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Catching up Trajectories in the Wine Sector: A Comparative Study of Chile, Italy, and South Africa

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Summary. — From a development perspective an investigation of the changes that have occurred in the wine industry is of particular interest because it provides evidence on how emerging economies have been able to acquire significant shares of the international market in a dynamic sector. Based on novel empirical evidence, this paper shows that emerging countries with diverse institutional models and innovation strategies have actively participated in the process of technological modernization and product standardization. These newcomers in the wine sector have responded particularly effectively to changes in demand, aligning emerging scientific approaches with institutional building efforts and successful marketing strategies.

Key words — catching up, wine sector, sectoral systems, Chile, South Africa, Italy

1. INTRODUCTION

Up to the end of the 1980s, "Old World" countries, and particularly France and Italy, dominated the international wine market. Since the beginning of the 1990s, their supremacy has been challenged by new international players, who are recording spectacular performance in terms of both exported volumes and values. These "New World" countries include affluent frontrunners that are relatively new to the wine sector, such as United States and Australia, and less developed but rapidly growing latecomers such as Chile, Argentina, and South Africa.

From a development perspective, an investigation of the changes occurring in the wine industry is of particular interest. The wine case provides empirical ground for assessing how emerging economies can take advantage of windows of opportunity opening up in agro-food sectors, combining technology adoption with original market-oriented research and engineering consistent organizational change.

In the wine industry, a number of different factors have contributed to the emergence in the international market of New World players and, among them, the late rapid expansion of developing economies. On the supply side, a process of technological modernization and pervasive organizational change has been spurred by consistent investment and research effort by newcomers and supported by the establishment of specialized research institutions. The research-driven industry transformation was first promoted by the affluent New World players, but has rapidly diffused to emerging economies, which have been dynamic adapters and adopters of the new business model. The demand side has also been important in this evolution. In fact, New World players have been particularly responsive to changes in wine consumption habits across the world, aligning emerging scientific approaches and institutional building efforts with their branding and marketing strategies.

This paper illustrates the significant discontinuities in both technologies and market demand that, we argue, favored the emergence to the global stage of affluent newcomers in the first instance and fast growing developing regions in more recent times. Furthermore, the paper discusses the co-evolution of physical and "social" technologies (Nelson & Sampat, 2001) that have supported the adoption of knowledge-oriented procedures and a novel division of labor among the main industry players. In fact, the rapid adoption of a scientific approach to a rather traditional industry and the co-ordination between

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research communities and wineries have spurred the performance of emerging economies.

The interplay between national features and sector specific dynamics, which emerges at the global level, is interpreted through the conceptual framework of the Sectoral System of Innovation (SSI) approach. This focuses on co-evolutionary mechanisms on the demand and supply side and is adopted in the present paper to single out relevant trends, key factors, and feedback mechanisms underpinning the catching up process.

The SSI perspective shows that the catch up experience in the wine industry significantly differs from the successful catch up trajectories in other industries, such as software and telecommunication, which have led the late entry of emerging economies into high value global chains (Lee, Cho, & Jin, 2009; Niosi & Tschang, 2009): in the wine sector developing economies have been actively participating in the process of technological modernization and product standardization, rather than focusing on market niches. At the same time, the wine industry case provides support for the argument that access to foreign knowledge is crucial for catching up and for sustaining diverse development trajectories.

In this paper, the catching up dynamics in the wine industry is investigated through comparative analysis of two emerging countries—Chile and South Africa—and a long established Italian wine region—Piedmont. New empirical evidence on academic researchers and wine cellars in these three areas is combined with secondary sources for interpreting catching up experiences. The comparative investigation of the different dimensions of the wine sectoral system demonstrates the variety of strategies and growth paths involved. The analysis highlights the main differences between latecomers and established countries, while at the same time pointing to the differences between the first and second tier of new players.

Overall, this paper contributes to the literature on catching up by providing new empirical evidence illustrating that, under certain conditions, latecomers can successfully catch up with leaders. The analysis provides useful insights into the strategies that emerging economies might implement to foster sectoral level growth and suggests, more broadly, that the agro-food sector can significantly contribute to the development of these economies.

The paper is organized as follows. Section 2 reviews the literature on catching up and SSI. Section 3 introduces the catching up process in the wine industry. Section 4 describes the methodology and the data and Section 5 discusses the empirical findings on Italy, Chile, and South Africa. Section 6 concludes.

2. THE CONCEPTUAL FRAMEWORK

(a) *Catching up and the Sectoral System of Innovation framework*

Over the past decades, catching up has attracted increasing attention in the economic literature. The spectacular performance of Newly Industrializing Countries (NICs) in Asia certainly played a relevant role in animating the debate and encouraging novel conceptualizations about economic growth and structural change. The Asian experience can be hardly explained as a result of import and adoption of technologies and organizational models developed in advanced countries, as implied by the economic growth theory prevailing in the 1950s and 1960s. A large wealth of investigations on Asian NICs has challenged the view that catching up is basically a question of relative speed, in a race along a fixed track, in which latecomers take advantage of mature technologies, forerunners' experience, and reduced market uncertainty (Mytelka, 2004). There is a broad consensus in the literature that the progress of Asian NICs has been involving significant deviations from earlier industrialization experiences, entailing distinctive strategic innovations, learning paths, accumulation of absorptive capacities, and institutional building (Altenburg, Schmitz, & Stamm, 2008; Bell & Pavitt, 1993; Hobday, 1995; Kim, 1997; Lall, 1992).

Following the pioneering contribution by Abramovitz (1986), numerous studies have been conducted on the institutional and political conditions needed for successful catch up (Fagerberg & Godinho, 2005; Hobday, 2003). Large emphasis has been placed on investments in "social technologies," the mechanisms of distribution and coordination of tasks and activities that are consistent with evolving physical technologies, and on efforts to mold supporting institutions, especially higher education and research infrastructure (Nelson, 2008).

The burgeoning literature on national innovation systems in developing areas exemplifies the increased attention placed on the broad institutional set up affecting learning, as well as searching and exploring (Lundvall, Joseph, Chaminade, & Vang, 2009). As Nelson and Nelson (2002) emphasize, the innovation system idea is an institutional conception *par excellence*, which is generally articulated at the national, regional, or local level and characterized by the interaction of actors, frameworks, and norms set within relatively well-defined boundaries.

In the catching up debate, the diffusion of the innovation system perspective has contributed to shift emphasis from resource endowments and comparative advantages to institutional variables, capabilities, and dynamic creation of competitive advantages. The sectoral system approach complements the national and regional perspectives by expanding the analysis to international linkages and transmission mechanisms and by underlying the transnational dimension of sectoral systems, that is, the role of multinational actors and limits of national policies in the framework of increased global integration. Besides the structuring of local innovation systems, inflows of knowledge and technology from external sources, as well as dynamics of demand along the internationally fragmented chains of production, are essential components for upgrading and learning in emergent economies (Pietrobelli & Rabellotti, 2009).

In the literature, vertical approaches, such as the global value chain analysis, have also contributed to the understanding of the linkages through which information and knowledge, as well as goods, flow among actors involved in international production and distribution networks and on how these flows impact on development opportunities (Gereffi, Humphrey, & Sturgeon, 2005; Humphrey & Schmitz, 2002; Ponte & Ewert, 2009). However, whereas the global value chain approach has paid attention most prominently to vertical governance mechanisms, the sectoral system approach mostly focuses on institutional variables and micro learning dynamics, investigating commonalities and differences across sectors. Concerning these aspects, there appears to be important room for research which might unveil the large variety of catching up experiences across countries and sectors. In fact, the SSI perspective provides useful insights on the dynamic interplay between, on the one hand, sectoral dynamics, in terms of coevolution of markets, technologies, production modes, and organizational forms, whose determinants and influence cut across national boundaries, and, on the other hand, idiosyncratic elements, which might explain the capacity of specific

latecomers to take advantage of technological and/or market windows of opportunities.

