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Abstract[1]

This paper explores the motivations and facilitators of ISO 9000 and ISO 14000 diffusion in Latin America. In particular, it analyzes how the internationalization and liberalization of these economies, accompanied by central government and industry policies aiming to support basic and technological infrastructures, affected their diffusion. Relying on nationally aggregated Latin American data for the period 1995-2005, and on firm-level data from the Chilean salmon farming industry, we find that exposure to international markets encourages compliance with these standards. Still, certification relies heavily on learning and capability building within firms, as well as on the institutional and infrastructural development at industrial and national levels.

Keywords: globalization, technological infrastructures, certification, capability, Latin America, Chile

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1. Introduction

International management standards (IMS) such as ISO 9000 and ISO 14001 emerged and spread widely around the world in the 1990s as the globalization process was consolidating. Increasingly, firms are required to certify using IMS to access deregulated, common or international markets, especially supply-chain production networks (Withers & Ebrahimpour, 2000; Larsen & Häversjö, 2001; King *et al.*, 2005; Graham & Woods, 2006).

IMS are codes of management practice. They may have special importance for the upgrading of capabilities and competitiveness of firms in developing countries where domestic public regulatory bodies and pressures from consumer groups tend to be absent or weak (UNIDO, 2005; Graham & Woods, 2006). Hence, some authors argue that by creating incentives for indigenous firms to conform to IMS, openness to international capital and markets may lead to self-regulation of social, quality and safety issues in developing countries (Christmann & Taylor, 2001; Graham & Woods, 2006; Yeung & Mok, 2005). Others instead stress that in developing countries, diffusion of compliance with IMS involves a long learning process at both firm and national level because adopting a standard requires technical and organizational knowledge (Hatanaka et al., 2005; Jaffee and Masakure, 2005). Moreover, as the competitiveness of developing countries increasingly depends on the capabilities of firms to obtain certification, IMS may deter their access to foreign markets, entry into global markets and production for global supply-chains (Reardon & Farina, 2002; Hatanaka et al., 2005; Jaffee & Masakure, 2005; UNIDO, 2005). Despite their importance, the study of how conformance IMS can be fostered in developing countries has not been fully explored.

In Latin America (LA), many countries undertook an 'open policy' in regard to international trade and capital in the 1990s. This policy has transformed the industrial and export structure of many LA countries. In particular, it has led to an increase in the exports of non-traditional natural resource-based products (ECLAC, 2002). In tandem with this, ISO 9000 and ISO 14001 certificates grew at a faster rate than in the rest of the world, especially from the late 1990s in LA (ISO, 2005).

This paper explores the motivations and facilitators underlying adoption of the ISO 9000 and ISO

14001 IMSs in LA. In particular, we analyze the impact of global integration and liberalization of LA economies, as well as of institutional and infrastructural development on the diffusion of compliance with IMS, at both macro and micro level. For this purpose, we first analyze at the macro level the underlying factors supporting diffusion of ISO 9000 and ISO 14001 certification in LA, as well as the industrial pattern of diffusion when compared with the world average. Then, using firm-level data for one of the most successful non-traditional natural resource export industries in the region, Chilean salmon farming, we explore in depth the motivations and facilitators of certification.

This paper suggests that in LA, exposure to international markets and knowledge created awareness and encouraged the decision of compliance with IMS by LA firms. Still, certification depended greatly on the capabilities of firms as well as on the development of adequate national institutions and infrastructures. Hence, compliance with IMS in developing countries depends on the technological capability within firms, as well as on the national and industrial efforts in institutional and standardization development, and in the provision of basic and technological infrastructures.

2. Standardization, certification, trade and development

This section reviews the context in which IMS emerged and diffused, as well as the required capabilities to achieve certification. In particular, we stress differences between the main motivations, expected outcomes and requirements for firm certification in developed and developing countries. Standards have been set by supply-chains and large buyers to govern the efficiency and quality of products and delivery, by buyers to procure delivery and management contracts and by national and international standardizing bodies[to do what? For instance to simplify . This paper focuses on the adoption of standards published by international standardizing bodies, especially on the voluntary process standards ISO 9000 and ISO 14001, which set guidelines for the implementation of a quality and an environment management system, respectively.

2.1 The context of emergence and diffusion of international management standards

Since the 1980s, as performance in international trade came to be increasingly explained by non-price competitiveness factors, testing and measurement standards became a source of competitive advantage and a way of defining market barriers (Temple & Urga, 1997). Consequently, increasing public efforts to control and signal the quality of national products and firms have been put in place in developed countries through standardization and the related building of infrastructure for supporting standardization process (Swann et al., 1996; Temple & Urga, 1997). In fact, ISO 9000 is based on the British standard BS5750, published in 1979, and widely promoted from 1981 in the UK and abroad, among British suppliers and affiliated companies (NAO, 1990).

Apart from the national and public standardization efforts, large firms started setting their own quality management standards to improve continuously through their supply base (improve quality, delivery and productivity, increase capacity, reduce lead times) as they increased global integration of production and outsourcing practices (Klassen & Vachon, 2003; Modi & Mabert, 2007).

Given the increasing importance of quality management systems and of confusing co-existence of multiple national and private standards, the International Standards Organization (ISO) published, in 1987, ISO 9000, as an international standard for quality management to facilitate certification procedures and to foster international trade. ISO 9000 was updated in 1994 and 2000. The third-party certification of conformance with standard is first introduced in 1994. ISO 9000 was followed by other IMS such as ISO 14001, the standards for environmental management published in 1996 and updated in 2004, and HACCP, a safety management standard for chemical, physical and biological hazards. These two later IMS were responses to pressures from consumer groups in developed countries on issues related to environmental impact, safety and health conditions, and consequently they became an important issue for large global buyers. Certification with these IMS also diffused quickly, especially after the publication of ISO 9000:2000, which facilitated the combined certification with other standards, in particular ISO 14001 (ISO, 2005).

In this manner, during the 1990s, IMS became increasingly important for coordinating international

production and accessing international markets. Therefore, in both developing and developed countries, major surveys and studies find that most firms identified “fulfilling the requirements of customers” as the first reason for adopting ISO 9000 and ISO 14001 certification. Indeed, governments, large buyers and multinationals have been requesting suppliers and contractors to certify (Ringe & Nussey, 1994; Larsen & Häversjö, 2001; Guller et al., 2002; Pan, 2003; King et al., 2005). Thus, complying with these voluntary IMS is not a 'choice' but a 'prerequisite' for market entry, in global as well as in some domestic markets, such as new deregulated sectors and provision of outsourced public services (Chu et al., 2001). Multinationals and supply-chains, which require certain standards of suppliers, become one of the most important channels for the diffusion of certification (Larsen & Häversjö, 2001; Guller et al., 2002; Pan, 2003; Klassen & Vachon, 2003; King et al., 2005). Foreign direct investment has also been a means for the diffusion of certification (Christmann & Taylor, 2001; Yeung & Mok, 2005). Requirement of certification from suppliers seems to be the first step of firms' strategy to enhance suppliers' capabilities through training and diffusion of manufacturing and production techniques (Modi & Mabert, 2007). Indeed, within groups, ISO 9000 seems to assure compatibility of business processes between the different affiliates (Blind & Hipp, 2001; Larsen & Häversjö, 2001; Pan, 2003). Moreover, as certification requires the qualification of suppliers, many firms meet this requirement by ordering their suppliers to certify; therefore, in supply-chains, IMS tend to prevail (Stevenson & Barnes, 2002).

Certification can be viewed as a signaling device used by firms to maintain or increase their market share (Bénézech et al., 2001; Blind & Hipp, 2001; Pan, 2003). Achieving external legitimation and avoiding negative image effects were also found as important motivations for certification (Bansal & Roth, 2000; Pan, 2003; King et al., 2005). Consequently, firms were found to decide to certify if many of their competitors had done so (Pan, 2003).

