasons: first, these issues are at the center of contemporary international debates about water policy reforms and integrated water resources management, as summarized at the beginning of this paper; second, the available evidence suggests that these issues are, in fact, serious problems in Chile, as I have argued elsewhere in more detail [*Bauer*, 1998b, 2004]. In short, the general state of knowledge about Chilean water markets is incomplete in many of the areas of greatest international concern. The fact that these problems have been secondary in research about the Chilean model points to one of the broader lessons to be learned from the Chilean experience: There has been too narrow a focus on the economic aspects of water markets, at the expense of other issues and analytical perspectives.

## 9. Summary and Conclusions

[77] After more than 20 years, we can assess the empirical results of Chile's experiment with unregulated water markets in at least two ways: by comparing them to the 1981 Water Code's original objectives and by comparing them to the issues considered critical for IWRM. The law's two main objectives were to strengthen private property rights, particularly in the agricultural sector, and to foster free-market incentives in water use and allocation generally. The law has been more effective in meeting the first objective: (1) The legal security of private property rights has been strengthened, which has encouraged private investment in water use, infrastructure, and management in some areas. (2) The counterreform in agrarian land tenure has been consolidated. (3) Government regulation of water use and water management has been tightly restricted. (4) The freedom to trade water rights has allowed reallocation of water resources in certain circumstances and geographic areas. (5) The autonomy of canal users' associations from government has been affirmed, which in some cases has encouraged them to improve their organizational capacity; however, this applies only within the agricultural sector and does not include nonagricultural water uses. (6) The creation of nonconsumptive water rights has encouraged hydroelectric power development, first by government enterprises and later by private companies, although not without serious and uncompensated impacts on other water users.

[78] The Water Code has been much less effective in achieving objectives having to do with the operation of water markets and market incentives: (1) Market incentives to promote more efficient water use, particularly within the agricultural sector, have not worked as expected. Irrigation efficiency remains low nationwide, and in the few areas

where it has increased the change reflects factors other than the water market, namely, investment to improve crop yields or reduce costs of labor and canal maintenance. Investment in these areas has been encouraged by the legal security of property rights but not by market incentives to sell unused water rights. (2) The government has had to continue to subsidize the construction and maintenance of irrigation works at small, medium, and large scales. (3) Examples of significant market activity, as indicated by the frequency of water rights transactions or the amount of water resources reallocated, remain limited to a few areas of the desert north and the metropolitan area of Santiago. (4) The definitions of water rights remain vague or incomplete; the legal and technical details are inadequate and confusing in most of the country. (5) The idea that water market forces would benefit peasants and poor farmers by improving their access to or ownership of water supplies has generally failed. (6) Reliance on private bargaining to coordinate different water uses and resolve river basin conflicts, particularly between consumptive and nonconsumptive water rights, has failed, and neither the DGA nor the courts have adequately filled the gap. (7) In the hydroelectric sector, nonconsumptive water rights have been subject to problems of speculation, concentrated ownership, and private monopoly power.

[79] The mixed performance of Chilean water markets is due to the variety of factors that shape their wider social, institutional, and geographic contexts. Institutional arrangements, i.e., the rules of the game, have been among the most important of these factors. The Water Code's laissez-faire definition of property rights has had a strong impact on the specific economic incentives and disincentives that are faced by water users and water rights owners.

[80] The most negative results of the Water Code have involved issues that were of little concern in Chile 20 years ago but that have emerged as ever more critical since the 1990s. These are the economic, environmental, social, and political problems that lie at the heart of contemporary international debates about IWRM and water governance: (1) the management of river basins, coordination of multiple water uses, and conjunctive management of surface water and groundwater; (2) the resolution of water conflicts through either judicial or non-judicial processes; (3) the internalization of both economic and environmental externalities; (4) the clarification, enforcement, and monitoring of the relationships among different property rights and duties, such as consumptive and nonconsumptive water rights; (5) environmental and ecosystem protection, including the maintenance of in-stream flows for environmental purposes; and (6) public assistance to poor farmers to improve social equity in matters of water rights and water markets.