According to Perez and Soete (1988), these windows are opened to followers particularly at a time of pervasive transformations in the techno-economic paradigm (i.e., the set of interrelated technical and organizational innovations that gradually come together to form the best-practice model), because the burden of structural adjustment for forerunners is heavier. Catching up, however, is not guaranteed and depends on the extent to which countries are equipped with the relevant capabilities and supporting institutions or can manage to build appropriate new institutions rapidly and effectively (Abramovitz, 1986; Justman & Teubal, 1991; Nelson, 2008; Niosi & Reid, 2008; Perez & Soete, 1988).

The SSI approach provides valuable analytical categories for investigating catching up trajectories in a highly dynamic sector such as the wine industry, the focus of this study, in which the evolution of technology and knowledge, largely induced by strategic policies and institutional building at the national level, interrelates with demand changes and restructuring in global markets that percolate along the industry.

(b) *The sectoral system approach*

Following the path set by the national and regional innovation system literature, the SSI approach departs from the traditional concept of sector adopted in industrial economics, as it considers a wider range of actors than firms, pays more attention to institutions, focuses on market as well as non-market interactions, and places emphasis on knowledge and learning processes, both on the supply and on the demand side. These dimensions do certainly reflect idiosyncratic national and local characteristics but the SSI perspective also places emphasis on the emergent globalization of production networks and knowledge flows, which are indeed a relevant source of differentiation across industries in terms of innovation dynamics and opportunities for latecomers to catch up and leap-frog (Malerba & Mani, 2009). A systemic perspective on the sectoral dynamics of innovation is relevant to analyze the determinants of the catch up process because it identifies the key elements that are different and specific to each industry and emphasizes the international, national, and local conditions that can amplify or hinder the sector-specific evolutionary mechanisms.

Knowledge domains, learning processes and technologies, demand, actors and networks, and institutions are the interrelated dimensions of analysis of a sectoral system, investigated with regard to the role of global-, country-, and sector-specific determinants of innovation performance and catching up.

Sectors differ in terms of *knowledge domains*, that is, in terms of the scientific and technological fields at the basis of their innovative activities, and in terms of the applications and types of users involved (Nelson & Rosenberg, 1993). In a sectoral system, features and sources of knowledge affect the organization of production and innovation, the paths of exploration and learning dynamics, the sequences of variety generation and selection, and the roles and interactivity of the main actors.

Identification of *key actors* and understanding of the *relationships* among them are other critical steps in the characterization of SSI. Firms (producers, suppliers, users) are the main object of investigation in the innovation literature, but they are not the only organizations relevant to the dynamics of technological change at sectoral level. Business associations; technical, training, and financial organizations; trade unions; government agencies; and universities play an important role, as they set conditions for business activity and innovative investments, provide capabilities and inputs to the business community, and engage directly in technological advancement and commercial application. In particular, Public Research Organizations (PROs) are acknowledged to be the key players in building indigenous technological capabilities, especially in applied fields such as agriculture, and are likely to become even more important as international property rights regimes become tighter (Mazzoleni & Nelson, 2007).

Demand is also vital for the evolution of a SSI. It may spur the emergence of an SSI and it represents, in general, an important stimulus to change; in other cases, however, it can become a major constraint to evolution. Demand influences both the scale of activities and the cognitive boundaries, the nature of the problems firms have to solve, and the incentives for their innovation behavior. Changes in demand imply substantial modification to the context in which firms operate and may favor the entry of new firms and/or the out positioning of established ones that find it difficult to recognize or adapt to new markets when they open up (Christensen & Rosenbloom, 1995). In globalized markets, changes in international demand and organization of commercial functions directly affect export-oriented players, but can also percolate at the local level through vertical chains.

The *institutional framework* is a dimension of the SSI that cuts across all the others. It encompasses the laws, standards, norms, routines, and established practices that shape agents' cognition and behavior and influence their interactions (Coriat & Weinstein, 2002; Malerba, 2004). At the institutional level, there is a strong interplay between sectoral specificities and national or regional factors. On the one hand, national institutions, such as the system of property rights, the regulation of standards and procedures, the education system, the norms ruling university research and its interaction with industry, and the antitrust or labor market rules, largely explain the different development paths and innovative dynamics within the same sectors across countries (Lundvall, Johnson, Andersen, & Dalum, 2002). In particular, they explain the capacity of national systems to respond effectively to changes in techno-economic paradigms and catch up (Perez & Soete, 1988). On the other hand, national or local institutions can exhibit, across sectors, different degrees of "congruence" in relation with the other defining elements of the SSI. Thus, they can support or hinder sector-specific catching up trajectories in a different degree.

The long-run dynamic interaction between national factors and sectoral systems is an open research question requiring robust comparative analysis. The recent empirical literature on sectoral systems and catching up has focused mostly on high-tech and large-scale manufacturing (Malerba & Mani, 2009). There is a need to extend the analysis to other sectors and, considering their relevance in the developing world, traditional sectors and the agro-food industries represent a key research target (Arocena & Sutz, 2000).

The present contribution tackles this open agenda by focusing on the significant transformations experienced in the wine industry, a highly dynamic agro-food sector. This provides an interesting case of catching up opportunities, exploited to different degrees by newcomers in developing areas.

3. THE UPSURGE OF THE NEW WORLD IN THE INTERNATIONAL WINE MARKET

The wine industry has undergone some radical changes since the late 1980s, including seismic shifts in production methods, research intensity and organization, global competitiveness,

and producer rankings. Although the so-called Old World countries, that is, Italy, France, Spain, Portugal, and Germany, are still among the main producers, exporters, and markets, they no longer dominate as they once did. New World producers, such as the United States, Australia, Argentina, New Zealand, South Africa, and Chile, have been rapidly gaining market shares, including the medium–high quality segments that once were the exclusive domain of traditional, long-established producers.

Before the late 1970s, New World production was concentrated in bulk wine of variable quality, which posed no real threat in terms of either volume or quality to the European hegemony in the international market. This dominance has been eroded by newcomers, which have managed to acquire important shares in the global market. In volume terms, the share of world trade of European exporters has declined from almost 95% in the late 1980s to 69% in 2008, while the New World share, which accounted for only 5% of world export in the 1980s, has reached 31% in 2008. Over the decade 1996–2006, the volume of exports from the New World countries have increased dramatically, and most notably from developing regions: 350% for South Africa, 280% for Australia and Chile, and 190% for the United States (OIV, 2009). In some markets, New World producers have overtaken the Old World: Australia has taken over from France as the second largest exporter after Italy to the United States and it has become the biggest exporter to the United Kingdom; besides, Chile has become the fifth largest exporter to the United States.

The remarkable performance of the New World countries becomes even more evident when considering the *value* of export, whose growth testifies the upgrading process along the quality ladder and the entry into the premium market segment that used to be contended by French and Italian wines. [1] Affluent newcomers, such as the United States and Australia, have been the frontrunners in this quality upgrading. Since the early 1990s, premium exports have contributed to 97% of the growth in the value of Australia's wine exports (OIV, 2009). Accordingly, the unit price of Australian wines went considerably up and, in the last period available in Table 1, Australia ranks second to France and ahead of a historical quality producer such as Italy. [2]

The expansion into high value segments has characterized also the more recent emergence of a second tier of New World producers, represented by developing areas in which production was typically started by colonial settlers, based on imported root stock and, up to recent times, concentrated in bulk wine of variable quality. Chile and South Africa, for instance, are still specialized in lower quality segments, but the unit value of their exports has been gradually converging toward the world average and has more than doubled in absolute terms since the early 1980s. Due to the quality upgrading and the volume expansion in Chile the value of wine exports has increased from US$20 million in the second half of the 1980s to more than US$ 1,400 million on average in the period 2005–07, and in South Africa from US$10 million to almost US$600 million. In terms of export value in 2007, Chile ranked 4th, very close to Australia in the 3rd position and after Italy and France while South Africa is in the 9th position. [3]

Overall, these figures suggest that the upsurge of New World producers is not a temporary anomaly, since they have acquired a significant position in the international market in both volume and value terms. Furthermore, these figures illustrate the very rapid upgrading along the value added ladder by some developing countries, for which the wine industry has turned into a relevant export-led growth engine. Going up the value added ladder has been one of the possible trajectories for upgrading. As Ponte and Ewert (2009) underline, this also resides in the general exposure to different managerial models and end-markets and has also consisted in more sophisticated commercial strategies and learning in basic quality segments.