Despite being codes of specific management technologies, the adoption of IMS might not lead to systemic outcomes in terms of improvement in the firm's performance. Financial and economic benefits (such as positive return on investment, financial performance, stock market gains or market share increase) from certification are difficult to prove empirically, especially in developed countries

(Curkovic & Pagell, 1999; Withers & Ebrahimpour, 2000; Lima et al., 2000; Delmas, 2002; Martinez-Lorente & Martinez-Costa, 2004; Casadesús & Karapetrovic, 2005; Terlaak & King, 2006). Evidence seems instead to support the conclusion that observed benefits from adoption of IMS are primarily related to internal organizational and managerial improvements, such as product conformity and reliability, customer satisfaction awareness, and process efficiency (Withers & Ebrahimpour, 2000; Delmas, 2001; Pan, 2003; Casadesús & Karapetrovic, 2005, King et al., 2005). These organizational benefits seem to reflect the fact that certification requires a review of design and production methods and the development of control management systems. Indeed, many studies find that after customer requirements (i.e. access to markets), the most important reason for firms certifying, is the expectation of improving process efficiency (Withers & Ebrahimpour, 2000; Bansal & Roth, 2000; Larsen & Häversjö, 2001; Delmas, 2002; Benner & Tushman, 2002; King et al., 2005).

Given dissatisfaction with organizational, technological and managerial practices in developing countries, the relationship between certification and technological capability building, innovation, or productivity enhancement might be stronger in those countries (Lima et al., 2000; Christmann & Taylor, 2001; Delmas, 2002; Yeung & Mok, 2005).

In sum, firms have been mainly adopting ISO 9000 and ISO 14001 to respond to customers' requests, and to avoid potential market entry or export barriers. Hence, in developed and developing countries, certification is increasingly a permit to enter and compete in certain specific markets and firms without certification might face a penalty (i.e. inability to access that market). In particular, for firms from developing countries, certification is required to enter the market of developed countries, and consequently it is considered as one of the major challenges (Nadvi & Waltring, 2004). As IMS only describe general guidelines, which the adopting firm needs to interpret and respect to build up its quality and environmental management system (Bénézech et al., 2001), certification would require the upgrade of firms and national capabilities, as we will discuss now.

2.2. Firm and national capabilities required for achieving certification

IMS are, to a certain extent, codified versions of management knowledge; consequently, they should be easily attained by firms. Compliance with IMS; however, seems to require a considerable internal process of learning, especially for firms in developing countries. In this sense, an analogy can be drawn from the studies on technological capability that argue that the import of advanced capital goods does not automatically improve the level of technological capability, which instead involves learning through diverse means within the firm (Bell & Pavitt, 1995; Lall, 1992; Kim, 1998). Moreover, the technological capabilities of firms are highly dependent on the prevalent national capabilities, i.e. technological infrastructures, institutions, regulations and enforcement procedures, and government policies. These prevalent national capabilities may encourage or restrain firms' compliance with IMS (Lall, 1992; Potoski & Prakash, 2005).

Standards adoption and technological diffusion, especially in developing countries, tend to be constrained by lack of financial and technological resources and access to efficient technologies, as well as skills to interpret and convert standards into non-abstract general guidelines (Dahlman et al., 1987; Lall, 1992; Jaffee & Masakure, 2005). Thus, technological and basic infrastructure, such as testing and measuring facilities, training courses, information and advice services, are crucial for the diffusion of certification, along with the development of industrial and technical expert organizations (Tassey, 1996). Moreover, firms need to access financial support to acquire equipment, train their employees, and secure expert consultant advice (Jaffee & Masakure, 2005). As studies on technological capability (Abramovitz, 1986; Dahlman et al., 1987; Lall, 1992) have demonstrated, it is not only the technological, productive, linkage and managerial skills and capabilities of firms, but also the capabilities at the national and industry level to restructure market and non-market institutions that need to be enhanced in order to facilitate diffusion of certification (Hatanaka *et al*., 2005).

Noteworthy is the fact that, in developed countries in the 1980s and early 1990s, governmental and industrial associations put great effort into supporting national firms to develop quality management

systems through awareness campaigns, financial help, development of technological infrastructure and adequate business support services (NAO, 1990; M.Qualité, 1992; Ringe & Nussey, 1994). In some countries, national standards preceded the adoption of IMS. Time, cost and management involvement are found to obstruct certification in developed countries; while lack of technological infrastructures, financial resources and capabilities, as well as inappropriate national regulations and institutions are barriers to certification in developing countries (Withers & Ebrahimpour, 2000; Potoski & Prakash, 2005; Cañada & Vásquez, 2005).

Evidence from successful experiences in developing countries suggests that institutional development, such as effective and credible governmental legislation, investment and monitoring, might be required to encourage the upgrade of national firms' capabilities, certification with IMS and access to foreign markets (Reardon & Farina, 2002; Raynolds, 2004; Hatanaka et al., 2005). In particular, investment in the development of national certification programs and in the use of international as national public standards may allow the gradual improvement of national firms' capabilities for compliance with IMS standards. Moreover, these efforts may permit communicating this institutional change to foreign buyers, and improving national product reputation (Cañada & Vásquez, 2005; Hatanaka et al., 2005; Graham & Woods, 2006).

Several authors argue instead that a self-regulation model, in which firms in developing countries are led to comply with IMS on quality, environment and sanitation by multinationals and developed countries' regulation, is a solution for lack of national regulatory capability (Christmann & Taylor, 2001; Yeung & Mok, 2005; Graham & Woods, 2006). However, as some studies suggests, national efforts set by governments, industrial associations and public-private alliances may be essential to support firms in specific sectors to build capabilities to comply with IMS and access global markets (Cañada & Vásquez, 2005; Jaffee & Masakure, 2005; Graham & Woods, 2006). Moreover, policy efforts in providing financial and technical assistance are crucial to support certification and avoid exclusion from the market, especially of small firms (Hatanaka et al., 2005; Jaffee & Masakure, 2005).

This review of the literature suggests that in developed and developing countries, customer pressures, market entry barriers and increased certification of industrial competitors, are the most important motivations for firms to certify with IMS. Therefore, from the mid 1990s, ISO 9000 and ISO 14001 diffused greatly, as outsourcing of production activities, globalization of production, trade and investment, environmental concerns and more demanding customer bases were gaining special relevance. National and industrial provision of incentives and infrastructure that facilitate certification and penalize non-conformance (including publication of national standards) seem crucial for fostering capability building and the diffusion of IMS certificates. Thus, especially in developing countries, the process of learning to comply with IMS seem to require sets of capabilities at firm, industry and national levels, and these may need to be developed in certain sequences.

In the literature, the learning process of the firm which is required to obtain certification is seldom related directly to institutional and infrastructural development efforts at the industrial or national levels or to international openness. This paper aims to fill this gap by providing evidence on how liberalization and internationalization of capital and markets, economic and institutional development, as well as national and industrial policy efforts, has provided incentives and resources for firms' certification in LA. In particular, we explore the processes of capability building required for complying with IMS at firm, industry and national levels.

3. Methodology and data

3.1. Data

To analyze the facilitators of adoption of ISO 9000 and ISO 14001 in LA and to illustrate the current situation of certification in LA, we use both aggregated data and firm-level data. In particular, we use data from the ISO surveys on the total number of ISO 9000 and ISO 14001 certificates by country and by industry in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. We use data from the World Development Indicators on Gross Domestic Product (GDP), labor force, exports, net inflows of Foreign Direct Investment (FDI), payments of royalties

and licenses, share of high technology exports from total exports, share of services on GDP, and share of agriculture on GDP.

