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

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Abstract

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 as well as secondary sources, this paper shows that emerging countries with diverse institutional models and innovation strategies, have been driving the process of technological modernization and product standardization. Newcomers in the wine sector have responded particularly effectively to changes in consumption habits, and in aligning emerging scientific approaches with institutional building efforts and successful marketing strategies.

Keywords: Catching up, Wine sector, Sectoral Systems, Chile, South Africa, Italy
JEL Codes: O13, O30, O38, O57

1. Introduction

Up to the end of the 1980s, European countries, and particularly France and Italy, dominated the international market for wine. Since the beginning of the 1990s, their supremacy has been under attack due to the spectacular performance in terms of both exported volumes and values, of new international players. The so-called 'New World' countries eroding the long established position of traditional (Old World) producers, includes affluent nations that are relatively new to the wine sector such as USA and Australia, and less developed countries 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, as it provides empirical evidence on how some emerging economies have been able to acquire significant shares of the international market in a dynamic sector. The emphasis on 'dynamic sectors' as the target of the catching of backward countries goes back to the pioneering work by Gerschenkron (1962) and the recent neo-Schumpeterian literature on Sectoral Systems of Innovation (SSI), which emphasizes differences across industries in the factors at the basis of catch up (Malerba, 2006; Malerba and Nelson, 2007).

In the wine industry, a number of different factors have contributed to the emergence in the international market of New World wines. On the supply side, a process of technological modernization and pervasive organizational change has been spurred by consistent investment and research effort in the new producing countries and supported by the establishment of specialized research institutions. The demand side has also been important in the wine industry's evolutionary trajectory, with New World players being particularly responsive to changes in wine consumption habits across the world, and aligning emerging scientific approaches and institutional building efforts with their branding and marketing strategies.

Given the multiplicity of factors involved in the evolution of the wine industry, a SSI approach provides a useful analytical framework for interpreting its trajectory and the New World catch up experiences. It offers a conceptual device that helps to disentangle the complex web of interactions between markets, firms, research organizations and government bodies, and to identify key factors and feedback mechanisms underlying the catching up process. The SSI approach takes account of the fact that it is the co-evolution of interrelated supply and demand dimensions that explains the emergence of New World countries in the international wine market.

In this paper, the catching up process 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, which provides new empirical evidence on academic researchers and wine cellars in these three areas.

We argue that the emergence of New World producers has been favoured by significant discontinuities in both technologies and market demand and implies a co-evolution of physical and 'social' technologies (Nelson and Sampat, 2001), that is, of formal and informal institutions supporting the adoption of knowledge oriented procedures and a novel division of labour among the main industry players. The rapid adoption of a scientific approach to a rather traditional industry, and co-ordination between research communities and wineries, has spurred New World performance.

This perspective shows that catch up experience in the wine industry significantly differs from successful catch up trajectories in other industries: in the wine sector the emerging countries have been driving 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 sustaining diverse development trajectories. Our 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 persisting heterogeneity among catching up countries.

Overall, this paper contributes to the literature on catching up by providing new empirical evidence 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 briefly 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

2.1. Catching up by countries and in dynamic sectors

The economic growth theory prevailing in the 1950s and 1960s referred to catching up as the ability of a country to reduce the gap in productivity and income with respect to the leading international countries through investments in physical and human capital. According to this perspective, access to technology is not an obstacle because it can be achieved through technology transfer, that is, import and adaptation of technology and organizational models developed in advanced countries, whose benefits are assumed to trickle down and diffuse within the economy at large. Latecomers are represented mostly as users rather than producers of technology. Thus, in this view, 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).

The appearance of new empirical evidence on catching up and leapfrogging in the Newly Industrializing Countries (NICs) in Asia produced a new conceptualization of the catching up process (Nelson, 1998), focused mainly on capabilities, learning and institutions. Perez and Soete (1988) argue that windows of opportunity are opened to latecomers, particularly during shifts 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 (Abramovitz, 1986; Justman and Teubal, 1991; Niosi and Reid, 2008). The Asian experience points at the relevance of absorptive, innovation and linkage capabilities in domestic firms (Altenburg et al. 2008; Bell and Pavitt, 1993; Lall, 1992, Kim, 1997).

Following Abramowitz's (1986) pioneering contribution on the institutional and political conditions needed for successful catch up, numerous contributions have tried to identify the factors influencing this process. For example, the importance of large investments in institutions and especially in higher education and research infrastructure, has been stressed (Fagerberg and Godinho, 2005; Mazzoleni and Nelson, 2007; Mytelka, 2004; Niosi, 2008). As the key technologies of different eras require different sets of supporting institutions, successful countries

are those that have the bases of these institutions already in place when they are needed, or can manage to build appropriate new institutions rapidly and effectively (Perez and Soete, 1998; Nelson, 2008).

Although the empirical literature is mostly focused on countries, the process of catching up is also associated with the emergence of certain leading sectors, including recently the auto and electronics sectors in Korea (Lee and Lim, 2001), and electronics in Taiwan (Amsden and Chu, 2003). At sectoral level, and particularly with respect to high tech industries, empirical work tends to focus on engineering excellence and rapid entry into new market segments as the common elements in the successful experiences of Asian newcomers (Hobday, 1995; Kim, 1997; Lee *et al*., 2005), while Nelson (1998) emphasizes the systemic character of innovation as a key dimension of any investigation of catch up experience.