4. THE COMPARATIVE ANALYSIS

(a) *Some background information*

For the purpose of investigating the main interrelated dimensions of catch up in the wine industry, we have conducted a comparative in-depth analysis on three areas—two New World regions Chile and South Africa, and an Old World country, Italy, represented by the highly specialized region of Piedmont. We first present some background information on each country, which explains why the selected cases are good examples of the dynamics in the industry as a whole.

Chile is a frontrunner among New World competitors. The wine industry developed during the 19th century, when several entrepreneurs, some of them linked to the exploitation of minerals, started growing vines. Chile presents ideal conditions for wine production because of the country's excellent natural endowments that result in numerous wine regions characterized by favorable *terroir* [4]. In recent times, the Chilean wine industry has made considerable efforts to modernize technologies and adopt novel productive practices. Considerable investment at an institutional level has also supported the firm-level efforts to upgrade and expand the Chilean industry (Bell & Giuliani, 2007).

In South Africa, the tradition of wine making dates back to the 17th century. After the end of the Apartheid in 1994, the whole South African economy, including its wine industry, has undergone profound structural reforms (Sandrey & Vink, 2008). Pre-1994, production quotas, import protection, and price support schemes prevented overproduction and regulation had the side effect of keeping prices high and distorting production toward high yields at the expense of quality. Deregulation forced a restructuring of the South African wine industry and a focus on quality rather than volume. Many producers adapted to the pattern of international demand, planting noble international varieties and adopting advanced enology and viticulture techniques. Italy is one of the traditional wine producing countries and one of the world's leading wine producers, contending to France the world's leadership (Corsi, Pomarici, & Sardone, 2004). Indeed, after being the second world's largest wine producer for almost a decade, Italy overtook France in 2008. Italy ranks first also in terms of volume share of world wine export, but is largely overtaken by France in terms of export value (OIV, 2009). Since the mid-1980s, the Italian wine sector has undergone a deep restructuring, in reaction to changes in both domestic and international markets. On the one hand, there has been a major decline in domestic demand and a shift in consumer preferences toward higher quality wines; on the other hand, as we described above, Italy has faced increasing competition in the international market from New World wine producers. As a result, firms have been forced to modify their production strategies and focus on quality and cost-efficient production processes. Within Italy, our focus is on Piedmont, which produces some of the best-known, top quality Italian wines (e.g. Asti Spumante, Barolo, Barbera) and is the second largest (after Veneto) exporting region in Italy.

Table 1. *Italy, Chile, and South Africa in the global wine industry (1975–2007). Source: Faostat (2009)*

Production and export volumes	1975–79	1980–84	1985–89	1990–94	1995–99	2000–04	2005–07
Volume of wine production (Tonnes '00)							
Australia	3,550	3,855	4,298	4,693	6,773	11,061	12,752
Chile	5,423	5,331	3,951	3,488	4,364	6,186	7,943
France	67,484	68,062	66,378	56,215	57,588	53,505	51,085
Italy	71,482	76,787	67,329	61,058	56,150	49,641	47,571
South Africa	5,812	7,443	7,477	7,382	7,953	7,748	9,196
USA	15,388	17,043	18,782	17,575	20,994	24,098	24,793
World	317,160	342,096	299,971	269,516	268,456	279,280	275,397
Volume of wine exports (Tonnes '00)							
Australia	55	78	242	852	1,612	4,682	7,464
Chile	124	138	170	774	2,709	4,185	6,802
France	7,196	9,662	12,730	11,558	14,328	15,005	14,408
Italy	13,238	16,419	12,790	12,920	15,062	14,479	17,240
South Africa	92	112	88	276	1,081	2,080	3,739
USA	97	310	467	1,104	2,026	3,089	3,793
World	41,848	47,854	45,159	46,690	60,010	68,221	86,234
Share of exports in wine production (%)							
Australia	1.55	2.02	5.62	18.16	23.80	42.33	61.02
Chile	2.29	2.59	4.29	22.18	62.08	67.65	85.71
France	10.66	14.20	19.18	20.56	24.88	28.04	28.36
Italy	18.52	21.38	19.00	21.16	26.82	29.17	36.60
South Africa	1.58	1.50	1.18	3.73	13.59	26.84	40.55
USA	0.63	1.82	2.49	6.28	9.65	12.82	15.59
World	13.19	13.99	15.05	17.32	22.35	24.43	31.43
Share of world wine export volume (%)							
Australia	0.13	0.16	0.53	1.83	2.69	6.86	8.68
Chile	0.30	0.29	0.38	1.66	4.52	6.13	7.63
France	17.20	20.19	28.19	24.75	23.88	21.99	16.77
Italy	31.63	34.31	28.32	27.67	25.10	21.22	20.03
South Africa	0.22	0.23	0.20	0.59	1.80	3.05	4.29
USA	0.23	0.65	1.03	2.36	3.38	4.53	4.40
World	100	100	100	100	100	100	100
Export values							
Value of wine exports (millions US$)							
Australia	7	13	45	177	531	1,343	2,228
Chile	10	13	20	105	387	665	1,416
France	1,070	1,608	2,959	4,044	5,304	5,742	8,030
Italy	553	787	929	1,457	2,175	2,729	4,166
South Africa	6	9	10	41	174	342	598
USA	11	34	62	156	391	585	774
World	2,925	4,073	5,885	8,329	12,396	15,333	23,827
Share of world wine export value (%)							
Australia	0.23	0.32	0.76	2.12	4.29	8.76	9.42
Chile	0.34	0.32	0.34	1.27	3.12	4.34	5.67
France	36.58	39.47	50.28	48.56	42.79	37.45	33.81
Italy	18.91	19.33	15.79	17.50	17.54	17.80	17.57
South Africa	0.21	0.23	0.17	0.50	1.40	2.23	2.53
USA	0.36	0.83	1.05	1.88	3.15	3.82	3.25
World	100	100	100	100	100	100	100
Unit value of wine exports ('000US$/Tonnes)							
Australia	1.22	1.70	1.86	2.07	3.30	2.87	2.98
Chile	0.79	0.95	1.19	1.36	1.43	1.59	2.08
France	1.49	1.66	2.32	3.50	3.70	3.83	5.56
Italy	0.42	0.48	0.73	1.13	1.44	1.88	2.41
South Africa	0.68	0.83	1.11	1.50	1.61	1.65	1.66
USA	1.08	1.09	1.32	1.42	1.93	1.90	2.03
World	0.70	0.85	1.30	1.78	2.07	2.25	2.75

(b) *Sources of information and data*

The study is based on original empirical evidence concerning industry players and the research community, collected through country surveys and in-depth interviews with key informants and privileged actors (see Appendix for a detailed list) in research centers, universities, extension agencies, and business associations, who provided in-depth qualitative

information on the institutional and historical transformations that have occurred in the different national contexts.

With regard to the overall picture of the industry, we have also drawn from secondary sources, in particular, industry-level data and reports from national and international organizations, national statistics, wine journals, and scientific literature.