Additionally, to get more details on the factors that supported certification and capability building within firms, we use data from a semi-structured survey conducted between March and May 2004 for 62 firms. The sample includes salmon producers – salmon egg producers, alvine producers (freshwater phase), salmon growers (saltwater phase), fishmeat processors (cutting, smoking, packing) and traders (exporters) – as well as two suppliers, fish net producers and feed producers.[i]

3.2. Methodology

To explore the pattern of diffusion of IMS in LA, we proceed empirically in two steps. First, using Revealed Advantage Ratios (RAR), we compare the industrial diffusion pattern of ISO 9000 and ISO 14001 certificates in LA with the world average (Balassa, 1965; Patel & Pavitt, 1994).[ii] Second, we identify the relative importance of several factors on the diffusion of certificates, in particular the internationalization pattern of a country and its level of economic, infrastructural and institutional development. The dependent variables are the number of ISO 9000 certificates from 1995 to 2005 and the number of ISO 14001 certificates from 1997 to 2005, in each LA country. To explore the role of internationalization on the decision of firms to certify, we include independent variables as follows: the relative intensity of exports, FDI and payments of royalties and licenses on GDP, as well as the growth rates of FDI intensity and of payments of royalties. FDI may be correlated with and hence serve as an instrumental variable for the transfer of production to LA and consequently the degree of participation in global production markets, while payments of royalties and licenses may be an instrumental variable for the intensity of franchising activities and the use of international knowledge in LA. Exports may represent the degree of importance of foreign customers and their requirements of new environmental and quality models for national production.

The diffusion of ISO 9000 and ISO 14001 seems related to the outsourcing and deregulation of industries and to the private delivery of public services, and consequently to developments in the

services sector (Chu et al., 2001). In addition, their diffusion reveals the existence of adequate infrastructures and institutions that support firms' compliance, and hence the level of economic development of countries (Guller et al., 2002). Therefore, we also include in the analysis the relative size of services in GDP, the relative size of agriculture in GDP, the growth rate of the service sector, and GDP purchasing power parity per capita. Additionally, to take into account the national technological capabilities we include the share of technology-intensive exports in total exports. To control for differences in countries' size, we include the logarithm of the national labor force.

Using these panel data on time and countries, we compute negative binomial regressions of the number of certificates on the two-year lagged values of the independent variables, as the process of certification was found to take longer than a year. We use the negative binomial model rather than the Poisson model because the dependent count variables are over dispersed (i.e. the probability of adoption in a fixed interval of time is variable and hence incompatible with the Poisson distribution) (Long, 1997; Long & Freese, 2003). To get a better understanding of the levels as well as of diffusion of certificates, we run a pooled-data model using country and year dummies, as well as panel models, using both fixed and random effects. In the panel models, we include a variable 'year' to take into consideration that the penalty for not having certification increased over time.[iii] Moreover, we explore whether there were changes in the factors affecting diffusion of certificates after 2000, when the ISO 9000:2000 was published. For this purpose, we repeat the pooled and the panel analyses for each of the periods without a constant and then test the similarity of coefficients.

To get more detailed accounts of the factors that supported certification and capability building within firms – in particular on the role of liberalization of markets and capitals, as well as of public and industrial policies – we analyze the diffusion of compliance with IMS in one of the successful natural resource-based industries in LA, the Chilean salmon farming industry. By relying first on secondary qualitative sources of information, we trace the effects of national and industrial efforts to support the competitiveness of this industry through standardization and diffusion of IMS, in the last 20 years. Second, we analyze the diffusion of level of compliance with IMS and their impact on performance, as well as the motivations of compliance with IMS in the salmon industry, using data

from a semi-structured survey. Third, using Ordinal Logit models, we analyze the relative explanatory power for the level of compliance with IMS of a set of independent categorical and dummy variables related to characteristics and learning efforts of firms, openness to international markets and capital, and impact of local, industrial and national efforts to support firms' compliance.[iv] The dependent variable the *level of compliance,* which takes the value 1 if the firm finds that the standard is not necessary, 2 if the firm is planning to get a certification, 3 if the firm is in the certification process, 4 if the firm is certified. When asked about compliance with IMS, many firms contested that they have an in-house written procedure manual Code of good practice – Codigo. The degree of firms' engagement in the development and compliance with an internal written manual is then a proxy for *preparedness for implementation.* Given the small sample size, we cannot run an Heckman Probit regression (i.e.first the selection model for *preparedness for implementation* and then the selected population for *implementation).* Thus, we run separately the reduced model describing *implementation* for each IMS and the selection model describing preparedness for implementation on the variable *Codigo*.

The independent ordinal variable nmarktexp captures the export openness of the firm (0%=0, 1-30%=1, 31-60%=2, 61-90%=3, 91-100%=4), newnodes contains information on the number of market destination for export (non-exporting=0, only one market=1, more than one market=2, more than 5 markets=3). The variable property contains information on the 4 different levels of participation of foreign capital (national 100%=1, foreign 1-49%=2, foreign 50-99%=3, foreign 100%=4). Saleran includes information on 4 levels of annual sales (US$0-1.5 million =1, US$1.501-5.000=2, US$5.001-50.000=3, US$50.001-100.000=4, US$100.001 plus=5) as a proxy for firm size.

To measure firms' technological competencies, we created the dummy variable ramptrat that captures information on whether the firm has more (>20%=1) or less (<20%=0) than 20% of professional and technical staff. Moreover, we included dummy variables that capture information on the associative behavior of the firm. Newcolst captures information on whether the firm engaged in collaboration with suppliers for standards compliance, and Newcocst on whether the firm engaged in collaboration with clients for standards compliance (collaboration=1, non-collaboration=0). To

reflect differences in activities, we include three dummy variables that capture if a firm is active in salmon (active=1, non-active=0), net or feed industry; feed being the reference category. Finally, to take into consideration the impact of industrial certification efforts we include the variable Nasoc, which reports on whether the firm is member of the industrial Association of the Chilean Salmon Industry, a major policy player[v] (association member=1, non-member =0).

4. Certification in Latin America

This section analyzes the diffusion pattern of ISO 9000 and ISO 14001 certificates in LA countries, exploring differences from world averages as well as the underlying reasons for the diffusion of IMS. In particular, we explore the relationship between certification and the internationalization of LA countries and their level of economic, infrastructural and institutional development.

4.1 Patterns of diffusion of ISO 9000 and ISO 14001 in Latin America

Since 2000, the growth rate of ISO 9000 and ISO 14001 certificates in LA countries (i.e. Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela) has been higher than the world average growth, especially for the ISO 14001. In 1996, the total number of ISO 9000 certificates in LA represented 1% of the total world certificates issued. In 2000, when the ISO 9000:2000 was published, obliging a firm to build a quality system that comprises design, production, and product inspection and testing, LA certificates already represented 2.5% of the world total. Given the efforts required to conform to the new standard, in 2005, this share did not surpass 3%. The number of ISO 14001 certificates in LA represented around 2% of the world total until 2001, rising to 3% by 2004.[vi]

To explore differences between LA countries and the world in industrial certification intensities, we compute the industrial share of certification in LA and in the world and then the RAR of certification. Table 1 (column 2 and 5) shows the share of ISO 9000 and ISO 14001 certificates by industry worldwide in 2005.[vii] Results suggest that the highest average number of ISO 9000 and ISO 14001

certificates are concentrated in construction, basic and fabricated material, electrical equipment, machinery and equipment and wholesaling, followed by other services, rubber and chemicals, food, and transport, storage and communication. The lower-adopting sectors are water, gas supply, publishing, shipbuilding, aerospace, wood products, publishing and nuclear fuels. A similar industrial pattern is found in LA (Table 1, column 1 and 4).