Thus, as Malerba (2006) stresses, a systemic perspective on the sectoral dynamics of innovation is relevant to analyse the determinants of the catch up process because it identifies the key elements that are different and specific to each industry and within the same industry, in different countries. This approach is introduced in the literature through the concept of SSI (Breschi and Malerba, 1997).

2.2. Sectoral Systems of Innovation

The SSI perspective focuses on sector-specific patterns of evolution, on their commonalities across countries and regions, and on the interplay between general sectoral dynamics and idiosyncratic factors, which account for differentiated performance and evolutionary paths.

Following Malerba (2004), a SSI is the specific set of new and established products used by heterogeneous actors interacting in the creation, production and sale of 'sectoral products'. Knowledge, learning processes and technologies, actors, networks and institutions are the building blocks of a SSI, the basic dimensions of analysis for understanding the learning and innovation processes specific to a sector, and the factors at the basis of the catching up strategies of firms and countries in a sector.

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 (Dosi, 1998; Nelson and 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 an 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. There are also business associations, technical, training and financial institutions, trade unions, government agencies and universities (Malerba, 2005). In particular, Public Research Organizations (PROs) are acknowledged to be 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 and Nelson, 2007). National factors also affect the main actors' functions, organization and networks of relationships, inter-playing with sectoral specificities related to the features of the knowledge base that generate various common traits across countries.

Demand is also vital for the evolution of a SSI, as it represents an important stimulus to change and may spur the emergence of a SSI; 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 behaviour. Changes in demand imply substantial modification to the context in which firms operate, and may favour the entry of new firms and/or the out positioning of established ones that find it difficult to recognize or to adapt to new markets when they open up (Christensen and Rosenbloom, 1995).

Finally, there is the *institutional framework* dimension of the SSI, which cuts across all the other dimensions, and encompasses the laws, standards, norms, routines and established practices that shape agents' cognition and behaviour and influence their interactions (Coriat and Weinstein, 2002; Malerba, 2004). At the institutional level there is strong interplay between sectoral specificities and national or regional factors. On the one hand, national institutions, such as the system of property rights, the education system, the norms ruling university research and its interaction with industry, and antitrust or labour market regulation, largely explain the different development paths and innovative dynamics within the same sectors across countries (Lundvall

et al., 2002). On the other hand, they may induce different effects across industries through their different coupling with the other defining dimensions in the sectoral system.

As Malerba (2006) indicates, the long run dynamic interaction between national factors and sectoral systems is an open research question requiring robust comparative analysis. Investigating the trajectories and timing of catch up experiences through the SSI lens may shed new light on the conditions that favour the opening of windows of opportunities to latecomers. Furthermore, as the empirical literature is dedicated mostly to high tech and large scale manufacturing there is a need to extend the analysis to other sectors. In this respect, considering their relevance in the developing world, traditional sectors and the agro-food industries would seem a worthy research target (Arocena and Sutz, 2000).

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

3. Catching up in the wine industry

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 USA, Australia, 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 (Aylward, 2003; Aylward and Turpin, 2003).

Up to 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 emerging areas, which have managed to acquire important shares in the global market (Figure 1). In volume terms, the share of world trade of European exporters has declined from almost 95% in the late 1980s to 71% in 2007, while the New World share, which accounted for only 5% of world export in the 1980s, reached

29% in 2007 (OIV, 2008). Over the ten years 1996-2006, volumes of exports from the New World countries have increased dramatically, at the rate of 350% for South Africa, around 280% for Australia and Chile, and 190% for the USA (European Commission, 2007). 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 USA, and it has become the biggest exporter to the UK; similarly, Chile has become the fifth largest exporter to the USA.

FIGURE 1 HERE

The remarkable performance of the New World countries becomes even more evident when we look at export values, whose growth testifies to the upgrading along the quality ladder and the entry into the premium market segments that used to be contended by French and Italian wines. For instance, since the early 1990s, premium exports[1] have contributed to 97% of the growth in the value of Australia's wine exports, the frontrunner among the newcomers. Accordingly, the unit price of Australian wines went up from US$1.22 per litre to US$3.14, ranking it second to France and ahead of a historical quality producer, Italy (Table 1). Chile and South Africa are specialized in lower quality segments, but the unit value of their exports has been gradually converging towards the world average, and has more than doubled in absolute terms since the early 1990s. As a consequence of quality upgrading and volume expansion, the value of Chile's wine exports has increased from US$72 million in the first half of the 1990s to almost US$900 million in 2004, and South Africa's from less than US$200 million in the second half of the 1990s to more than US$500 million in 2004.

TABLE 1 HERE

Overall, these figures suggest that the upsurge of New World producers is not an anomaly, since they have acquired a significant position in the international market in both volume and value terms. We adopt an SSI approach to investigate the role played in this process by the interrelated

[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). Wines in the premium segment are characterized by brand recognition and appellation of origin; their price ranges between €5 and €euro (Heijbroek, 2003).

dimensions of demand, knowledge content and technology, main actors and networks, and institutional framework.