Key informants helped in the selection of a sample of *wine firms* (37 in Piedmont, 27 in Chile, 20 in South Africa) to whom it was administered a questionnaire in the period during October 2005–October 2006. The wineries included in the sample are producers selling their own branded wine. Hence, wholesalers, traders, and grape growers have not been included in the sample. Assistance in the selection process was provided in South Africa by the executive manager of Winetech (Wine Industry Network of Expertise and Technology), the technical arm of the SA Wine Industry Council, and by agro economists at Stellenbosch University; in Piedmont by the directors of the two main consortia of appellation wines, by the president of the regional enology association, and by the senior viticulturist of the largest association of wine growers (Vignaioli Piemontesi); in Chile by the two main business associations (ChileVid and Vinas de Chile) and by some local wine makers. We asked the key informants involved to indicate those wineries they regarded as *dynamic and innovative*, in the sense that they have been engaged in some innovative activity (e.g. adoption of new technologies and enological practices; implementation of novel marketing strategies; and product differentiation) and/or they have shown some innovation propensity, for example, because they submitted applications for research grants at funding bodies. Hence, the empirical investigation on the innovation behavior of wineries has been designed to obtain insights into the activities and strategies of those players recognized by the local wine community as innovation leaders. Furthermore, in accordance with earlier evidence about diversity of upgrading trajectories (e.g. Ponte & Ewert, 2009), non-technological innovation is also taken into account.

The wineries interviewed exhibit differences across countries that are largely consistent with the diverse structure of the industry, investigated in more detail in Section 5. In Piedmont, wineries are relatively small in terms of employees and hectares (although less so in terms of sales), reflecting the typical fragmentation of the Italian wine industry. The Chilean sample is composed of fairly large firms, many of them belonging to a business group, which is, in some cases, an international group. These firms reflect the process of concentration and rationalization that has been lately characterizing many New World regions. The much smaller South African firms, on the other hand, are representative of a New World industry which has yet to embark on a path of sustained concentration and it is mostly dominated by domestic capital. In terms of exports, in our sample, Chilean firms are the most focused on international markets, while Piedmont and South African producers sell a significant part of their production to the domestic market (Table 2).

Besides the wineries, we have also surveyed the population of *researchers* in universities and research centers working on wine-related issues in several disciplines, spanning from viticulture to enology, agronomy, agriculture, microbiology, genetics, chemistry, and engineering. We sent a questionnaire to 40 researchers in Chile, 42 in South Africa, and 53 in Piedmont and interviewed most of them, collecting relational data about their professional linkages with other researchers and with the industry. Furthermore, in order to introduce some measures of quality and performance of the researchers, we have referred to data about international publications and citations in peer-reviewed journals, as reported in the ISI Web of Knowledge.

Quantitative data on firms and researchers are used mainly in Section 5(b), focused on the knowledge base of the wine sectoral system. Secondary sources and qualitative information from interviews with experts and representatives of the industry are the main inputs for the analysis of the remaining dimensions of the sectoral system: demand (Section 5(a)), actors (Section 5(c)), and institutions (Section 5(d)).

5. THE FOUR DIMENSIONS OF THE WINE SECTORAL SYSTEM

(a) *Demand*

The demand side plays a central role in the evolutionary trajectory of the wine industry. New World producers have not only upgraded the quality of their wines but they have also addressed and taken advantage of changing consumer tastes, thus ending what Aylward (2003) describes as the historical monopoly of Europe over the wine culture. The New World expansion has changed how wine is valued in terms of flavor, variety, and national origin (Cohen & Labys, 2006), forcing worldwide adaptations in the production process of both grapes and wine, in research and in the organization and marketing strategies of wine producers.

The changing consumption habits are part of a wider transformation in consumer attitudes, which, since the 1980s, has characterized the market in European countries with a tradition in wine drinking (e.g., Italy, France, and Spain) and in other affluent countries with an incipient wine culture (e.g., UK, Scandinavia, and the United States). In the 1980s a "gourmet culture" spread in the rich countries, increasing the popularity of wine as a "beverage" and consolidating a preference for varietal wines, such as *cabernet*, *sauvignon*, *merlot*, and *chardonnay*, typically produced in the New World (Cohen & Labys, 2006).

These changes in tastes were accompanied by a sharp decline in wine consumption in almost all wine producing countries. During 1985–2004, consumption fell sharply in France (−35%) and Italy (−20%), a decline that was partly compensated for by the growing demand from the Northern European countries, the former Soviet Union, and some Asian emerging

Table 2. *Main features of the firms interviewed*

Country (no. of firms)	Ownership		Employees			Hectares			Sales	Export
	Part of a group (%)	% foreign shareholders (mean)	Average	Min	Max	Average	Min	Max	Average (mln. Euro)	% Mean
Italy ($n = 37$)	10.8	0	29.4	1	400	375.3	3	2051	17	45.8
Chile ($n = 27$)	74.1	29	196,4	21	1000	1033.9	100	4000	21	84.1
South Africa ($n = 20$)	15.0	5	38.7	2	181	186.7	25	780	1.7	44.6

Source: The authors' survey.

countries (OIV, 2009). [5] It is interesting, therefore, to note that the emergence of new producers and the erosion of historical incumbent export shares coincided with declining or stagnating consumption in volume terms, particularly in the European Union. It is, however, to be noticed that the volume reduction was matched with an increase in unit value, as in affluent markets a shift occurred in the type of consumption, from bulk to premium wines.

What is interesting is that these pervasive demand changes have substantially modified the role of the consumer: definition of wine "quality" is no longer the exclusive domain of producers and, beyond any intrinsic characteristics, the ultimate criterion of quality is the value perceived by the market. Furthermore, the capacity to distinguish a particular wine and to build its reputation has become a major competitive advantage in a market characterized by a large and increasing share of relatively inexperienced consumers. Quality ratings provided by wine experts and guides do increasingly play a key role in shaping the perception and behavior of potential consumers (Odorici & Corrado, 2004).

Moreover, wine purchases are increasingly made in supermarkets and the consolidation of distribution, at both the wholesale and retail levels, has had a major effect on competition in the wine market (Gwynne, 2008). In the United States, the 20 largest wholesalers control 70% of the market, and supermarkets and hypermarkets account for more than 40% of retail wine sales, with a similar trend emerging in all the affluent countries (Castaldi, Cholette, & Hussain, 2006). This consolidation among distributors has made it increasingly difficult for smaller producers to get their wines onto the shelves. Wholesalers and supermarkets prefer to stock only the top selling brands, at the expense of small and new labels. This sales strategy is damaging wine industries such as Italy's, which is characterized by small, often micro, wineries with an incredibly rich variety of vines, and enter markets with wines sold under a myriad of different labels.

These quantitative and qualitative changes in the market were initially embraced by California, the first New World region that posed a threat to Old World dominance. US wine experts played a major role in changing established patterns of perception, thus altering the reputation and media recognition of wine regions traditionally associated with low quality segments and low status in international markets. Californian wines played a crucial role in attracting interest and improving the reputation of wine areas that were not part of the traditional establishment.

Australia was also quick to take note of this market evolution and responded with increased branding and marketing efforts. In particular, and in order to send a clear and strong message to consumers, Australia chose to promote "Brand Australia," putting aside differences among wines and regions in a bid to target the "popular-premium" (€3–5) segment of the world market (Aylward, 2006).

Following the way opened by California and Australia, other New World producers have been changing their positions in the international market. The latecomers include Chile and South Africa, whose wine industries began to surge in the 1990s. Although, as already mentioned, they still lag behind Australia in terms of export quality, both countries' industries have dramatically increased the value of their exports since the 1990s (Table 1).

The response of Old World producers to the aggressive marketing strategies of New World countries was to emphasize the concept of "*terroir*," thus maintaining a producer-driven approach. In the case of both France and Italy, this response was reinforced by a strengthening of their institutional settings in terms of the regulation on wine appellations of origin and production (Pompelli & Pick, 1999). This initial, rather inertial, response left much room for the penetration of New World producers in a changing world market and it has more recently forced changes in Old World strategies (see Section 5(d)).