[Table 1]

The RAR data (Table 1, column 3 and 6) suggest that industries related to the exploration and manufacturing of natural and energy resources (coke and petroleum, pulp and paper, mining, non-metallic mineral products, food, rubber and plastic, agriculture and fishing, concrete, leather) have a greater relative share of ISO 9000 and ISO 14001 certificates in LA than the world average. These high RAR in these industries are observed in all LA countries. Pharmaceuticals, aerospace, chemicals and services related to energy supply, transport and distribution, and health and social services have considerably higher shares of certificates than the world average in some LA countries.[viii] Instead, construction, and manufacturing sectors related to machinery and equipment, electrical and optical equipment, transport equipment, and wholesaling in LA fall below the world average. It is worth noting that in Chile, the share of ISO 9000 certificates in the food industry is 5.7 times higher than the world average, while the share of ISO 14001 is 14.2 times higher, for reasons to be explored further in section 5.2.

Overall, the diffusion of certificates in LA countries has occurred mainly in the same sectors as in the rest of the world. Still, the RAR figures suggest that resource-intensive sectors are more certification-intensive in LA than in the rest of the world, as well as some services and some small technology-intensive manufacturing industries like pharmaceuticals or aerospace in some LA countries. Results put forward by the RAR seem to confirm the existing literature that argues that LA countries have increased their participation in external trade of resource-intensive products rather than in technology- and capital-intensive global products (such as electronics, machinery or transport) (ECLAC, 2002). Furthermore, national deregulation and privatization of some services and some

domestic capital- and technology-intensive industries, such as pharmaceuticals and chemicals, may have fostered certification. We will now analyze the relative impact of economy-wide factors, such as liberalization of capital and markets, technological capabilities and economic and institutional development, which seem to underlie this industrial specialization of certification.

4.2 Impact of national internationalization pattern and diffusion of certification

In this section, we analyze the factors affecting the diffusion of ISO 9000 and ISO 14001 certificates in LA countries. Table 2 shows the negative binomial estimates for the number of ISO 9000 and ISO 14001 certificates in LA, using both pooled and panel analysis.

ISO 9000

The pooled data analysis (Table 2, column 1) suggests that the number of ISO 9000 certificates in LA is greater in countries with higher GDP per capita, greater labor force, larger agriculture sector as well as with increasing speed of using foreign proprietary knowledge and assets. Moreover, the higher the export and fixed-capital investment propensity of a country, and the greater the presence of FDI, the fewer the number of ISO 9000 certificates the country is expected to have.[ix]

[Table 2]

To take into account the process of diffusion over time and the within and between country differences, we analyze the results of the panel analysis with random-effects, as the Hausman test indicates this model is more appropriate than assuming fixed-effects. Results suggests that the number of ISO 9000 certificates increased with the GDP per capita, with the relative size of agriculture and services, with the export intensity of the country, and to a lesser extent with the speed to which countries were attracting more FDI and using more foreign proprietary knowledge and assets. ISO 9000 certificates also diffused as penalization for non-certification became stronger. In other words, rather than a static degree of openness, investment and country size, it has been the economic and services development and the speed of internationalization of markets, capitals and

knowledge flows that have supported the diffusion of ISO 9000 in LA. [x]

Table 3 shows the pooled and panel results for the period before and after 2000. Results suggest that there was a structural change in the diffusion of ISO 9000 in LA. According to the pooled model (Table 3, column 1 and 2), before 2000, the number of ISO 9000 certificates was larger in LA countries with a larger labor force, higher level of economic development, and technological capabilities, but with a smaller relative propensity to export and to attract FDI. From 2000, the number of ISO 9000 certificates was greater in countries with larger labor force, with relative larger investments in fixed capital, relative lower ability to export high-technology products and to attract FDI. Ceteris paribus, ISO 9000 certificates increase with increased efforts to attract FDI.

[Table 3]

Panel analysis corroborated the direction of these results (table 3, column 3 and 4). Before 2000, certification diffused more in countries that had relative lower export propensity, attracted relatively less FDI, used lesser foreign knowledge but increased the rate of using it, exported relatively more high-technology products and developed their service sectors. After 2000, certification diffused more in countries that observed an increased GDP per capita, an inversion in their industrialization and tertiarization processes, and a relatively small but increasing FDI presence, with low export intensity especially of high-technology exports. Thus, the diffusion of ISO 9000 certification is increasingly explained by the speed of national openness to international capital rather than by the speed of using foreign knowledge and assets or by the export of high technology-intensive products. Hence, it is supported by developments in agriculture and low-technology and resource-intensive manufacturing and exports, and consequently with stagnation of services development.

Overall, ISO 9000 diffusion in LA seems to be explained by national levels of economic, infrastructural, services and agriculture development, as well as (to a lesser extent) the degree to which the LA economies open to international capital, knowledge and property rights. A structural change is observed in the diffusion of ISO 9000 in LA, after the update of the standard in 2000. Thereafter, certification seems to be increasing not so much due to the raising of firms' capabilities to

use foreign knowledge and assets and to export technology-intensive products, but to the increased presence of FDI and growth of low-technology and resource-intensive manufacturing and exports.

ISO 14001

The pooled data analysis (Table 2, column 4) suggests that the number of ISO 14001 certificates is larger in LA countries with a higher level of national income per capita, larger labor force, relatively smaller agriculture sector, relatively lower but increasing levels of FDI, and with increased use of foreign knowledge and assets.[xi] To take into account the process of diffusion over time and the within- and between-country differences, we analyze results of the panel analysis with random-effects, as the Hausman test again indicates this model to perform better. Results suggest that the number of ISO 9000 certificates increased with the level of GDP per capita, national labor force, high-technology exports, relative size of services, and to a lesser extent the rate of growth of FDI. Moreover, penalties for non-certification also supported diffusion of ISO 14001 in LA. Thus, although countries with a smaller population, relatively small agriculture sector, relatively low FDI presence, and increasingly tapping into foreign knowledge have a larger number of ISO 14001 certificates; their diffusion in LA is supported by the level of economic, infrastructural and institutional development, growth of services, as well as the speed at which high-technology products exports increase, and to a lesser extent the speed in attracting more FDI. [xii]

Results on the structural change on diffusion of ISO 14001 before and after 2000 are shown it table 3. Results of the pooled model (Table 3, column 5 and 6) suggest that there was a structural change in the diffusion of ISO 14001 certificates in LA; but the panel analysis (Table 3, column 7 and 8) does not confirm it. According to the pooled model, before 2000, ISO 14001 certificates were greater in number in LA countries with higher GDP per capita, relatively high use of foreign knowledge and technology assets and export of high-technology products, relatively low export and fixed investment intensity, and slow services development. From 2000, ISO 14001 certificates were larger in LA countries with larger labor force, with faster service development, with relatively low use of foreign knowledge and low FDI presence. Hence, economic development and growth of services seem

increasingly important for the diffusion of ISO 14001 after 2000, while technological capabilities and the level of use of foreign proprietary knowledge and assets are each time less important.

Overall, the diffusion of ISO 14001 in LA seems mainly explained by the level of economic and infrastructural development, and by the capability to export relatively more technologically sophisticated products and by the speed of increasing presence of FDI, revealing the importance of a more demanding customer base for the diffusion of environmental standards. There is not enough evidence to confirm a structural change in the diffusion of ISO 14001 in 2000, when combined certification with ISO 9000:2000 was facilitated. Still, ISO 14001 certification seems to be increasingly explained by the speed of industrial (service) development, and each time less affected by the technological capabilities or the use of international knowledge and copyright.

The main difference between factors affecting ISO 14001 and ISO 9000 diffusion relates to the relative size of the agriculture sector, export intensity, and technology-intensity of exports. The diffusion of ISO 14001 seems mainly dependent on the technological capabilities of countries. Instead, the growth of the agricultural sector, improvement in the propensity to export, and greater speed in using foreign knowledge favors the diffusion of ISO 9000. These differences might reflect the fact that ISO 14001 is a relatively younger standard than ISO 9000, and despite its relevance for resource-based activities, its diffusion has only taken off in the most technology-intensive sectors.

In sum, in LA, the diffusion of ISO 9000 and ISO 14001 certification seems dependent on the level of national economic, industrial and institutional development, as well as on the speed at which national economies are entering the global production and trade of goods and knowledge. In the next section, we analyze in depth the relative importance of these and other factors supporting the diffusion of capabilities to comply with IMS in the Chilean salmon industry.