4. The comparative analysis

4.1 Some background information

For the purposes of investigating the main interrelated dimensions of catch up in the wine industry, we 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 and South Africa are two emerging countries, which are representative of different tiers of New World competitors, in which Chile is considered a frontrunner among New World producers. Since the mid 1970s, apart from a dip in the early 1990s, Chile's production growth rates have been dramatic and its share of exports in total production has risen to nearly 50%, a significantly more rapid rise than in other New World countries. This has produced an extraordinary transformation in the structure of production and trade (Bell and Giuliani, 2007).

The tradition of wine making in South Africa dates back to the 17th century. After the end of Apartheid in 1994, the whole South African economy including its wine industry has undergone profound structural reforms. 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 towards 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 oenology and viticulture techniques. As a result, over the last ten years the South African wine industry has experienced a rapid boost in exports and in 2004 accounted for 3.1% of world wine production and was ranked 4th among the New World producers and 9th at world level (Anderson and Norman, 2006).

Italy is one of the traditional wine producing countries and one of the world's leading wine producers, ranked second after France and accounting for 18% of world production in 2004

(Anderson, 2006). 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 towards 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, with a share of about 20% of all Italian exports in 2005. The Piedmont wine region is comparable in size to the wine industries in Chile and South Africa. In 2006, wine exports in Piedmont amounted to US$700 million, ranking it between Chile (US$900 million) and South Africa (US$530 million).

4.2. *The data*

The study is based on original empirical data on industry players and the research community, collected through in-depth interviews and country surveys. Interviews with key informants and privileged actors, from local research centres, universities, extension agencies and business associations, provided in-depth qualitative information on the institutional and historical transformations that have occurred in the different national contexts.

These key informants also assisted in the selection of the sample of dynamic *wine firms* (37 in Piedmont, 27 in Chile, 20 in South Africa) which were administered a questionnaire in the period October 2005 to October 2006. The empirical investigation was designed to obtain insights into the activities and strategies of those players supposedly leading innovation.

The firms interviewed exhibit differences across countries that are consistent with the diversity of the features of the main industry actors, which are analysed in more detail in Section 5.3. Piedmont producers are relatively small in terms of employees and hectares (although less so in terms of sales), reflecting the fragmentation typical of traditional wine areas; the Chilean sample is composed of fairly large firms, usually belong to a group, in some cases an international group. These firms contribute to the dynamic of concentration and rationalization that characterizes

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 is mostly related to domestic capital. In terms of exports, in our sample, Chilean firms are the most focused on international markets, while the majority of Piedmont and South African producers have important markets within their own countries (Table 2).

We also surveyed the population of *researchers* in universities and research centres whose work focuses on wine-related issues, spanning several disciplines (e.g. viticulture, oenology, agronomy, agriculture, microbiology, genetics, chemistry, engineering). We sent questionnaires to 40 academic researchers in Chile, 42 in South Africa and 53 in Piedmont. In order to introduce some measures of the quality and performance of the researchers interviewed, we refer to international publications and citations in peer reviewed journals, as reported in the ISI Web of Knowledge.

TABLE 2 HERE

5. The main dimensions of the wine SSI

5.1. Demand

The demand side plays a central role in the industry's evolutionary trajectory. New World producers have not only upgraded the quality of their wines, but they have also addressed and taken advantage of changing consumer tastes, ending what Aylward (2003) describes as the historical monopoly of Europe over the wine culture. The New World expansion has changed the way wine is valued in terms of flavour, variety and national origin (Cohen and Labys, 2006), forcing adaptations in the organization of production and research and in the marketing strategies of Old World 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 of wine drinking (e.g. Italy, France, Spain), and other affluent countries with an incipient wine culture (e.g. UK, Scandinavia, US). In the 1980s, a 'gourmet culture' began in the rich countries, increasing the popularity of wine as a 'beverage', and consolidating a preference for *cabernet*,

sauvignon, *merlot* and *chardonnay* varietal wines, typically produced in the New World (Cohen and Labys, 2006). These changes in taste were accompanied by a sharp decline in wine consumption in almost all wine producing countries. Between 1985 and 2004, consumption fell sharply in France (-35%) and Italy (-20%), a decline that was partly compensated for by growing demand from the Northern European countries, the former Soviet Union and China (European Commission, 2007).[2] 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 EU.

Other demand side, qualitative changes favoured the emergence of New World producers. Among the more affluent and educated consumers, wine drinking gradually became a 'cultural experience', a sensory approach to other cultures where history, origin and variety complement taste. This cultural change was quickly embraced and promoted by European wine producers, who encouraged the diffusion of knowledge about '*terroir*'[3] and quality varieties, and a link between wine drinking and lifestyle. The idea of wine drinking as part of a wider cultural experience became the stimulus among educated consumers for 'tasting' other cultural products, including New World wines.

What is interesting is that this pervasive demand side change has substantially modified the role of the consumer in the industry. Definition of wine 'quality' is no longer the exclusive domain of wine producers; beyond any intrinsic characteristics the ultimate criterion of quality is the value perceived by the market (Aylward and Zanko, 2006). 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, whose wine purchases are mainly made in supermarkets.

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 US, 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 *et al.*, 2006). This consolidation among distributors has made it increasingly difficult for smaller producers to get

[2] France is still the most important market for wine with a 32.2% share of world consumption, followed by Italy (26.9%) and USA (26.5%) (OIV, 2008).

