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**Radical innovation in luxury carmenere wine from Chile**

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**Abstract**

Radical innovation from emerging wine regions, especially in quality and luxury production, is under-researched. This article addresses this gap and makes methodological and substantive contributions. This is the first study of luxury wines from Chile. It examines, among other factors, the contribution of foreign influence to opportunity recognition and exploitation, and the determinants of the speed at which national companies start playing roles initially played by foreigners. Results from several research methods (X2 tests, binary probit, ordered probit, censored and truncated regressions) are compared. Not all the results are robust. Significant roles are confirmed for foreign influence, the long-term presence of a senior expert winemaker and, (‘perversely’), successful participation in international competitions, but not for other, often mentioned factors. Other conclusions refer to the gradual decline of the foreign role, winemaker migration between employers, and unusual pricing strategies. Results from any individual research method should be checked against other methods and periods, including non-econometric methods. We study luxury wine (US 50 dollars plus per bottle) from Chile, but the findings are relevant to other wine regions.

**Keywords**

Innovation, Exports, Entrepreneurs, FDI, Knowledge workers, Wine, Chile

**JEL:** F14, F61, F63, O14, O31, O33

The author gratefully acknowledges comments from two anonymous referees.**Introduction**

Innovation is one of the most fascinating subjects in wine research. However, not much has been written about wine innovation in developing countries. This applies in particular to quality and luxury innovation (with respect to the product) and radical innovation (with respect to technology, market and consumer). This article aims to bridge the gap in the literature. It is the first study of luxury wines from Chile. Additionally, the article uses several alternative research methods and compares the respective results. Identifying results which are robust to research method changes is important, given recent criticism of the estimation and interpretation of econometric estimates by researchers (Hoetker, 2007; Zelner, 2009; Bettis, 2012; Yang and Aldrich, 2012; Semadani, Withers and Certo, 2013). The study of wine innovation in Chile offers implications which are relevant to other wine regions.

By 2012, over 40 Chilean wineries (about 20 percent of the total) were making, marketing and exporting their own brands of luxury carmenere or carmenere-blend wines. Carmenere is a long-lost Bordeaux wine grape variety, believed extinct after the phylloxera epidemic in the 1870s, and rediscovered in Chile in the 1990s (Pszczolkowski, 2004, 2013; Richards, 2006; *Decanter*, 2011). Following Beverland (2004), we define ‘luxury wine’ as retailing at US 50 dollars or more per 750 ml bottle. Wine in this price bracket amounts to about one percent of the world supply. Luxury wine has been part of the global market for a long time, and its roles in consumption, investment, gifts and ostentation have been studied at length (Beverland, 2004; Ashenfelter, 2008; Weinberg, 2008; Reyneke, Berthon, Pitt and Parent, 2011; Lyons, 2012; Moore, 2012; Williams and Atwal, 2013). However, until very recently no one thought that luxury wine could be made in Chile. The production and distribution of luxury carmenere (LC) from Chile is an example of radical innovation (to be defined below).

This is a study of Chilean wine. It is not about the economics of innovation or econometric methodology, although we use innovation theories to build our hypotheses upon them, and our hypothesis testing contrasts results from alternative research methods. LC from Chile is both special as a radical innovation experience, and it offers valuable lessons applicable to other wine regions. There are many recent instances of major innovation in Chilean wine, in product, process, and organisation and marketing (Richards, 2006; Farinelli, 2013). Before the 1990s, even the concept of using high prices to signal quality was completely alien to wine in Chile. But it would be wrong to claim that LC in Chile is an absolutely unique wine innovation experience, which cannot be reproduced elsewhere. Hundreds of wine regions and over a thousand wine grape varieties have been identified around the world (Anderson, 2010, 2014). In the near future, world demand will be pushed by ever more discerning consumers from many different countries (Maguire and Lim, 2014; Rod and Beal, 2014). Opportunities for wine innovation are likely to arise in many places.

LC innovation from Chile is an ideal case study, because it represents both technical and social innovation (Richards, 2006; Linton, 2009; Farinelli, 2013). Substantial technical change was needed to improve quality so much that the market would accept five-fold, or even ten-fold price increases. But social innovation was also needed in the form of new partnerships between local firms, which typically supplied land and local knowledge, and foreign investors and experts, who contributed capabilities towards both opportunity recognition and opportunity exploitation (Visser and de Langen, 2006; Overton, Murray and Silva, 2012). Social innovation was also behind the enhanced role of a vibrant class of knowledge workers, the employee expert winemakers (Hojman, 2006, 2007). Moreover, a new market had to be created and new distribution channels identified for the new product, where nothing existed before. All three types of radicalness apply to this innovation: technological, market, and business-model radicalness (Sainio, Ritala and Hurmelinna-Laukkanen, 2012). Technological, commercial, organisational and social uncertainties had to be successfully addressed by Chile’s LC innovators (Hall, Matos, Silvestre and Martin, 2011).