5. Chilean salmon industry

According to UNIDO (2005), food industry is considered an outlier industry given its lower

compliance level with IMS despite a high proportion of exports. In Chile, however, food is the industry with highest RAR in using ISO 9000 and 14001, compared with the rest of the world. The Chilean salmon industry, in particular, exports more than 90% of its production mainly to the USA, Japan and Europe. Conformance with IMS is therefore crucial for the competitiveness of the industry. In this section, we analyze the diffusion of certification in the Chilean salmon industry and explore the factors that facilitate this process, using both quantitative and qualitative data.

5.1 Background of the salmon industry in Chile

The Chilean salmon industry started commercial production in the mid 1980s for export. It experienced such strong growth that it became the top producer after Norway by the early 1990s. Parallel with the upward surge of exports, several initiatives to control the quality of the national product and enhance its international competitiveness were undertaken.

The first attempt to develop a quality standard for Chilean salmon was carried out by the private sector. In 1987, the Association[xiii] with the technical cooperation of the FundacionChile, a privately run institution with the public purpose of promoting technological transfer, created the private standard called ‘quality seal’ (sello de calidad). A private voluntary standard, this outlined the sanitary procedures for the fish processing plant, for exports. The Association monitored and controlled this certification, enforcing all exporting members to comply with this certification. In this way, the Association aimed at controlling and differentiating the quality of the products of member firms. This effort by the Association contributed to enhancing national competitiveness, as Chile became the biggest exporter of farmed salmon after Norway in 1992.

The public sector followed this private initiative. In particular, in 1985, the National Fishery Service (Servicio Nacional de Pesca: SERNAP, later SERNAPESCA) started developing the 'Sanitary Operation Procedure' (POS- Procedimiento Operacion de Saneamiento) and respective standard, based on the international standard HACCP- Hazard Analysis and Critical Control Point. Since the mid 1990s, SERNAPESCA has monitored and regulated the developed standard, PAC- Programa

Aseguramiento de Calidad (hereafter HACCP-PP) for farmed fish exports (interview with SERNAPESCA, 2004). Hence, all the fish-processing plants producing for export need to comply with this standard and SERNAPESCA is the official responsible for enforcing that requirement. In the early 2000s, SERNAPESCA has used the same procedure to develop and enforce HACCP-CC, as the national HACCP standard for fish farming center. The introduction of HACCP-PP by SERNAP in the mid 1990s replaced the privately initiated 'quality seal' (Alvial, 2005).

The involvement of the public sector in the standardization of quality control and the certification ensured transparency in the certification system and consequently the wider diffusion of standards. These efforts permitted firms to reduce transaction costs in searching for information or technical assistance to adopt standards, as well as to be reassured of the international credibility of these standards. Over and above these gains, such efforts supported decodifying IMS to the specificity of sector and local context and re-codifying to facilitate compliance further.

In the 2000s, international environmental concerns increased and some Chilean salmon producers started obtaining ISO 14001 certification. Aiming at responding to the market demand, in 2002, the Association and the public regulatory bodies developed the protocol Acuerdo de Produccion Limpia (APL) – Cleaner Production Agreement – to ensure that Association members would meet the agreed targets on environmental issues. From 2004, firms that participated and complied with the targets set by the APL were given the APL certificate. Despite being a voluntary scheme at industry level, this private-public collaboration for the setting of national environmental standards ensured transparency in monitoring and regulation (interview with SalmonChile, 2004).

In 2003, the Association created SIGes (Sistema Integrada de Gestions: Integrated Management System) as a voluntary best-practice code and certification scheme that incorporates several standards. Designed to facilitate the compliance with all the important standards in the salmon industry, SIGes aimed to become the umbrella standards for the salmon sector.[xiv] Consequently, SIGes is expected to demonstrate a signal of the firms' engagement in compliance with IMS, such as ISO 9000, ISO 14001 and OHSAS 18000.[xv]

Parallel to the above, the Undersecretary of Fisheries established sectoral regulation on environmental (RAMA in 2001) and sanitation (RESA in 2002) issues, involving a committee of representatives of various private aquaculture associations. This participatory regulatory process allowed policy-makers to get information on the latest developments in the market and technology as well as on the specific local conditions in which firms were operating. Stakeholders of this sector were very much aware that Chile could no longer rely on 'copying and pasting' solutions – regulations, standards, policies – from developed countries. A specific regulatory system that addresses the geographical, natural and cultural conditions of the national industry is required (interview ArmadaChile, 2004).

Overall, in the last 20 years, conscious efforts were made by both private and public sector in supporting firms attempting to upgrade their capabilities and competitiveness by means of certification. We next analyze the impact of these national investments and policies to facilitate firms' adoption of IMS.

5.2 Results and analysis of data on standards compliance

We start by analyzing the diffusion of national (HACCP-PP, HACPP-CC, APL, SIGEs) and international (ISO 9000, ISO 14001, OHSAS 18000) standards, as well as the motivations of Chielan salmon producers for engaging in the process of certification. Table 4 shows for each standard recognized as important for the salmon industry, the level of compliance with international and national standards and their performance. The national HACCP-PP is the most widespread standard among salmon producers, followed by ISO 9000 and HACCP-CC. A group of industrial, national and international standards follows these, such as SIGes, ISO 14001 and OHSAS 18000. The high positive and significant Spearman's correlation coefficients between levels of compliance with different standards suggests that conformance with national standards is not a substitute for IMS. Thus, the industrial and national efforts towards standardization and codification of quality, safety and environmental best-practices seem to support national firms to upgrade their capabilities to conform to IMS. The conformance with national quality and safety standards may allow firms

developing the capabilities to certify with IMS. Concerning performance, certified firms are mostly better off than three years before. Moreover, the share of better performing firms is higher among certified firms, except for HACC-PP, than among firms that considered certification not necessary. Firms that were planning or in the process of obtaining a certification had similar average performances in the last three years.

[Table 4]

Table 5 shows the reasons considered important or very important for firms that certified or were in process of certification. Firms say that they engage in certification mainly to increase their value added as well as to respond to the demand from customers and market pressure, but also to improve their image. Compliance with national regulations and demand from industry association are also important but scored relatively lower. Thus, conformance with standards seems mainly a reactive decision of firms to increase their value added and respond to their customers' requests, in which the national standards might have had a role of guiding these firms in a certain learning direction.

[Table 5]

To understand the relative role of international market pressure as well as of the national policy efforts towards standardization and certification on the decision of Chilean salmon producers to comply with standards, Ordinal Logit models are computed for the categorical variable level of compliance with standards.[xvi] Table 6 provides the Logit estimates on the compliance with standards. The estimates of compliance with HACCP-PP, HACCP-CC and APL do not provide good fits due to the small number of observations and consequently small variance in the sample. Notably, these standards were set, promoted and monitored by public bodies to upgrade the national products.

[Table 6]

As for ISO 9000, results suggest that the level of compliance is higher for firms with larger sales that collaborate with suppliers, are active in net or feed industries, and to a less extent among the greater exporters. The level of compliance with ISO 14001 is also expected to be higher for firms that are

active in feed or net activities, and to a less extent for firms that collaborate with suppliers in obtaining certification. The level of compliance with OHSAS 18000 is higher among firms with larger sales, with domestic capital and exporting greater shares of production but to a small number of destinations. The level of compliance with SIGes is higher for member firms of the Association.

P*reparedness for implementation of IMS,* i.e. the degree of firms' engagement in the development and compliance with an internal written manual is higher in firms that are members of the Association, use a greater share of technical human resources, and export greater shares of their production but to a small number of markets. Moreover, Codigo is more likely among net producers.