[3] "*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.

their wines onto the shelves. Wholesalers and supermarkets prefer to stock only the top selling brands, at the expense of small or 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 producing wines sold under a myriad of different labels.

These quantitative and qualitative changes in the market were embraced first by California, the first New World region that posed a threat to Old World dominance. US wine experts played a major role in initially changing established patterns of perception and the reputations 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' 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).

This picture is partly confirmed by our investigation of innovative firms in Piedmont, Chile and South Africa. Table 3 shows that Chilean and South African firms are positioned in the medium segment of the market, not too distant from the Italian wineries which tend to specialize in wines in the upper segment of the market (i.e. ultra-premium and icon wines).

TABLE 3 HERE

The response of Old World producers to the aggressive marketing strategies of New World countries was to emphasize the concept of '*terroir*', and maintain 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 and Pick, 1999; Aylward and Zanko, 2006). Their response left much room for the

penetration of New World producers in a changing world market and is forcing substantial changes in Old World strategies (see Section 5.4).

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.[4]

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, 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.[5]

5.2 Knowledge base and technologies

5.2.1 Science and researchers

Since the 19th century, when oenology became and 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 (Giuliani, 2006). For many years, inputs from science mainly were used to inform the areas of microbiology and wine fermentation, in traditional production methods, typically based on the idiosyncratic knowledge and experience and manual dexterity of farmers. 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

[4]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 5.4, this regulation will change in 2009 as part of EU agricultural policy reform.

[5] 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).

"*terroirs"* in France and Italy, and implied context specific learning processes and knowledge cumulativeness.

In the New World, the local industry, initially developed by colonial settlers and based on imported root stock, was sustained traditionally by simple oenological culture and research, and for a long time was confined to local markets and the production of bulk wine. However, since the mid 1980s, the emergence of New World players in the international wine market has corresponded with the take off in these countries of an intense process of modernization, driven by strong involvement in scientific research, innovative approaches to markets, branding and business systems, and large investments in human resources (Aylward and 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 towards responding to (and further strengthening) changes in demand. One of the focuses of research has been on the introduction of new grape varieties, and 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 scientific breakthroughs, but on consistent modernizing research-based approaches.

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 and Veugelers, 2006). From the early 1990s to 2006, scientific publications on wine-related issues, mostly within Food Science & Technology, but increasingly spanning Biology and Biotechnology, recorded a growth rate five times larger than the average across the spectrum of scientific disciplines (Figure 2).

FIGURE 2 HERE

The New World's dynamism in terms of scientific research output has been sustained over the last decade, with the number of publications doubling annually - although in absolute terms Chile and South Africa both lag behind Italy – with respective total publications over the period 1992-2006 being 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 7 (France, Italy, Germany, Spain, Canada, USA and Israel) in the period 1992 to 1997, to 36 in the period 2002 to 2006 (Cassi *et al.*, 2008). 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. Analysis of co-authorship, however, depicts a diverging trend in the degree of openness of research communities (Cassi *et al.*, 2008): the degree of international openness of Italian scholars has decreased whereas in Chile and, particularly, South Africa there is a growing trend towards greater foreign collaboration (Table 4). This result is partly explained by a size effect: researchers in smaller countries tend to have fewer opportunities for domestic collaborations and a higher proportion of international ones (Glänzel and 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 need and incentives to link up with foreign researchers.

Differences also emerge for geographical span of collaborations. Although Italy, France, Spain and Germany are still perceived by New World producers as important centres for the generation of scientific knowledge, the USA and Australia have emerged recently as key players.

TABLE 4 HERE

5.2.2. Innovation and firms

The increased importance of scientific research is demanding changes to 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 wine producers and sometimes by wine regions, have significantly contributed to the rapid transfer of scientific advances and technologies, and have emerged as key actors in the global wine system and symbolize the New World's leading role in modernization (Aylward and Zanko, 2006; Lagendijk, 2004).

This is confirmed by our investigation of innovative firms, and particularly comparing those in Chile and Piedmont. Table 5 shows that the Chilean firms rely largely on external agronomists and oenologists, while firms in Piedmont have higher levels of in-house technical competencies, and are less likely to collaborate with external consultants. Also, in Piedmont wine producers rely exclusively on experts from the same region, while firms 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).

TABLE 5 HERE

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 copying external technologies, but also creative adoption of and selection among, accompanied by mastery of 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.[6] Table 5 shows that Chilean (81.5%) and Italian (70.3%) producers are concentrated in the two upper categories, with Italian wineries clustered in the top category (27.0% vs. 14.8%), while the distribution of South African firms is skewed towards the lower categories. It is also interesting that the most advanced experimenters are generally large firms - in Chile, Italy and South Africa (respectively, €32 million, €18 million and €4 million of sales on average).

It is also interesting to examine the fields in which innovative firms invest. In Chile and South Africa, firms are more likely to invest in new grape varieties and clones, than in Piedmont. According to some of our key informants, these investments are aimed at changing and

[6] The four profiles were defined with the assistance of technical experts in Italy and checked with technical experts in Chile and South Africa.

broadening the type of product supplied to the market in order to respond to international tastes. Innovative producers in Piedmont, on the other hand, prefer to address established national (or even regional) markets and international outlets, with traditional varieties,[7] and engage largely in process related investments to improve or acquire new machinery and equipment for the vineyards and cellars.