This article examines the determinants of the company-level decision to produce LC wine in Chile. Our unit of analysis is the individual firm. Why some Chilean wineries became LC innovators, and others did not? Or why did some wineries pioneer LC innovation, as others waited for years (in some cases up to ten years) before they followed the innovation leaders? These two questions are not exactly equivalent, and addressing both requires using different research methods. Moreover, in order to answer some important related questions, a different, non-econometric approach may offer more insights than any multiple regression models. Several recent studies have warned against the dangers of jumping to incorrect conclusions from econometric work (Hoetker, 2007; Zelner, 2009; Bettis, 2012; Yang and Aldrich, 2012; Semadeni et al, 2013). Comparing empirical results from different research methods should help to put individual estimates in perspective.

The next section examines the history and revival of carmenere in Chile. The following section explores the literature and makes several hypotheses explicit. Then we explain the data and sample used in the empirical work. This is followed by presentation of the empirical results, which is done in four sections, respectively X2 (chi-square) tests of association, binary probit regression, then an alternative, non-regression approach, and finally ordered probit, censored and truncated regression models. The last section concludes.

**History and revival of carmenere in Chile**

In the nineteenth century, before it disappeared from French vineyards, the carmenere grape had been an important contributor to the wine quality of some of the most famous Medoc properties (Robinson, 2006). Genetically, carmenere may be related to other Bordeaux grape varieties (Boursiquot et al, 2009), but both its production requirements and contribution to final product quality are specific to carmenere. The possibility that ‘Chilean merlot’ (as the grape was then known) could in fact be something else was suggested as early as 1979 by French experts such as Denis Boubals, Claude Valat and Jean-Michel Boursiquot (Pszczolkowski, 2013). However, initially these views were angrily rejected by some Chilean winery executives. The first Chilean bottling of carmenere, a 1994 harvest, was called Grande Vidure (an alternative, traditional name for carmenere) rather than carmenere by its winemaker, Alvaro Espinoza, then at Vina Carmen. This wine won a gold medal in the 1997 *Selections Mondiales* competition in Montreal. Also in 1997, the first Chilean bottling of carmenere which used that name, made by Adriana Cerda for Vina Santa Ines (today called De Martino), was confiscated by the official agency in charge, on the grounds that the winery had no plantations registered as carmenere.

By the first decade of the twenty first century, carmenere had the fourth largest area among red grape plantations in Chile (7284 hectares in 2007, Overton el at, 2012) after cabernet sauvignon, pais and merlot, and before syrah, pinot noir, malbec, cabernet franc and carignan, in that order (Anderson, 2010). Carmenere plantations also show the fastest growth rate. The trend is for carmenere plantations to become eventually as extensive as merlot’s, both because new carmenere plantations are expanding at a faster rate, and because some of the existing carmenere is still wrongly classified as merlot. The size of carmenere’s presence in Chile is different from region to region. It is among the top five grape varieties in Valparaiso, Metropolitana, O’Higgins, and Maule (all regions in Chile’s geographical centre), but not in the north (Atacama and Coquimbo) or south (Bio-Bio and Araucania). In relation to cabernet sauvignon, the area under carmenere plantations ranges from about 20 percent of cabernet sauvignon’s in places such as Loncomilla and Lontue, to over 40 percent in Casablanca (Farinelli, 2012).

Today, all the large and medium-size wineries in Chile bottle a range of single varietals, and carmenere is always included as one of them. According to the brand manager of Chile’s largest winery, Concha y Toro, carmenere, both as a single varietal and in blends, is an important factor in the company’s success in the British market (Mora, 2009). As to small, garage or boutique wineries in Chile, which make only one or two wines, they tend to go for blends and carmenere is usually part of the blend. In 2009, Chilean carmenere exports as a single varietal amounted to 67 million US dollars, slightly less than five percent of total Chilean wine exports (Agosin and Bravo-Ortega, 2012). That year, Chilean carmenere exports reached a higher price per litre than cabernet sauvignon and merlot, but not as high as syrah or pinot noir (Pszczolkowski, 2013). By 2012, the carmenere share of Chilean wine exports had grown to about 25 percent (Farinelli, 2012).