Therefore, besides size of the firm or its market, individual firm efforts and capabilities, being a member of the Association and cooperating with local suppliers are of major importance for compliance with IMS. As the earlier brief historical description suggests, the importance of being a member of Association for the level of compliance reflects the efforts required beyond the firm to improve their competitiveness in international markets. Firms involved in using the existing informational and technological infrastructures to improve their competencies and competitiveness are more likely to engage in compliance with IMS. Concerning the importance of collaboration for certification, it should be noted that from the late 1990s, the emphasis on traceability of food-related products in international markets as well as increased competition pressures, led firms to concentrate on their core activities and outsource many activities that firms withheld (Montero, 2002). Therefore, as firms' dependence on suppliers for auxiliary activities has increased significantly, conformance to IMS increasingly requires collaboration with suppliers. As in all processes of technological catch-up, the development of linkage capabilities at both firm and national level is crucial (Lall, 1992).

Overall, the analysis of the Chilean Salmon industry confirms what was put forward by the macro analysis that access to external markets created in firms the need to comply with IMS and increase their value added. However, it also shows that external exposure alone would not enable firms to fulfill the standards requirements, and improve performance. The national and industrial standardization and infrastructural efforts, often based on private-public collaboration and on

industry associations together with producer-supplier collaboration, played a crucial role in supporting salmon farmers to upgrade capabilities and conform to IMS.

6. Conclusions

This paper has aimed at analyzing the motivations and facilitators underlying adoption of international quality and environmental standards, such as ISO 9000 and ISO 14001 by firms in LA. It has done that by analyzing both aggregated data on the national and sectoral number of certificates in LA countries as well as firm-level data on the Chilean salmon industry.

This paper has shown that the diffusion of ISO 9000 and ISO 14001 in LA is positively associated with the national levels of development, including the development of service sectors, as well as with the speed at which LA economies open to foreign markets and capital and tackle foreign knowledge. In particular, after 2000, the speed of attracting more FDI, the growth of the agricultural sector and participation in trade in (so-called) low-technology products have become more important means of ISO 9000 diffusion than the degree to which economies are using international knowledge and copyrights, exporting high-technology exports and developing their service sector, which were motivating diffusion before 2000. Thus, despite having occurred mainly in the same sectors as in the rest of the world, the diffusion of certificates is wider in LA than for the world average in resource-intensive sectors. In some countries, diffusion is also relatively wider in some services such as transport and distribution or health and social services, and some small technology-intensive manufacturing sectors such as pharmaceuticals or aerospace. Most of these sectors have the lowest shares of world certificates, but they are of particular importance in LA economies, which suggests the strong association of certification and export capacity in LA. This may also be confirmed by the fact that certification in LA has increased faster than in the rest of the world in a period of liberalization of the LA economies in international markets and capital.

Focusing on the Chilean salmon industry, we find that firms indeed feel the need to comply with IMS when aiming to access international markets, mainly due to increase their value added and respond to

requests from customers in developed countries. However, that external exposure alone would not enable firms to fulfill the standards required by multinationals or by the institutional and regulatory framework of developed countries. Instead, membership of the Association and collaboration with suppliers seem particularly important in supporting compliance with IMS. Thus, despite many studies on globalization emphasizing the diminishing role of national government and local institutions, our analysis seems to reveal that international competitiveness of salmon farmers depends on an ability to mobilize resources collectively towards technological and institutional improvement as well as on firm-level capability.

The presence and development of institutional and technological infrastructures are essential to the upgrading of firms' capabilities and consequently their ability to comply with IMS. Selected and timely policy support for the development of institutional and technological infrastructures (including national standardization efforts) appears essential for the diffusion of firms' compliance. Moreover, as our evidence suggests, private-public collaboration in the design of infrastructures and institutions, and producer-supplier collaboration towards creating innovative responses to their market, are crucial in the development of firm and sectoral capabilities, and consequently for their international competitiveness. Quicker and customized responses in changing environments increasingly require polices to facilitate different types of collaboration and alignment of interests, as well as to keep the pace with international standards, and foster national participation in standard negotiations in low and high technology industries.

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[i] Integration of tasks in the sample varies from single tasking to multiple tasks, with over 50% of the firms conducting more than 3 functions (egg production, salmon growing and processing).

[ii] The RAR gives clear information on whether the intensity of certification in one sector is larger or smaller than the average world intensity. Values higher than one reveal higher than average intensity of certification. Values lower than one reveal lower than average intensity. The RA for the use of practice *i* in the sector *j* is a variation of the Balassa (1965) revealed comparative advantage ratio and of the Patel and Pavitt (1994) revealed technological advantage ratio, and is computed as follows:

$$RA = \frac{\frac{\sum_{i}^{m} P_{ij}}{\sum_{k}^{n} F_{kj}}}{\frac{\sum_{i}^{m} P_{i}}{\sum_{k}^{n} F_{k}}}$$

[iii] Using the Multivariate augmented Dickey-Fuller test, we found that panels of ISO 9000 and ISO 14001 lagged two years are stationary (Sarno and Taylor, 1998).

[iv] Given the reduced number of observations, we use categorical rather than discrete variables to reduce the risk of spurious the analysis of variance, when using them together with other dummy and ordinal variables.

[v] APSTC- Associacion de Productores de Salmon y Trucha de Chile, which later became SalmonChile.

[vi]Brazil has the highest number of certificates in LA, followed by Argentina, Chile and Colombia. When considering the number of ISO 9000 certificates per number of employees (or per GDP in constant 2000 dollars), Argentina and Uruguay have a higher rate of certificates per employee in 2005 (3 certificates per 10,000 employees in 2005) followed by Chile and Colombia with 2 per 10,000 employees, and next Brazil with 1. Concerning ISO 14001 certificates, Chile has the highest intensity at 0.4 per 10,000 employees, followed by Uruguay (0.3), Argentina, Brazil (0.2) and Colombia (0.1).

[vii] Data at industry level in LA is not available for 2001; consequently, we do not compute RAR in 2001.

[viii] In Brazil, publishing, printing and aerospace have a higher share of national ISO 9000 certificates than the world average. The share of ISO 9000 certificates in the Chilean food industry and public administration as well as in the Argentinean other transport equipment and public administration is much greater than the world average. The share of ISO 14001 certificates is substantially higher than the world average in health and social works in Argentina and Brazil, in the pharmaceutical industry in Argentina and Colombia. The share of ISO 14001 certificates is higher than the world average in electricity and transport, storage and communication in Brazil as well as in the food industry in Chile, Colombia and Paraguay.

[ix] Results with enter and backward estimation methods are similar, only the share of agriculture on the GDP becomes non-significant with the backward method.

[x] The random-effects model produces a better fit than the pooled model.

[xi] Results with enter and backward methods are quite similar. Payments of royalties and licences abroad on the GDP become positively significant, while their growth rate becomes not significant in the backward method.

[xii] The random-effects model produces a better fit than the pooled model.

[xiii] The Association of Salmon and Trout Producers of Chile (APST) was established in 1986 by salmon producers. In 2001, the membership was extended to suppliers and its name changed to Association of the Salmon Industry in Chile (SalmonChile).

[xiv] SIGes includes the elements of: APL, RAMA, RESA, Code of good practice for environment, ISO 14000, ISO 9000, Ohsas 18000, Safe quality food (SQF), HACCP-PP, HACCP-CC, RCA (Environmental Qualification Resolution). SIGEs conforms to Safe Quality Food standards of the Association of Salmon Farming in Canada and the USA. It is also currently used by Wal-Mart in its procurement of salmon.

[xv] *OHSAS 18001 is the Occupational Health and Safety* Zone management specification, created by a group of the world's leading national standards bodies, certification bodies, and specialist consultancies.

[xvi] Binary Logit models on the dummy variable *certification* are not significantly better than the intercept only model, as there were only 3 and 4 firms with OHSAS 18000 and ISO 14001 certification, respectively.