5.3. Actors and networks

The new competitive context, based on technological modernization, 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 world-wide: 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 and Wood, 2004). However, international acquisitions is also 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 oenological techniques are the driving forces behind the recent consolidations and the wave of alliances that have occurred in the wine industry worldwide (Anderson *et al.*, 2003). The process of concentration and rationalization concerns most New World regions to different extents, with the three largest companies coming from the USA.[8]

Among the newcomers, Chile's industry showed remarkable growth during the 1990s; its number of wineries increased, the largest being *Vina Concha y Toro*, which is the 9th largest in the world in terms of production volume. 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,

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

[8] Constellation Wines is the largest wine company in the world, belonging to the Constellation Brands group, a world leader in beverages, which has recently increased in size and scope through an aggressive takeover strategy. The second and the third largest producers are 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 group in the world (Ponte and Ewert, 2007).

2004), but there is increasing participation of foreign capital in the sector (Moguillansky *et al.*, 2006).

South Africa has been less affected by the trend towards consolidation due in part to the still limited expansion of vineyards based on lack of suitable land and small industry profit margins (Ponte and Ewert, 2007). International players, such as *Gallo* and *Pernod Ricard,* play a minor role in the country, with activities related mainly to marketing and branding agreements with local firms.

While New World wine companies are vertically integrated, the long established wine making regions in Europe in general are characterized by fragmented industry structures, the process of concentration here being rather slow. However there are significant differences among Old World wine countries. While French companies have grown in size and expanded overseas,[9] Italian companies are still small and mainly family based. The two largest Italian companies are cooperatives - *GIV* and *Caviro* - with turnovers in 2007 of €290 million and €280 million respectively (Mediobanca, 2008). The total sales of the top five Italian wine producers is only €1 billion, much less than the world leaders such as *Constellation Brands* which reached almost €4 billion (Mediobanca, 2008).

In addition to highlighting the presence of large firms, the technological changes of recent decades have brought research institutions, technology transfer organizations and innovation-oriented alliances to centre stage in the industry. The creation and continued strengthening of institutions specialized in research and training has been a major driver of growth in New World areas such as California and Australia. And 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 national and foreign professionals in the wine industry. We found that joint research agreements are the most diffused type of

[9] Some wineries have become part of large multidivisional groups, such as the wine branch of the luxury group *LVMH*, mainly specialised in champagne, and *Castel Fréres*, the largest European wine company, which is among the top ten wine producers in the world. With regard to foreign operations, the Paris based beverage group *Pernod*

collaboration in Italy and Chile, while in South Africa relationships are mostly based on informal contacts or industry commissioned research with universities.[10] Overall, Italian researchers have fewer links with the industry (59.3%) compared to South African (81.4%) and Chilean (92.5%) researchers while Chilean and South African researchers in universities and PROs are more involved in consultancy than their Italian colleagues. Confirmation of the less intensive nature of the relationships between university and industry in Italy comes from our interviews with innovative firms: Italian firms consider research centres to be much less important sources of information for innovation, than do Chilean and South African firms.

As described in more detail in Section 5.4, the different degrees of contact and involvement of researchers in industry projects also depend on the different institutional frameworks and the policy initiatives implemented in the countries under investigation.

5.4 The institutional framework

Institutional changes have played an important role in the trajectories of evolution and catch up of New World producers. The successful experience of Australia has become best practice for adoption by latecomers, in particular South Africa and more recently Chile. The Australian model is rather centralized, with two main actors, the Australian Wine and Brandy Corporation, which is the national sectoral organization, and the Australian Wine Research Institute, which is the national research body, playing a pivotal role, but 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.

Spurred by the successful experience of Australia, other New World countries have adopted a similar institutional framework, one of the first being South Africa, where a national system to support the wine industry has been developing progressively since the late 1990s. Stimulated by government, the South African Wine and Brandy Corporation (SAWB) was established to enhance competitiveness. R&D and marketing promotion are among its main areas of

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Ricard has become the third largest wine maker in Australia and the first wine producer in Spain, New Zealand and Argentina.

[10] The analysis of university-industry linkages in the same contexts of this article is the focus of Giuliani *et al.* (2008).

intervention along with training of human resources and social promotion. SAWB has also set up a business unit (Wine Industry Network of Expertise and Technology - Winetech) specifically to finance and promote applied research in the wine sector. Thus, the export orientation of the industry, the major concern of the early industry bodies, has now become integrated within a more comprehensive governance structure. Collaboration and interactive learning among industry and public bodies have sustained the industry's export orientation and promoted R&D. The South African industry has found a champion in the South Africa Wine Trust (SAWIT), which has acted as a catalyst in the launch of a visionary industry-wide exercise (Strategy 2020) and also contributed to the 'The South African Wine Industry Strategy Plan' (WIP) (SAWB, 2003). This is another step towards consensus among industry stakeholders and led to the foundation at the end of 2006, of the South African Wine Industry Council, the new single representative body of the industry.