Among the Italian wine regions, Piedmont has fully embraced the strategy of strengthening the specificity of its "*terroir*" and therefore is an interesting case of a competitive response by incumbents. The region produces 11 DOCG (*Denominazione di Origine Controllata e Garantita*) wines (over 38 in all Italy) and 45 DOC (*Denominazione di Origine Controllata*) (over 316 in all Italy), which account for almost 80% of total regional production in Piedmont, and 15% of Italian production of appellation wines. [6] Piedmont wineries have chosen to target market niches dominated by highly educated consumers, who demand "experience goods," that is, unique wines linked to a specific heritage and story. These consumers represent a small, but culturally relevant and rapidly increasing, market segment, reacting to the standardization of tastes and the dominance of supermarkets and international retail chains in the global wine market by drawing attention to small independent producers and local wine varieties. [7]

(b) *Knowledge base and innovation*

In order to keep pace with the changing patterns of demand, both firms and organizations have to identify, build, and develop new competencies. These are micro learning processes whose success depends on the existing stock of knowledge available in the system (e.g., firms, universities, and PROs) as well as on the knowledge which can be acquired and absorbed from external sources (e.g., foreign direct investments, foreign buyers, external consultants, and research collaborations). Demand and institutional factors also play an important role in it, as they shape the system of incentives that can facilitate or hinder the production and diffusion of knowledge. In the next two subsections we analyze the knowledge dimension of the wine sectoral system, with a focus on the interplay between the research system and the industry.

(i) *Science and researchers*

Since the 19th century, when enology became an established field of scientific investigation in French universities, research has played a key role in the wine industry, with leading scientists, including Louis Pasteur, contributing to its advancements. For many years, inputs from science were mainly used to inform the areas of microbiology and wine fermentation, in traditional production methods, typically based on the idiosyncratic knowledge, experience, and manual dexterity of farmers (Giuliani & Arza, 2009). Up to the 1980s, scientific research on wine-related issues was largely producer driven and mainly aimed at responding to the specific needs of the traditional "*terroirs*" in France and Italy, based on context-specific learning processes and knowledge cumulativeness.

In the New World the local industry, for a long time confined to local markets and the production of bulk wine, was sustained traditionally by simple enological culture and research. However, since the mid-1980s it was precisely in the New World that an intense process of modernization took off, consisting in large investments in scientific research and human resources, innovative approaches to markets, branding, and business systems (Aylward & Turpin, 2003).

Among New World producing areas, California has been the pioneer in introducing the novelty of a full-fledged "scientific

approach." In these areas, research has been significantly oriented toward responding to (and further strengthening) changes in demand. In fact, the main focus of research has been on the introduction of new grape varieties and on reducing the variability of output in order to produce wines of regular taste and quality despite the variability in climate conditions, soil characteristics, and other local specificities. In general, the recent changes in technologies and production methods have been based on consistent modernizing research-based approaches rather than scientific breakthroughs.

This scientific drive of newcomers has emerged in a global context of increased knowledge codification and formal investigation effort across a wide range of disciplines related to the wine industry (Glänzel & Veugelers, 2006). From the early 1990s to 2006, scientific publications on wine-related issues, mostly within Food Science and Technology, but increasingly spanning Biology and Biotechnology, recorded a growth rate five times larger than the average across the spectrum of scientific disciplines (Figure 1).

In spite of research infrastructures that are generally well below the international frontier, the New World's dynamism in terms of scientific research output has been sustained over the last decade, with the number of scientific publications doubling annually, although in absolute terms both Chile and South Africa lag behind Italy: over the period 1992–2006 their relevant publications amounted to, respectively, 121, 179, and 1,376. Also the number of coauthored publications by academic researchers is evidence of the increasing international nature of research in wine: the number of countries connected through co-authorship has increased from seven (France, Italy, Germany, Spain, Canada, United States, and Israel) in the period 1992–97, to 36 in the period 2002–06 (Cassi, Morrison, & Rabellotti, 2010). Chilean and South African researchers have been particularly active in establishing international linkages *via* co-authorship with other emerging countries and with colleagues in the Old World.

An analysis of co-authorship shows a growing trend in the degree of openness of research communities in emerging economies (Cassi *et al., in press*). Chilean and particularly South African scholars have increased substantially their international collaborations, while Italian ones are pretty stable overtime (see Table 3).[8] Differences also emerge for the geographical span of collaborations: although Italy, France, Spain, and Germany are still perceived by New World producers as important centers for the generation of scientific knowledge, the United States and Australia have recently emerged as key players.

(ii) *Innovation and firms*

The increased importance of scientific research is demanding changes in producers' competences. Production techniques that used to be driven by farmers' experience and practical, problem-solving approaches have become highly codified and need to be managed by highly skilled professionals, making formalized training and access to external knowledge extremely important. The so-called "flying winemakers," that is, consultants contracted worldwide by most dynamic wine producers and sometimes by wine regions, have significantly contributed to the rapid transfer of scientific advances and technologies and emerged as key actors in the global wine system and symbolize the New World's leading role in modernization (Lagendijk, 2004).

This seems to be particularly true for innovative firms, as it emerges from our investigation. Table 4 shows that the Chilean firms in our sample rely largely on external agronomists and enologists, while firms in Piedmont have higher levels of in-house technical competencies and are less likely to collaborate with external consultants. Also, in Piedmont the wine producers surveyed rely exclusively on experts from the same region, while the firms investigated in South Africa and Chile largely use foreign external consultants. This finding is consistent with the argument that the knowledge bases of Old World producers are strongly related to the local wine culture and locally accumulated competencies (Aylward, 2003).

The information collected on experimental activities is strongly indicative of a catching up process among New World firms, especially in Chile, with respect to Old World producers. Experimentation consists not only in copying external technologies but also in the creative adoption of and selection among, accompanied by mastery of, the best practices, which can be adapted to local and firm-specific needs.

In our fieldwork, we identified four categories of experimental activities, which correspond to four innovation profiles: the lower profiles (1 and 2) depict passive adopters of external technologies, involved in simple experimentation closely supported by suppliers or extension technicians; the higher profiles (3 and 4) identify active innovators, involved in continuous experimentation, on which firm specific practices are built, often in close collaboration with extension agencies and universities.[9] Table 4 shows that the Chilean (81.5%) and the Italian (70.3%) producers interviewed are concentrated in the two upper categories, with Italian wineries clustered in the top category (27.0% *vs.* 14.8%), whereas the distribution of the South African firms in the sample is skewed

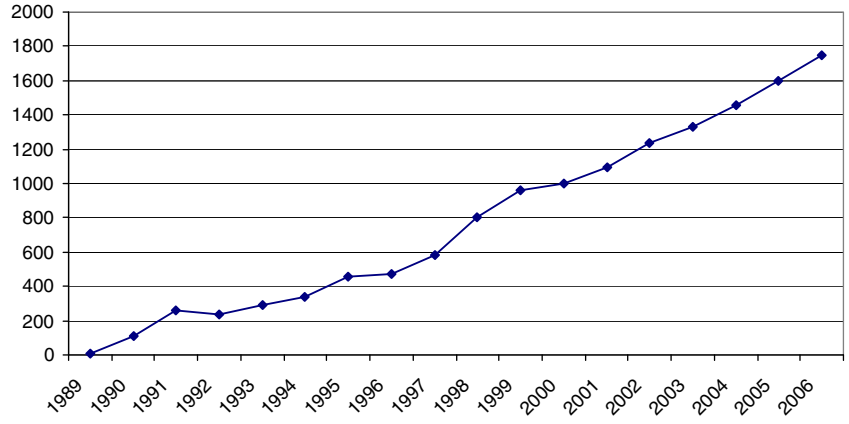

Figure 1. *Number of WineScientific Articles (1989–2006). Source: Our elaboration based on Web of Science–ISI data.*

Table 3. *Number of ISI co-publications 1992–2006*

International co-publications*	1992–2006	1992–1997	1997–2001	2001–06
Italy	57.7	61.3	55.9	58.3
South Africa	59.2	44.4	52.1	65.7
Chile	52.1	40.0	58.6	50.5

Source: Our own elaboration based on Web of Science—ISI data.
* denominator = number of co-publications.