[81] Under the current Chilean institutional framework, these issues have generally been addressed in an ad hoc or ineffective manner and in some cases have not been addressed at all. Many of these flaws in the existing framework have been widely recognized by Chilean water experts, regardless of their political viewpoints. In addition to those cited above, Humberto Peña, who has been the head of DGA since 1994, made a similar assessment in his own review of the Water Code's first 20 years [*Peña*, 2001].

He said that the law was strongest in its treatment of the economic aspects of water use, though not without problems, and weakest in environmental and social aspects, and he emphasized that IWRM was simply not considered in 1981.

[82] Because the Water Code did not address these issues, it may be unfair to criticize the code for its failure to solve them. However, that is not the point here. Rather, the larger point is that after more than 20 years of experience, the current legal and institutional framework, which is determined by Chile's Constitution as well as by the Water Code, has shown itself incapable of handling these unforeseen problems and highly resistant to reform. The current framework is characterized by a combination of elements that reinforce each other to maintain the status quo: strong and broadly defined private economic rights, tightly restricted government regulatory authority, and a powerful but erratic judiciary that is untrained in public policy analysis, reluctant to intervene in issues with political implications, and committed to a narrow and formalistic conception of law. The problems of water management will only get worse as the demands and competition for water continue to increase, putting ever more pressure on an institutional framework that is already obsolete in crucial respects [Bauer, 2004].

[83] The performance of the broader institutional framework, including the judicial and political systems, is not usually included in discussions about water markets. The Chilean experience makes clear, however, that water markets involve more than simply trading water rights, whether or not the trading is efficient. Chile's free-market approach to water law and economics has had major institutional consequences for other issues of water management and water governance. Because water markets do not exist in isolation from those issues, either in Chile or anywhere else, we can answer the question posed at the beginning of this paper: The Chilean model is not compatible with integrated water resources management.

[84] **Acknowledgments.** This article has been adapted from portions of the author's recent book, *Siren Song: Chilean Water Law as a Model for International Reform* [Bauer, 2004]. This research was supported by Resources for the Future and by a grant from the William and Flora Hewlett Foundation.