The need for collaboration in the Chilean wine industry has become urgent, although it is only recently that there have been moves towards a major institutional renewal. Following years of internal division, In 2000???? 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. There has so been some collaboration in the research field, with the establishment in 2006 of two consortia, supported by the Chilean Economic Development Agency (*CORFO*) through *Innova Chile* and involving the two industry associations in partnership with the main research institutions and universities. Both consortia aim to promote investment 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 5.3, these connections are already quite strong, and are being further strengthened by the use of appropriate policy instruments.[11]

It is interesting to note that, under pressure to adapt to ongoing EU agricultural policy reforms, France's wine sector is also undertaking a profound restructuring of its institutional framework. The French reform is aimed at rationalization and simplification through the establishment of a

[11] 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).

national bureau to manage research, and EU funds, and to coordinate ten regional offices representing the main geographical wine production areas.

The Italian institutional framework is still highly fragmented. All the main regional production areas have their own supporting institutions and research centres. 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. In the case of Piedmont a number of research institutions participate in R&D projects in wine related fields, funded mainly by the regional government. 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 oenological colleges, such as the Oenology School of Alba.

In the case of Piedmont, although the direct link between the industry and the research centres may appear rather weak, it is reinforced by the presence of important quasi-public intermediate extension organizations, which act as hubs for dissemination of knowledge to companies (Morrison and Rabellotti, 2007). 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. 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. 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 favoured by these traditional producers (Aylward, 2006).

Another important institutional aspect which represents a major difference between the New and Old Worlds, is the regulatory environment. The wine industry in Italy is embedded in a dual layer of regulation: national level, especially in the DOC and DOCG categories (see fn. 7) and European level within the framework of the Common Agricultural Policy (CAP) (Corsi *et al.*, 2004). As Anderson (2004) points out, European producers have to satisfy to 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. This exacting regulatory environment

is seen 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 and Giuliani, 2007). To address this situation, EU countries are currently engaged in a restructuring of their wine regulatory frameworks, reforming the agriculture Common Market Organization (CMO). These changes are aimed at increasing competitiveness among EU wine producers through marketing and promotion, simplification of wine-making practices and labelling policies, as well as reducing the amount of direct subsidies to producers (European Commission, 2007).

6. Conclusions

The last several years of technological evolution and global competition in the wine industry show clear examples of catching up, which may add to the knowledge on catching up opportunities and strategies in the agro-food industry, an extremely important sector in the least developed countries. Building on original empirical evidence and data from secondary sources, the present paper interprets as the story of a trajectory of co-evolution on the demand and supply sides, that has led to the emergence of a novel, knowledge-based, market driven model, that competes successfully with 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 the result of adaptive strategies or market segmentation and a focus on specific niches. Rather, emerging countries have been driving the process of technological modernization, product standardization and marketing innovation, which have proved consistent with and even favoured, 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 the New 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 Australian 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, 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. And in traditional wine regions exemplified by Piedmont, the industry has been unaffected by the international wave of consolidation, remaining highly fragmented and constrained in their 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, 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 inappropriate to tackle the emerging pattern of diversified demand. Indeed, in this perspective, the traditional regions' endowments of wine culture, labour market, localized linkages and dense institutional infrastructure represent a valuable asset.

To conclude we would 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 and Kim, 2008; Niosi and Reid, 2008). Second, the study combines secondary sources with original micro level data on firms and researchers, to analyse catching up within the framework of SSI. We acknowledge that our findings may show some bias being focused on only one industry and few countries; thus the implications from this work for catching up would be made more robust by further empirical analyses along the same lines. Nevertheless, the wine industry represents an extremely interesting case of technological renovation driven by emerging countries, which, following different trajectories, have moved the competitive game into new playgrounds. The main message of this paper is that when opportunities for sectoral-driven catching up arise at times of significant industry transformation, there is space for highly diverse institutional models and innovation strategies.

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Table 1 – Italy, Chile and South Africa in the global wine industry (1975-2004)

B. EXPORT VALUES

		1975-79	1980-84	1985-89	1990-94	1995-99	2000	2001	2002	2003	2004
Value of Wine Exports (millions US $)	France	1.070	1.608	2.950	4.077	5.336	5.166	4.787	5.391	6.609	6.878
	Italy	553	787	954	1.488	2.396	2.356	2.339	2.608	3.030	3.542
	Australia	7	13	49	214	513	860	911	1.224	1.550	2.018
	Chile	10	13	16	72	513	860	911	1.224	1.550	2.018
	South Africa	NA	NA	NA	NA	189	242	241	307	414	535
	World	**2.924**	**4.070**	**5.856**	**8.362**	**12.784**	**12.997**	**12.787**	**14.099**	**17.043**	**19.585**
Share of World Wine Export Value (%)	France	36,6	39,5	50,4	48,8	41,7	39,8	37,4	38,2	38,8	35,1
	Italy	18,9	19,3	16,3	17,8	18,8	18,1	18,3	18,5	17,8	18,1
	Australia	0,2	0,3	0,8	2,6	3,9	6,6	7,1	8,7	9,1	10,3
	Chile	0,3	0,3	0,3	0,9	2,9	4,5	5,0	4,2	4,3	4,6
	South Africa	NA	NA	NA	NA	1,5	1,9	1,9	2,2	2,4	2,7
	World	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**
Unit Value of Wine Exports (US$/litre)	France	1,49	1,66	2,29	3,24	3,43	3,11	2,79	3,30	4,15	4,67
	Italy	0,42	0,48	0,75	1,2	1,34	1,22	1,40	1,58	2,25	2,50
	Australia	1,22	1,7	1,85	2,21	2,85	2,77	2,43	2,60	2,96	3,14
	Chile	0,79	0,95	0,95	0,91	1,87	2,11	2,10	1,73	1,85	1,89
	South Africa	NA	NA	NA	NA	1,85	1,73	1,39	1,36	1,17	1,81
	World	**0,7**	**0,85**	**1,31**	**1,77**	**1,96**	**1,89**	**1,85**	**1,99**	**2,26**	**2,47**
Relative Unit Value of Wine Exports (Relative to World)	France	2,13	1,95	1,75	1,83	1,76	1,64	1,50	1,66	1,83	1,89
	Italy	0,6	0,56	0,57	0,68	0,69	0,64	0,76	0,80	1,00	1,01
	Australia	1,74	2	1,41	1,25	1,46	1,46	1,31	1,31	1,31	1,27
	Chile	1,13	1,12	0,73	0,51	0,95	1,12	1,13	0,87	0,82	0,77
	South Africa	NA	NA	NA	NA	0,96	0,92	0,75	0,69	0,52	0,73
	World	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