Table 4. *Knowledge base and technology: firm level indicators*

	Italy (Piedmont)	Chile	South Africa
Human capital			
% of employees with a technical degree			
Secondary	15.2	9.8	3.0
Tertiary	9.3	6.6	0.1
External consultants (% firms)			
Viticulturist	32.4	92.6	50.0
Oenologist	51.4	88.9	30.0
○ Of which foreign	0.0	62.2	50.0
Experimental activity over last 5 years (% firms)[a]			
None	0.0	0.0	25.0
Passive technology adopters (Profiles 1 and 2)[b]	29.7	18.5	45.0
Active innovators (Profiles 3 and 4)	70.3	81.5	30.0
% of firms conducting experimental activity with external collaboration	48.0	85.0	67.0
Areas of investments over the last 5 years (% firms)[c]			
New grape varieties	43.2	77.8	60.0
New or improved clones	59.5	88.9	55.0
Vineyard improvement	73.0	96.3	70.0
Vineyard enlargement	78.4	81.5	50.0
Machinery and equipment for the vineyard	80.6	96.3	78.9
Machinery % equipment for the cellar	100.0	100.0	94.7
New or improved wine-making techniques	70.3	100.0	65.0

Source: The authors' survey.
[a] F-test = 12.92; Prob > F = 0.0000.
[b] The profiles are described in details in Footnote 9.
[c] Multiple answers are possible.

toward the lower categories. It is also interesting that the most advanced experimenters are generally larger firms in Chile, Italy, and South Africa (respectively, €32 million, €18 million, and €4 million of sales on average).

Taking into account the fields in which the innovative firms interviewed invest, in Chile and South Africa the respondents are more likely to invest in new grape varieties and clones than those in Piedmont. According to some of our key informants, these investments are aimed at changing and broadening the type of product supplied to the market in order to respond to international tastes. Our sample of producers in Piedmont, on the other hand, prefer to address established national (or even regional) markets and international outlets, with traditional varieties [10] and engage largely in process-related investments to improve or acquire new machinery and equipment for their vineyards and cellars.

(c) *Actors and networks*

The interplay and co-evolution of the elements of the wine sectoral system presented above (i.e., demand factors, knowledge base, and innovation) influence the nature and opportunities of the actors in the system. Indeed, the new competitive context, based on technological innovation, global marketing, and predominance of international, large-scale retail chains, has affected the structure of the industry in a significant way. A remarkable process of consolidation has taken place worldwide: since the late 1990s, national and transnational mergers, acquisitions, and strategic alliances have intensified. The branding and volume capabilities of the leading global wine firms and their ability to produce wines of an even quality satisfy the requirements of supermarket channels, which prefer a few large suppliers in order to reduce procurements costs (Kaplan & Wood, 2005). However, international acquisitions have also been driven by quality concerns, brand diversification strategies, and innovation-related motives. The opportunity to source grapes at competitive prices from multiple areas, the need to capture key brands and confidence with the most innovative enological techniques are the driving forces behind the late wave of consolidations and alliances in the wine industry worldwide (Anderson, Norman, & Wittwer, 2003). The process of concentration and rationalization concerns most of the New World, although to a different extent, with the largest wine companies coming from the USA. [11]

Among the emerging countries, Chile's industry showed remarkable growth during the 1990s; its number of wineries increased, the largest being *Vina Concha y Toro*, which is in the top 10 largest companies in the world (Mediobanca, 2009). The Chilean wine industry is still dominated by few family-based companies, with the four largest groups

accounting for more than 45% of export value (Visser, 2004), but there is increasing participation of foreign capital in the sector (Moguillansky, Salas, & Cares, 2006).

South Africa is an exception to the process of vertical integration and to the increase in foreign investments which is taking place in most of the New World. Ponte and Ewert (2009) explain that the South African wine industry is undergoing a process of vertical disintegration, with many private cellars and producer–wholesalers moving away from grape growing. According to the two authors, the high fragmentation of the industry, the lack of suitable land for expanding vineyards, the specialization in a low margin segment such as the popular premium one, together with the perceived political and currency risks in the country explain why South Africa has so far failed to attract substantial foreign investments. Nevertheless, in South Africa there are some large companies, among which the *Distell* group also included among the 10 world largest wine companies (Mediobanca, 2009).

In Europe, the long established wine making regions have remained in general characterized by fragmented industry structures, the process of concentration here being rather slow. However, there are also significant differences among Old World wine countries. While French companies have grown in size and expanded overseas,[12] Italian companies are still small and mainly family based. The two largest Italian companies are cooperatives—*GIV* and *Caviro*—with turnovers in 2008 of about €280 million (Mediobanca, 2009). The total sales of the top five Italian wine producers is about €1 billion, much less than world leaders such as *Constellation Brands* and *Foster*, with a turnover, respectively, of about €3 and €2 billion in 2009. Also Chilean and South African companies stay well ahead of the Italian leaders, for example, *Concha y Toro* from Chile and *Distell* from South Africa both double the turnover of the two largest Italian companies (Mediobanca, 2009).[13]

In addition to increasing the role of large firms, the technological changes of recent decades have brought research institutions, technology transfer organizations, and innovation-oriented alliances to center stage in the industry. The creation and continued strengthening of institutions specialized in research and training have been a major driver of growth in New World areas such as California and Australia. The second tier of newcomers has followed the frontrunners by engineering institutional building. Institutions engaged on industry-wide applicable research are being targeted by policy in emergent producing areas such as New Zealand, South Africa, and Chile. Bodies dedicated to the funding and promotion of wine-related research projects, often in partnership with national research organizations and universities, are being established.

In order to investigate the effectiveness of sectoral systems in diffusing knowledge, we looked at the linkages between researchers in universities and PROs and professionals in the wine industry. We have found that joint research agreements are the most diffused type of collaboration in Italy and Chile, while in South Africa relationships are mostly based on informal contacts or industry-commissioned research to universities. Overall, Italian researchers have fewer links with the industry (59.3%) compared to both South African (81.4%) and Chilean (92.5%) researchers who are also more involved in consultancy than their Italian colleagues (Giuliani, Morrison, Pietrobelli, & Rabellotti, 2008). Confirmation of the less intensive nature of the relationships between university and industry in Italy also comes from our interviews with innovative firms: Italian firms consider research centers to be much less important sources of information for innovation than Chilean and South African firms do.

As further described in the next section, the different degrees of contact and involvement of researchers in industry projects also depend on the different institutional frameworks and on the policy initiatives implemented in the countries under investigation.

(d) *The institutional framework*

Institutional changes have played an important role in the trajectories of evolution and catch up of New World producers in developing regions. The successful experience of Australia has become the best practice for adoption by latecomers, in particular South Africa and more recently Chile. However, implementation has proved more difficult in those contexts, such as the South African one, characterized by political instability or incipient institutional capital. The "Australian model" is in fact rather demanding in terms of governance capacity and co-ordination across institutions and levels of government. The Australian experience in institutional building is a case of successful centralization and co-ordination at the national level of industry organizations and research institutions, converging on a long-term vision for the industry and export-related objectives. Two national actors, the Australian Wine and Brandy Corporation (AWBC), which is the national sectoral organization, and the Grape and Wine Research and Development Corporation (GWRDC), which is the national research body, play a pivotal role and are strongly linked to government action (Aylward, 2004).

This model has proved successful for rationalizing, coordinating, setting export-oriented priorities and targets, and promoting and socializing a vision for the industry at large.

Accordingly, the main targets of the institutional reforms have been marketing, training, and R&D. South Africa was one of the first latecomers to adopt a similar institutional strategy. A national system of market-oriented R&D institutions has been developing progressively since the late 1990s. Stimulated by the government, in 2002, the South African Wine and Brandy Corporation (SAWB) was established to enhance the industry competitiveness. Technology innovation and market development were among its main areas of intervention along with training of human resources, social promotion, and provision of information about the industry. In 2006, to create a larger consensus among industry stakeholders and in particular to overcome the legacies of the apartheid regime and give proper representation to the interests of black workers and investors, a new single representative body of the industry, the South African Wine Industry Council (SAWIC), has been established. However, the reorganization of the wine industry is far from being completed. Power relations between old and new economic and political groups are still unstable, and the process of "black empowerment," which would enhance the participation of black investors and workers in the wine business, is still incipient and subject to controversy (Toit du, Kruger, & Ponte, 2008; Williams, 2005).