Table 1: Industrial revealed advantages in the number of ISO 9000 and ISO 14001 certificates, in Latin America compared with the world average

	ISO 9000 industrial shares		LA revealed advantages	ISO 14001 industrial shares		LA revealed advantages
	LA	World		LA	World	
Nuclear fuel	0.2%	0.0%	**10.09**	0.0%	0.3%	0.14
Publishing companies	0.3%	0.1%	**2.77**	0.0%	0.1%	0.29
Gas supply	0.2%	0.1%	**1.41**	0.1%	0.4%	0.20
Shipbuilding	0.2%	0.2%	0.97	0.0%	0.1%	0.32
Aerospace	0.4%	0.2%	**2.36**	0.1%	0.2%	0.87
Recycling	0.2%	0.2%	0.64	0.5%	3.0%	0.18
Water supply	0.5%	0.2%	**1.98**	0.7%	0.7%	1.05
Manufacture of coke & petroleum products	0.4%	0.3%	**1.26**	2.9%	0.9%	3.10
Mining and quarrying	0.5%	0.4%	**1.36**	6.1%	1.0%	5.89
Leather and leather products	0.6%	0.4%	**1.71**	0.3%	0.3%	0.90
Electricity supply	0.7%	0.4%	**2.05**	4.1%	1.7%	2.45
Pharmaceuticals	1.5%	0.5%	**3.33**	0.9%	0.8%	1.08
Hotels and restaurants	0.5%	0.6%	0.88	0.7%	0.9%	0.84
Public administration	0.8%	0.7%	1.19	0.2%	1.3%	0.13
Manufacture of wood and wood products	0.4%	0.8%	0.50	0.5%	0.8%	0.62
Agriculture, Fishing and Forestry	0.6%	1.0%	0.68	3.3%	1.7%	1.98
Pulp, paper and paper products	1.2%	1.0%	**1.27**	1.2%	1.7%	0.71
Printing companies	1.0%	1.0%	1.03	0.3%	1.4%	0.26
Other social services	1.6%	1.1%	**1.39**	1.9%	4.8%	0.40
Manufacturing not elsewhere classified	0.8%	1.2%	0.65	0.9%	1.0%	0.85
Non-metallic mineral products	1.8%	1.5%	**1.22**	0.7%	1.3%	0.56
Concrete, cement, lime, plaster etc.	1.5%	1.5%	1.01	1.6%	1.0%	1.51
Financial intermediation, real estate, renting	1.8%	1.7%	1.04	0.2%	0.9%	0.24
Textiles and textile products	1.6%	1.8%	0.86	1.7%	1.4%	1.26
Other transport equipment	1.4%	2.1%	0.68	4.8%	3.3%	1.47
Information technology	2.9%	2.1%	**1.38**	0.9%	0.9%	1.01
Education	1.3%	2.1%	0.60	0.4%	0.4%	0.92
Health and social work	3.7%	2.2%	**1.70**	0.9%	0.5%	1.81
Engineering services	3.2%	3.5%	0.91	2.0%	2.6%	0.76
Chemicals, chemical products & fibres	5.7%	3.9%	**1.46**	9.1%	6.0%	1.51
Transport, storage and communication	7.1%	3.9%	**1.84**	8.9%	4.0%	2.23
Food products, beverage and tobacco	4.6%	4.2%	1.09	12.4%	4.7%	2.62
Rubber and plastic products	4.9%	4.4%	1.11	3.8%	5.8%	0.66
Other Services	10.1%	5.7%	**1.77**	3.6%	3.7%	0.98
Wholesale & retail trade; repairs	4.1%	7.2%	0.57	2.7%	6.7%	0.41
Machinery and equipment	1.8%	7.4%	0.24	2.8%	5.9%	0.48
Electrical and optical equipment	7.0%	9.4%	0.74	7.2%	11.0%	0.65
Basic metal & fabricated metal products	11.8%	11.4%	1.04	7.7%	9.6%	0.81
Construction	10.9%	13.6%	0.80	3.6%	7.1%	0.50

Source: ISO Survey 2005, elaboration of the authors

Table 2: Estimates of Negative binomial regressions for the number of ISO 9000 and ISO 14001 certificates (lagged 2 years) in Latin America

	ISO 9000			ISO 14001		
	Pooled	Panel		Pooled	Panel	
		Fixed-effects	Random-effects		Fixed-effects	Random-effects
Constant	-109.25*** (38.49)	-519.73*** (57.54)	-455.47 (52.65)	104.48** (43.02)	-966.5*** (71.44)	-865.72*** (56.56)
Ln (national labor force)	6.27*** (2.09)	-0.02 (0.31)	0.66 (0.46)	-5.72** (2.35)	0.49*** (0.23)	0.84*** (0.17)
GDP PPP	0.0004*** (0.00)	0.0003*** (0.00)	0.0004*** (0.00)	0.0002* (0.00)	0.00 (0.00)	0.0003*** (0.00)
Share exports in the GDP	-0.042*** (0.02)	0.02 (0.02)	0.05** (0.02)	0.01 (0.02)	-0.02 (0.02)	-0.01 (0.02)
Share royalties in the GDP	-1.35 (0.85)	1.61 (1.02)	0.22 (1.21)	1.74 (1.09)	1.41 (1.35)	0.76 (1.25)
Share FDI in the GDP	-0.053** (0.02)	-0.05 (0.03)	-0.02 (0.03)	-0.09*** (0.04)	-0.08* (0.04)	-0.05 (0.04)
Share services in the GDP	0.02 (0.02)	0.06*** (0.02)	0.09*** (0.02)	0.01 (0.02)	0.02* (0.01)	0.03** (0.01)
Share agriculture in the GDP	0.055** (0.03)	0.05** (0.02)	0.06** (0.03)	-0.18*** (0.03)	-0.02 (0.04)	0.00 (0.03)
Growth rate services	0.00 (0.01)	0.00 (0.01)	0.01 (0.01)	0.02 (0.01)	0.01 (0.02)	0.02 (0.01)
Growth rate royalties	0.022*** (0.00)	0.01* (0.01)	0.01* (0.01)	0.01*** (0.00)	0.02* (0.01)	0.01 (0.01)
Growth rate of FDI	0.03 (0.03)	0.14** (0.06)	0.11* (0.06)	0.15** (0.08)	0.16* (0.09)	0.14* (0.07)
Share gross fixed capital	-0.053** (0.02)	0.05** (0.03)	0.02 (0.03)	-0.03 (0.03)	0.01 (0.03)	-0.01 (0.02)
Share high technology exports	0.00 (0.01)	-0.01 (0.02)	-0.04 (0.02)	0.00 (0.01)	0.02 (0.01)	0.02** (0.01)
Year		0.26*** (0.03)	0.22*** (0.03)		0.48*** (0.04)	0.43*** (0.03)
Country dummies	All Significant			All Significant		
Year dummies	All Significant			All Significant		
Observations	104.00	104.00	104.00	97.00	97.00	97.00
Wald chi2	5056***	632***	693***	14365***	820***	1157***
Df	31	13	13	31	13	13
Log Likelihood	-567.14	-518.82	-613.84	-275.25	-256.43	-323.35
Hausman test		6.78			16.08	

Note 1: *** p<0.01, **p<0.05, * p<0.1.

Table 3: Estimates of Negative binomial regressions for the number of ISO 9000 and ISO 14001 certificates (lagged 2 years) in Latin America, before and after 2000.