A. PRODUCTION AND EXPORT VOLUMES

		1975-79	1980-84	1985-89	1990-94	1995-99	2000	2001	2002	2003	2004
Volume of Wine Production ('000 hl)	France	66.614	67.453	66.088	56.309	57.925	60.109	55.383	56.388	47.500	58.500
	Italy	71.276	76.787	67.470	61.058	56.233	57.044	53.677	45.703	44.000	53.000
	Australia	3.535	3.992	4.391	4.693	6.790	8.592	10.765	12.204	10.860	14.712
	Chile	5.399	7.085	4.007	3.488	4.605	6.674	5.652	7.091	6.870	7.532
	South Africa	NA	NA	NA	NA	8.327	7.620	7.610	8.342	9.560	10.157
	World	**319.335**	**340.626**	**302.867**	**270.274**	**282.708**	**307.257**	**288.556**	**293.601**	**286.451**	**316.892**
Volume of Wine Exports ('000 hl)	France	7.196	9.662	12.905	12.569	15.628	16.620	17.179	16.345	15.934	14.724
	Italy	13.238	16.419	12.738	12.404	17.997	19.378	16.676	16.469	13.451	14.148
	Australia	55	78	266	968	1.785	3.107	3.750	4.710	5.242	6.426
	Chile	124	138	174	789	1.982	2.770	3.051	3.451	3.953	4.746
	South Africa	NA	NA	NA	NA	1.050	1.399	1.734	2.249	3.524	2.954
	World	**41.939**	**48.045**	**44.773**	**47.203**	**65.262**	**68.730**	**69.018**	**70.848**	**75.346**	**79.392**
Share of Exports in wine Production (%-Volume)	France	10,8	14,3	19,5	22,3	27,1	27,6	31,0	29,0	33,5	25,2
	Italy	18,6	21,4	18,9	20,3	32,0	34,0	31,1	36,0	30,6	26,7
	Australia	1,6	1,9	6	20,6	25,9	36,2	34,8	38,6	48,3	43,7
	Chile	2,3	1,9	4,3	22,6	42,9	41,5	54,0	48,7	57,5	63,0
	South Africa	NA	NA	NA	NA	12,6	18,4	22,8	27,0	36,9	29,1
	World	**13,1**	**14,1**	**14,8**	**17,5**	**23,1**	**22,4**	**23,9**	**24,1**	**26,3**	**25,1**
Share of World Wine Export Volume (%)	France	17,2	20,1	28,8	26,6	23,9	24,2	24,9	23,1	21,1	18,5
	Italy	31,6	34,2	28,5	26,3	27,7	28,2	24,2	23,2	17,9	17,8
	Australia	0,1	0,2	0,6	2,1	2,7	4,5	5,4	6,6	7,0	8,1
	Chile	0,3	0,3	0,4	1,7	3,0	4,0	4,4	4,9	5,2	6,0
	South Africa	NA	NA	NA	NA	1,6	2,0	2,5	3,2	4,7	3,7
	World	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Source: Anderson and Norman (2006)

Table 2 – Main features of the firms interviewed

Country (n° 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	255.8	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: Authors' survey

Table 3 - Wine production by market segment (%)

Countries (n° of firms)	Basic, Table and Popular Premium wines (<4euro)	Premium & Super-Premium wines (between 4 and 7euro)	Ultra-premium & Icon wines (>7euro)
Italy (n=35)	31.7	41.2	27.1
Chile (n=25)	29.7	50.0	20.3
South Africa (n=17)	47.0	34.0	20.0

Source: Authors' survey

Table 4 - Number of ISI co-publications 1992-2006

International co-publications*	**1992-2006**	**1992-1997**	**1997-2001**	**2001-2006**
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
Co-Publications**	**1992-2006**	**1992-1997**	**1997-2001**	**2001-2006**
Italy	41.9	44.5	37.7	43.9
South Africa	65.0	75.0	60.0	65.7
Chile	73.0	50.0	64.7	77.2