The process of institutional renewal has been slower in Chile. Following years of internal division, in 2007, the wine industry announced the creation of a single representative body. The two major winery associations in Chile, *Viñas de Chile* and *Chilevid*, have merged to form *Vinos de Chile* to provide a single voice, in a bid to achieve a more coherent strategy to guide the entire industry. With regard to research, there has been some collaboration since 2006 with the establishment of two consortia, Vinnova and Tecnovid, supported by the Chilean Economic Development Agency (*CORFO*) through the program *Innova Chile* and involving the two industry associations in partnership with the main research institutions and

universities.[14] Both consortia are aimed at promoting investments in innovation and research in wine-related areas in order to enhance wine quality and to strengthen the linkages between the universities and industry. As described in Section 5(c), these connections are already quite strong and are being further strengthened by the use of appropriate policy instruments.[15]

The Old World countries have been slow in reacting to this evolution. The institutional picture is one of a greater and persistent fragmentation, which results from the historical differentiation of traditional wine regions and from the competitive relevance of local specificities. Besides institutional fragmentation related to regional specificities and inertial mechanisms, the strict regulatory framework has imposed additional constraints and reinforced differences across regions. European producers have to satisfy numerous restrictions on which grape varieties can be used in an appellation, on maximum yield and alcohol content, on vine density, and on irrigation systems. Local wine industries are generally embedded in a dual layer of regulation—national level, especially in the appellation wines categories (DOC and DOCG), and European level within the framework of the Common Agricultural Policy (CAP) (Corsi et al., 2004). This exacting regulatory environment has often been considered as a constraint on the flexibility of European, and particularly Italian, producers to react as quickly as New World producers to rapidly changing international markets (Bell & Giuliani, 2007).

To address this situation EU countries are currently engaged in a restructuring of their wine regulatory frameworks. The recent reform of the EU wine market, applying from August 2009, is aimed at the simplification of wine-making practices and labeling policies, as well as reducing the amount of direct subsidies to producers. In Italy, these changes have been beset with controversy as they seem to address the interest of large industrial groups to the detriment of small wineries, this latter group being the backbone of the Italian wine industry (Castriota & Delmastro, 2009).

Under pressure to adapt to ongoing EU agricultural policy reforms, institutional renewal is also occurring at the national level. France is undertaking a profound restructuring of wine-related institutions, aimed at rationalization and simplification through the establishment of a national bureau to manage research, and EU funds and to coordinate 10 regional offices representing the main geographical wine production areas.

On the other hand, the Italian institutional framework is still highly fragmented. All the main regional production areas have their own supporting institutions and research centers. Policy decisions are taken at many different levels, leading to high coordination costs and often misleading and contradictory objectives; research activities involve a large variety of institutions, whose specialist fields often overlap. Both PROs and universities conduct research on wine, with the latter playing a leading role in Piedmont and in Italy, along with some well-established enological colleges, such as the Oenology School of Alba. Nevertheless, although the direct link between the industry and the research centers may appear rather weak, in the case of Piedmont this is reinforced by the presence of important quasi-public intermediate extension organizations, which act as hubs for dissemination of knowledge to companies (Morrison & Rabellotti, 2007).[16] Overall, the extension and R&D systems in Piedmont appear to satisfy local needs and be well suited to dealing with the development of market niches for differentiated and unique products. In this sense, the organization of the innovation system appears to be consistent with the competitive emphasis on quality and local specificities. Furthermore, if the producer-driven and highly regulated approach has left much room for the penetration of New World producers in international markets in the last couple of decades, this same institutional framework presents advantages in the light of late evolution in markets (see Section 5(a)). Indeed, in traditional regions, it is felt more and more that highly centralized R&D policies, such as those implemented by New World countries, would be inadequate to tackle the new emerging patterns of diversified demand favored by these traditional producers (Aylward, 2006). Evidence of this shift of perspective can be also found in South Africa, where, for example, the industry marketing organization Wine of South Africa (WOSA) has undertaken several marketing initiatives to promote the diversity and uniqueness of local "*terroir*" along with an image of fair and environmental friendly industry.[17]

6. CONCLUSIONS

The last several years of technological evolution and global competition in the wine industry represent interesting illustrations, which may add to the knowledge of catching up opportunities and strategies in the agro-food industry. Building on original empirical evidence and information from secondary sources, the present paper interprets what has recently happened in the wine industry as the story of a trajectory of co-evolution on the demand and supply sides, which has led to the emergence of a novel, knowledge-based, market-driven model, challenging the producer-driven approach of incumbents.

Since the late 1970s, changes in consumers' attitudes and tastes—mainly the increasing popularity of wine as a beverage and the diffusion of wine drinking to relatively inexperienced consumer groups—along with the growth in mass distribution channels, have opened the way for standardized and easily identifiable wine varieties. New World producers, first from California and Australia, and more recently from developing countries such as Chile and South Africa, have been quick to take advantage of this discontinuity.

Contrary to what has occurred in other industries, the spectacular performance of latecomers is not only the result of adaptive strategies or market segmentation and a focus on specific niches. Rather, emerging countries, following the path opened by other New World producers (i.e., California and Australia), have significantly contributed to the process of technological modernization, product standardization, and marketing innovation, which have proved consistent with and even favored changes in demand. The strategy of "building up" wine products to fit with international tastes is based on an innovative scientific approach to production, in which economies of scale and the timing and alignment of R&D strategies with market objectives are key competitive drivers. Access to foreign knowledge and linkages between local research communities and global networks have been feeding this process of modernization, contributing to the diffusion of this approach across both the New and Old World.

This market-driven scientific turn has had enormous effects not only on the industry knowledge base but also and importantly on the relevant industry actors. Universities and scientists have emerged as key players, and the ties between industry and research institutions have become ever more important and are being strengthened across the New World by institutional changes. Following the early successful Aus-

tralian experience, a top-down planning approach has diffused, with industry associations and research bodies strongly linked to government action and research efforts, explicitly tuned to export-oriented strategies. These institutional innovations have taken place within a framework of increasing concentration at industry level, mirroring global marketing strategies and large-scale retailing.

The initial response of traditional producers has been to strengthen the long-established producer-driven approach, based on context-specific and cumulative learning processes, traditional varieties, and wine making techniques, all highly embedded in specific local cultures. The strict regulatory framework has imposed additional constraints on the ability—or possibility—to react as flexibly as New World producers to the rapidly changing international markets. In traditional wine regions, exemplified by Piedmont, the industry has been largely unaffected by the international wave of consolidation, remaining highly fragmented and constrained in the access to large-scale retailing. Fragmentation has also characterized the policy level and that of supporting institutions, such as business associations and the research infrastructure.

However, more recently the Old World has begun to respond to the increasing competition from the New World through strategies related to diversification and experimentation for upgrading. These strategies address the demand side evolutions, mainly the diffusion of a gourmet culture, in which wine drinking is perceived as contributing to a richer cultural experience, and variety and specificity are positive attributes. In this perspective, highly centralized R&D policies, such as those implemented by New World countries, are perceived to be increasingly inappropriate to tackle the emerging pattern of diversified demand. Indeed, in this perspective, the traditional regions' endowments of wine culture, labor market, localized linkages, and dense institutional infrastructure represent a valuable asset.