## References

- Alegría, M. A., F. Valdés, and A. Lillo (2001), El mercado de aguas: Análisis teórico y empírico, paper presented at 4th Water Law Conference, Catholic Univ. Law School, Santiago, Chile, 19–20 Nov.
- Bauer, C. (1993), Los derechos de agua y el mercado: Efectos e implicancias del Código de Aguas Chileno de 1981, *Rev. Derecho Aguas*, 4, 17–63.
- Bauer, C. (1997), Bringing water markets down to earth: The political economy of water rights in Chile, 1976–1995, *World Dev.*, 25(5), 639–656.
- Bauer, C. (1998a), Slippery property rights: Multiple water uses and the neoliberal model in Chile, 1981–1995, *Nat. Resour. J.*, 38, 109–155.
- Bauer, C. (1998b), *Against the Current: Privatization, Water Markets, and the State in Chile*, Kluwer Acad., Norwell, Mass.
- Bauer, C. (2004), *Siren Song: Chilean Water Law as a Model for International Reform*, RFF Press, Washington, D. C.
- Briscoe, J. (1996), Water as an economic good: The idea and what it means in practice, paper presented at World Congress of the International Commission on Irrigation and Drainage, Cairo, Egypt, Sept.
- Briscoe, J., P. Anguita, and H. Peña (1998), *Managing Water as an Economic Resource: Reflections on the Chilean Experience*, Environ. Dep. Pap. 62, World Bank, Washington, D. C.
- Cosgrove, W., and F. Rijsberman (2000), *World Water Vision: Making Water Everybody's Business*, World Water Council, London.
- Dirección General de Aguas (1999), Política Nacional de Recursos Hídricos, Minist. de Obras Públicas, Santiago.
- Donoso, G. (1999), Análisis del funcionamiento del mercado de los derechos de aprovechamiento de agua e identificación de sus problemas, *Rev. Derecho Admin. Econ.*, 1(2), 295–314.
- Donoso, G., J. P. Montero, and S. Vicuña (2001), Análisis de los mercados de derechos de aprovechamiento de agua en las cuencas del Maipo y el Sistema Paloma en Chile: Efectos de la variabilidad de la oferta hídrica y de los costos de transacción, *Rev. Derecho Admin. Econ. Recursos Nat.*, 3(2), 367–387.
- Dourojeanni, A., and A. Jouravlev (1999), El Código de Aguas de Chile: Entre la Ideología y la Realidad, *Ser. Recursos Nat. Infraestructura* 3, Div. de Recursos Nat. e Infraestructura, La Com. Econ. Para América Latina (CEPAL), Santiago.
- Gazmuri, R., and M. Rosegrant (1994), Chilean water policy: The role of water rights, institutions, and markets, in *Tradable Water Rights: Experiences in Reforming Water Allocation Policy*, pp. 35–70, U.S. Agency for Int. Dev., Washington, D. C.
- Global Water Partnership (2000a), *Toward Water Security: A Framework for Action*, Stockholm.
- Global Water Partnership (2000b), Integrated water resources management, *Tech. Adv. Comm. Background Pap. 4*, Stockholm.
- Hadjiageorgalis, E. (1999), Private water markets in agriculture and the effects of risk, uncertainty and institutional constraints, Ph.D. dissertation, Dep. of Agric. Econ., Univ. of Calif., Davis.
- Hearne, R. (1998), Institutional and organizational arrangements for water markets in Chile, in *Markets for Water: Potential and Performance*, edited by K. W. Easter, M. Rosegrant, and A. Dinar, pp. 141–158, Kluwer Acad., Norwell, Mass.
- Hearne, R., and K. W. Easter (1995), Water allocation and water markets: An analysis of gains-from-trade in Chile, *Tech. Pap. 315*, World Bank, Washington, D. C.
- Instituto Libertad y Desarrollo (2003), Reforma al Código de Aguas: Otro paso atrás, *Temas Públicos* 624, Santiago.
- International Conference on Water and the Environment (1992), The Dublin Statement and Report of the Conference, paper presented at International Conference on Water and the Environment: Development Issues for the 21st Century, World Meteorol. Organ., Dublin, 26–31 Jan.
- Jarvis, L. (1988), The unraveling of Chile's agrarian reform, 1973–86, in *Searching for Agrarian Reform in Latin America*, edited by W. Thiesenhausen, pp. 240–275, Chapman and Hall, New York.
- Peña, H. (2001), 20 años del Código de Aguas: Visión desde la administración, paper presented at 4th Water Law Conference, Catholic Univ. Law School, Santiago, 19–20 Nov.
- Ríos, M., and J. Quiroz (1995), The market of water rights in Chile: Major issues, *Tech. Pap. 285*, World Bank, Washington, D. C.
- Rogers, P., and A. Hall (2002), Effective water governance, report, Global Water Partnership, Stockholm.
- Rosegrant, M., and H. Binswanger (1994), Markets in tradable water rights: Potential for efficiency gains in developing country water resource allocation, *World Dev.*, 22, 1613–1625.
- Solanes, M. (1996), Mercados de derechos de agua: Componentes institucionales, *Rev. CEPAL*, 59, 83–96.
- Vergara, A. (1998), *Derecho de Aguas*, Ed. Jurídica de Chile, Santiago.
- World Bank (1993), *Water Resources Management: A World Bank Policy Paper*, Washington, D. C.
- World Bank (1994), Peru: A user-based approach to water management and irrigation development, *Rep. 13642-PE*, Washington, D. C.

C. J. Bauer, Resources for the Future, 1616 P Street, NW, Washington, DC, 20036, USA. (bauer@rff.org)