* denominator=number of co-publications
** denominator=number of publications

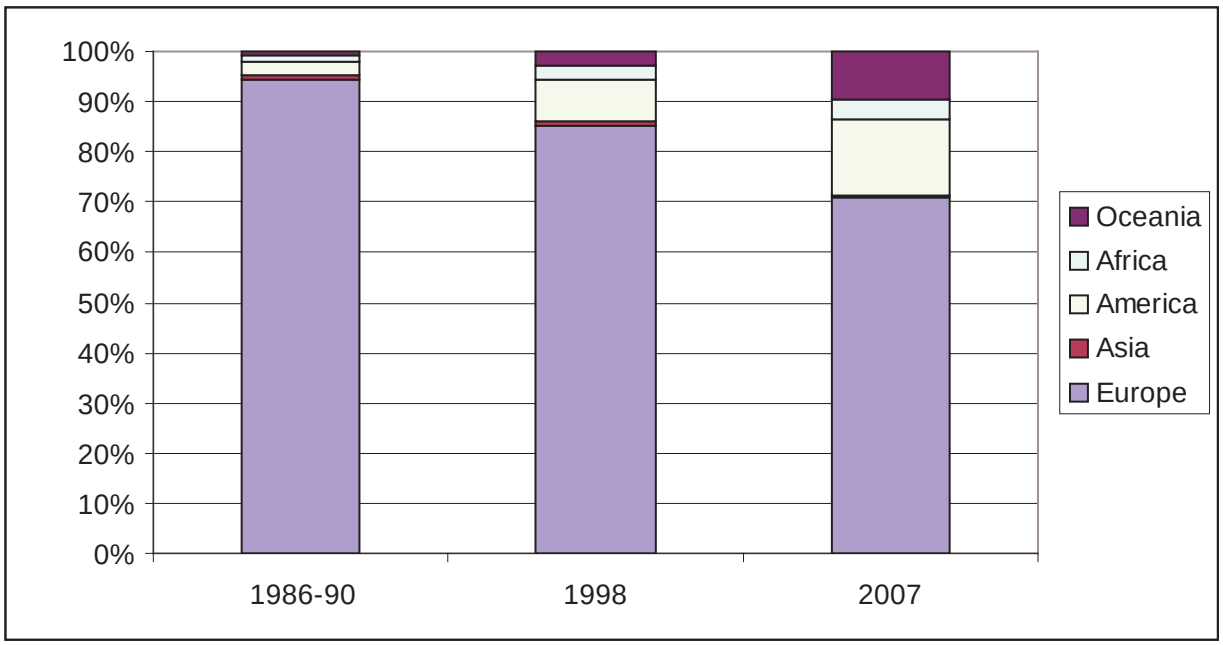
Source: Our own elaboration based on Web of Science – ISI data

Table 5 – 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
o **Of which foreign**	0.0	62.2	50.0
Experimental activity over last 5 years (% firms)[1]			
None	0.0	0.0	25.0
Passive technology adopters (Profiles 1 & 2)	29.7	18.5	45.0
Active innovators (Profiles 3 & 4)	70.3	81.5	30.0
	100.0	100.0	100.0
% of firms conducting experimental activity with external collaboration	48.0	85.0	67.0
Areas of investments over the last 5 years (% firms)[2]			
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 & 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

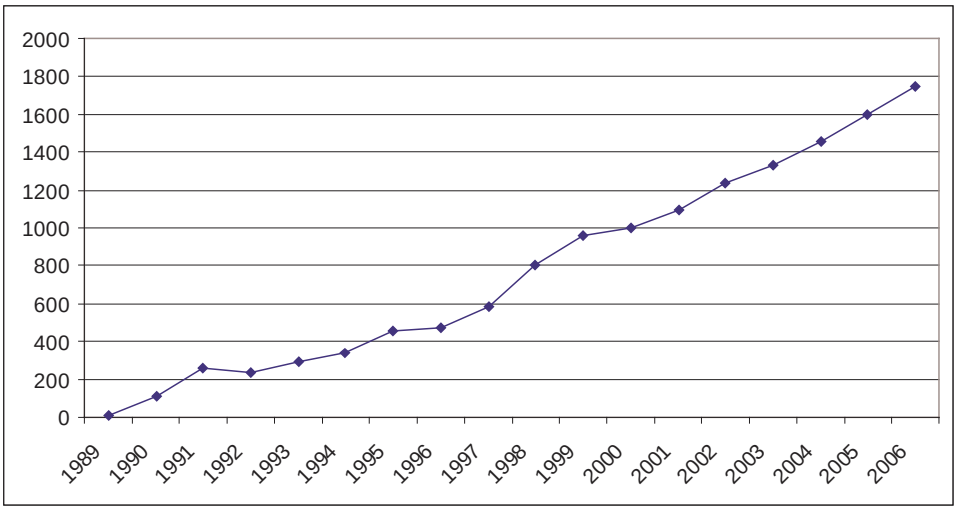
[1] F-test=12,92 Prob > F = 0.0000
[2] Multiple answers are possible
Source: Authors' survey

Figure 1 – World wine exports by macro region (1986-2007)



Source: OIV (2008)

Figure 2 - Number of Wine Publications, 1989-2006



Source: Our elaboration based on Web of Science – ISI data

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