If what has happened in the wine industry illustrates that opportunities for sectoral-driven catching up arise at times of significant industry transformation, the most recent changes in the demand and supply side have opened the way for the co-existence of highly diverse institutional models and innovation strategies. In particular, developing regions have first taken advantage of the windows opened by affluent newcomers, following them into a market-driven scientific approach to production in a traditional industry. This top-down approach, however, has proven demanding in terms of institutional building and governance capacity, and its implementation more difficult in contexts characterized by political instability or institutional weakness. Furthermore, the late emergent patterns of diversified demand have provided incentive and created room for differentiation in developing regions that have so far entered international markets with strong national brand strategies.

To conclude we would like to point to the original contributions of this study to the literature on catching up. First, it is one of the few studies that focuses on catching up in the agro-food sector; most studies focus on manufacturing, including telecommunications, software, information and communication technologies, automobiles, and electronics (Altenburg *et al.,* 2008; Katz, 2000; Lee & Kim, 2008; Niosi & Reid, 2008). Second, the study combines secondary sources with original micro level data on firms and researchers to analyze catching up within the framework of SSI. This is not to say that this approach is exempt from limitations. We recognize that other theoretical perspectives, in particular the Global Value Chain framework, have proved to be important lenses for the researcher who wants to investigate the factors behind the competitiveness of various sectors in developing countries (in particular on the wine industry see Ponte & Ewert, 2009). We also acknowledge that our approach might have put more weight on the analysis of scientific institutions and technology-related innovations, rather than on issues like governance mechanisms, the international distribution channels, and the resulting power relations. Moreover, our findings may show some bias, being focused only on one industry and few countries. Thus the implications for catching up from this work would be made more robust by further empirical analyses both along the same lines and following other theoretical perspectives. Nevertheless, this study shows that the wine industry represents an extremely interesting case of technological renovation driven by affluent newcomers and the dynamic adoption and adaptation of research-intensive strategies by emerging countries, which, following different trajectories, have moved the competitive game into new playgrounds.

NOTES

1. Wines are commonly ranked on a six-point scale, from the best to the lowest quality (i.e., icon, ultra premium, super premium, premium, popular premium, and basic) with consumer prices ranging from less than €3 (basic) up to more than €150 (icon). Wines in the premium segment are in the price range between 5 and 7€ (Heijbroek, 2003).

2. It is worth highlighting that Italy has been a traditional producer and exporter of bulk wine. Nevertheless in the last few decades we observe in this country a significant shift toward quality wine (see Table 1).

3. Data are from Faostat (2009).

4. "*Terroir*" is a French term used to denote the special characteristics of an agricultural site, in terms of soil, weather conditions, and farming techniques, each contributing to the unique qualities of the wine.

5. France is still the most important market for wine with a 32.2% share of world consumption, followed by Italy (26.9%) and United States (26.5%) (OIV, 2009).

6. The attribution of these appellations depends on strict regulations that establish production area, grape varieties that can be used in a particular regional blend, vine yield, wine/grape yield, alcoholic content, production and ageing methods, and the type of information that is put on the wine label. As discussed in Section 5(d), this regulation has changed since August 2009 as part of EU agricultural policy reform.

7. A non-profit organization promoting this philosophy with a wide visibility in Italy and increasing popularity in other parts of the world is the *Slow Food* movement, founded in Piedmont in 1989 (www.slowfood.com).

8. It is worth to be noticed that this result can be partly ascribed to a size effect: researchers in smaller countries have fewer opportunities for domestic collaborations and in turn a higher proportion of international linkages (Glänzel & Veugelers, 2006). In particular, in Chile and South Africa, the national community of researchers involved in wine-related activities is much smaller than in Italy and, therefore, there is greater scope for linking up with foreign researchers.

9. The four profiles have been defined with the assistance of technical experts in Italy and checked with technical experts in Chile and South Africa. The first profile identifies "recipients" of experimental results. These are firms which mostly conduct simple experiment on occasional basis or make the company's facilities (vineyards and cellars) available for that purpose to research organisations, eventually accessing and sharing the results with other firms. The second profile depicts rather "passive" innovators, which mostly rely on embodied technology and inputs from suppliers. Experimentation is conducted through simple empirical observations of the performance of those inputs. The third profile describes firms which add to these empirical observations significant effort for data gathering and analysis of results (e.g. organoleptic tasting). The fourth profile comprises firms, which directly conduct advanced experimental activity, consisting, for instance, selection of grape clones in old vineyards or of native yeast through in-vitro growing techniques, followed by distinct microvinification (e.g. to test resistance to illness).

10. In our sample, export intensity is significantly and negatively correlated with the introduction of new grape varieties among these firms.

11. *Constellation Wines,* a part of the US group *Constellation Brands*, is the largest wine company in the world. The second and the third largest wine producers are also from the USA, E&J Gallo Winery and The Wine Group. In Australia, *Foster's* take-over of the second largest wine maker Southcorp has made it the 4th largest wine group in the world (Rabobank World Wine Map 2008).

12. Among the largest wine companies in the world there are three French groups: the wine branch of the luxury group *LVMH*, mainly specialized in champagne, *Castel Frères* and *Pernod Ricard*, which has been very active in foreign operations in Australia, Spain, New Zealand, and Argentina.

13. *Costellation Brands* and *Foster* are multi-beverage conglomerates. However, the figures reported in the paper refer only to their wine divisions (retrieved from www.cbrands.com and www.fosters.com.au/media.htm). Also, South African Distell sells wine as well as spirit and cider but here we focus on turnover from wine sales as presented in Mediobanca (2009).

14. With the unification of the two associations, the two existing consortia have also begun to be managed jointly.

15. Among these instruments are a number of initiatives promoted by CORFO such as the *Proyectos de Fomento* (Profos) and the *Consorcios* (Moguillansky *et al.*, 2006).

16. A prominent example is *Vignaioli Piemontesi*, the largest association of wine and grape producers in Italy, with more than 8,000 members. *Vignaioli Piemontesi* participates directly in many of the research projects ongoing in Piedmont, acting mainly as a technical partner and providing access to technical information and knowledge for small firms and farmers.

17. For more information see http://varietyisinournature.com. For a critical analysis of this and related initiatives see Toit du (2002) and Toit du *et al.* (2008).

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APPENDIX A

Key informers interviewed in the three countries are:

Chile: Chile Vid, Viñas de Chile; Vinnova (Research Consortia); Corfo (National Economic Development Agency); Corporacion Chilena de Vino; Fundacion Chile; Servicio Agricolo y Ganadero (National Extension Agency); National Oenology Association; Cepal-United Nations; the Faculty of Viticulture and Oenology and the Faculty of Engineering at Universidad Católica; the Faculty of Viticulture and Oenology, the Faculty of Medicine and the Faculty of Economics at the Universidad de Chile; Universidad de Talca; Universidad de Concepción; Universidad Tecnica Federico Santa Maria; Universidad de Santiago; National Research Institute for Agriculture (INIA).

Italy: In Regione Piemonte the Regional Advisory Phytopathological Service and the Department of Agriculture; Vignaioli Piemontesi (extension agency and wine growers association); Barolo Langhe and Barbera Monferrato Consortia; technical high schools in viticulture and enology (in Alba, Asti, Cussanio, Bibbiana); the Institute of Plant Virology of the National Research Council (CNR); the Agriculture Research Council (CRA), the Experimental Institute of Oenology and of Viticulture; the Department of Arboriculture and Pomology and the Faculty of Agriculture at the University of Torino; the Faculty of Pharmacy at the University of Piemonte Orientale. Moreover, in Piedmont we have also drawn on information gathered in previous research projects conducted by two of the authors (see Morrison and Rabellotti, 2007, 2009).

South Africa: Wines of South Africa (WOSA), South African Wine Industry Trust (SAWIT); ARC-Nietvoorbij Institute for Viticulture and Oenology; Wine Industry Network for Expertise and Technology (Winetech); VinPro; Wine

and Spirit Board (WSB); the Departments of Agriculture Economics, Viticulture and Oenology, Forestry and Wood Science, Zoology and the Institute for Wine Biotechnology at the University of Stellenbosch; the Graduate Business School at the University of Cape Town; the Human Sciences Research Council in Cape Town.