	ISO 9000				ISO 14001			
	Pooled		Panel Fixed-effects		Pooled		Panel Fixed-effects	
	Before	After	Before	After	Before	After	Before	After
Constant			-1158.8*** (142.55)	-250.16*** (93.38)			-1612.6*** (227.47)	-962.4*** (135.43)
Ln (labor force)	0.3*** (0.10)	0.6*** (0.14)	0.24 (0.44)	-1.64*** (0.36)	-0.07 (0.27)	0.49*** (0.19)	-0.18 (0.58)	-0.04 (0.65)
GDP PPP	0.0004* (0.00)	0.00 (0.00)	0.00 (0.00)	0.0004*** (0.00)	0.001** (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Share exports in the GDP	-0.072*** (0.03)	0.01 (0.03)	-0.05** (0.02)	-0.07*** (0.02)	-0.17** (0.09)	0.04 (0.03)	-0.15** (0.06)	0.00 (0.03)
Share royalties in the GDP	-0.99 (1.20)	-3.40 (2.19)	-2.63*** (0.97)	-2.31 (1.78)	7.33** (2.96)	-6.64*** (2.17)	-0.73 (2.39)	-3.97 (2.41)
Share FDI in the GDP	-0.07** (0.03)	-0.09** (0.04)	-0.06** (0.03)	-0.13*** (0.03)	-0.06 (0.08)	-0.09** (0.04)	-0.02 (0.07)	-0.08* (0.05)
Share services in the GDP	0.00 (0.02)	-0.01 (0.02)	-0.02 (0.02)	-0.09*** (0.03)	0.00 (0.06)	0.01 (0.03)	-0.02 (0.04)	0.01 (0.03)
Share agriculture in the GDP	0.04 (0.06)	-0.02 (0.05)	0.01 (0.05)	0.085* (0.04)	0.19 (0.14)	-0.07 (0.08)	0.10 (0.10)	-0.12* (0.07)
Growth rate services	-0.01 (0.02)	0.01 (0.02)	0.04*** (0.01)	-0.04*** (0.01)	-0.12*** (0.04)	0.06*** (0.02)	0.03 (0.03)	0.04 (0.03)
Growth rate royalties	0.02*** (0.00)	0.15 (0.19)	0.02*** (0.00)	0.15* (0.09)	0.01 (0.01)	0.00 (0.34)	0.03*** (0.01)	0.08 (0.28)
Growth rate of FDI	0.05 (0.04)	0.28*** (0.09)	0.01 (0.05)	0.23*** (0.05)	-0.07 (0.18)	0.17 (0.13)	-0.09 (0.15)	0.11 (0.12)
Share gross fixed capital	-0.03 (0.03)	0.14** (0.04)	-0.03 (0.02)	0.02 (0.03)	-0.14*** (0.05)	0.03 (0.04)	-0.05 (0.04)	-0.01 (0.04)
Share high technology exports	0.044*** (0.01)	-0.024*** (0.01)	0.03*** (0.01)	-0.023** (0.01)	0.04* (0.02)	0.01 (0.01)	-0.01 (0.03)	0.00 (0.02)
Year			0.58*** (0.07)	0.14*** (0.05)			0.81*** (0.12)	0.49*** (0.07)
Country dummies	Most Significant	Most Significant			Most not Significant	Most Significant		
Year dummies	All Significant	All Significant			Not Significant	All Significant		
Observations	64.00	40.00	64.00	40.00	58.00	39.00	58.00	39.00
Wald chi2	162280***	132899***	998***	234***	172620***	192700***	343***	177***
df	25	24	13	13	25	24	13	13
Log likelihood	-298.62	-237.42	-228.57	-171.45	-133.37	-138.46	-91.76	-103.92
Log likelihood test	581.24***		38.06***		217.09***		0.01	

Note 1: *** p<0.01, **p<0.05, * p<0.1.

Table 4: The level of compliance with international and national standards by Chilean firms in the Salmon Industry and their performance

	Share of certified firms	Not necessary			Planning			In process			Certified		
		All	% Better	% Worse	All	% Better	% Worse	All	% Better	% Worse	All	% Better	% Worse
ISO 9000	21.7	6	70	30	18	60	20	11	50	20	10	**80**	0
ISO 14001	9.1	11	60	20	18	60	20	9	70	10	4	**100**	0
OHSAS 18000	8.6	14	60	20	13	60	20	5	60	20	3	**100**	0
HACCP- PP	70.3	8	80	0	0			3	70	30	24	**80**	20
HACCP- CC	21.2	10	50	40	7	60	10	8	100	0	7	**90**	10
SIGes	8.8	12	80	30	7	70	0	11	60	20	3	**100**	0
APL	4.3	6	80	20	37	60	20	0			2	**100**	0

Source: survey data, 2004

Note: Firms performance can be better, worse or equal than three years ago

Table 5: Reasons considered important or very important for compliance with management standards

	Total answered important and very important	**ISO 9000**	**ISO 14001**	**OHSAS 18000**	**HACCP-PP**	**HACCP-CC**	**APL**	**SIGes**
Required by the association	**16**	38.1	**50.0**	**50.0**	0.0	**56.3**	31.7	**57.1**
Competitors have them	**16**	38.1	**50.0**	37.5	48.3	43.8	34.1	**57.1**
Required by the consumer	**20**	47.6	**57.1**	**50.0**	**51.7**	**56.3**	39.0	50.0
Improve the image of firm	**36**	**71.4**	**92.9**	**100.0**	**89.7**	**87.5**	**65.9**	**92.9**
Required by the market	**34**	**61.9**	**71.4**	**62.5**	**89.7**	**87.5**	**61.0**	**78.6**
Required by the clients	**32**	**57.1**	**71.4**	**62.5**	**79.3**	**75.0**	**58.5**	**71.4**
To comply with national regulation	**29**	42.9	42.9	**62.5**	**65.5**	**68.8**	**53.7**	**57.1**
Increase value added	**30**	**61.9**	**78.6**	**75.0**	**79.3**	**87.5**	56.1	**78.6**
No. of firms with high level of compliance		21	14	8	29	16	41	14

Note 1: Source: survey data
Note 2: Only firms with high level of compliance i.e. firms that are in process of certification or already certified.

Table 6: Logit estimators of the level of compliance with management standards

	ISO 9000	ISO 14000	OHSAS 18000	SIGes	Codigo
newcocst	-0.17	-0.43	-0.39	-0.66	-0.36
	(0.44)	(0.40)	(0.46)	(0.46)	(0.50)
newcolst	0.94**	0.76*	0.49	0.41	-0.40
	(0.43)	(0.46)	(0.49)	(0.53)	(0.50)
nasoc	-0.09	0.69	-0.31	1.55**	1.25**
	(0.49)	(0.55)	(0.56)	(0.66)	(0.56)
saleran	0.25**	0.14	0.38**	0.09	-0.07
	(0.12)	(0.13)	(0.18)	(0.14)	(0.15)
ranptrat	-0.21	-0.01	-0.25	0.36	1.29***
	(0.27)	(0.23)	(0.30)	(0.34)	(0.36)
nmrktexp	0.48*	0.32	0.97***	0.28	0.62***
	(0.29)	(0.30)	(0.32)	(0.29)	(0.20)
newnodes	-0.57	-0.23	-1.28**	-0.34	-0.87**
	(0.50)	(0.51)	(0.52)	(0.61)	(0.38)
foredome	-0.30	-0.04	-1.01**	-0.28	0.38
	(0.41)	(0.46)	(0.44)	(0.45)	(0.52)
salmon	-2.11**	-2.17***	-0.74	-0.43	0.49
	(0.88)	(0.83)	(0.89)	(1.56)	(0.85)
net	-1.18	-1.45	-0.08	0.84	3.41***
	(1.07)	(1.05)	(1.17)	(1.64)	(1.16)
/cut1	-2.48	-1.66	-1.09	0.03	1.61
/cut2	-0.81	0.07	0.26	0.76	1.91
/cut3	0.11	1.41	1.35	2.36	4.37
Observations	44.00	43.00	36.00	33.00	44.00
df	10.00	10.00	10.00	10.00	10.00
Wald chi2	26.59***	31.82***	33.41***	26.56***	23.52***
Log Pseudo-likelihood	-44.95	-39.95	-33.18	-34.22	-35.99
Pseudo R2	0.21	0.26	0.24	0.19	0.22

Note 1: *** p<0.01, **p<0.05, * p<0.1.