In this article we use the expression ‘luxury carmenere’ (LC) to include both single varietals and blends. Many of the most successful LCs from Chile are not single varietals but blends. Some LC wines from Chile have been very successful. There is independent evidence of high quality (Richards, 2006), which increasingly commands higher prices at home and abroad. Out of the 84 wines listed by *Mesa de Cata: Guia de Vinos de Chile 2013* as retailing at 50 US dollars or more in the domestic market, 47 are LC (CAV, 2013). *Descorchados 2013*, the other highly respected Chilean wine guide, includes 13 wines priced at 50 US dollars or more, of which six are LC, in its list of the 22 best red wines in the country (scoring 94 to 96 points in a 100-point scale, Tapia, 2013). The US magazine *Wine Spectator* made a LC from Chile (Lapostolle’s Clos Apalta) its ‘Wine of the Year’ in 2008. In March 2012 *The Wine Advocate*, owned by US wine critic Robert Parker, selected five LCs among its top ten wines from Chile. *The Wine Advocate* had previously awarded 97 (out of 100) points to Concha y Toro’s top carmenere, Carmin de Peumo, in 2009. With a few exceptions (such as Almaviva, which exports about 10 million US dollars per year), most Chilean LCs export about one or two million dollars each. The current contribution of LCs to total Chilean wine exports is unknown, possibly ranging between 10 and 20 percent, and growing.

There are some carmenere plantations in other countries, including Italy and the US (Robinson, 2006; Pszczolkowski, 2013; in contrast, there were only 15 hectares of carmenere in France in 2006, Boursiquot et al, 2009). However, cultivating and processing carmenere is unlikely to be successful everywhere, because it needs both warmer conditions and plentiful and therefore relatively inexpensive labour (Pszczolkowski, 2013). On the other hand, carmenere is extremely attractive to some potential international investors, since it was once a major ingredient of some of the best French wines. The extent of innovation in Chilean wine has been immense. Farinelli (2012) classifies such knowledge-intensive innovation into agronomy (basic inputs: types and quality of grapes), engineering and physics (capital goods: machinery and equipment), biochemistry, microbiology and genetics (materials and intermediate inputs), and neurobiology, economics and psychology (taste and olfactory receptors). Dutz et al (2013) classify knowledge-based-capital (KBC) in the Chilean wine industry into investments in knowledge, in protecting / enabling, in insurance, and in coping / leveraging. These innovations apply not only to carmenere but to all Chilean wine. What makes carmenere in Chile special is its history and in particular the French connection.

**Literature and hypotheses**

Radical innovation has been defined by successive authors. According to McDermott and O’Connor (2002, p. 424), ‘radical product innovations involve the development or application of significantly new technologies or ideas into markets that are either non-existent or require dramatic behaviour changes to existing markets’. Seidel (2007, p. 523) refers to ‘processes in which the desired outcome will be new both to the firm and to the market’. ‘The market is unknown and the focus is as much on customer understanding as on the design of solutions’, has been proposed as a definition of radical innovation by Motte, Yannou and Bjarnemo (2011, p. 79). Brettel, Oswald and Flatten (2012, p. 154) maintain that ‘radical innovations are designed to satisfy the needs of latent, emerging customers and markets by offering new designs, creating new markets, or developing new channels of distribution’. ‘The novel, unique, or state-of-the-art technological advance in a product category that significantly alters the consumption patterns in a market’, has been proposed by Zhou and Li (2012). According to Chang, Chang, Chi, Chen and Deng (2012, p. 442), it is not enough for radical innovation to be ‘new-to-the-firm’: it also needs to be ‘new-to-the-world’. Datta and Jessup (2013) define radical innovation as ‘innovation that is original and forms the foundation for future innovation outcomes’. Despite some differences between these authors, and despite the fact that none of them may have had LC from Chile in mind, all of these definitions apply to LC from Chile (Pszczolkowski, 2004, 2013; Goode, 2005; Richards, 2006; Morande and Maturana, 2010; *Decanter*, 2011; Farinelli, 2013).

Since at the beginning of a radical innovation process neither product nor market exist, access to finance for innovation purposes is likely to be particularly difficult (Chemmanur and Fulghieri, 2014). This applies generally and also to Chilean wine (Cederberg, Gustafsson and Martensson, 2009; Dutz, O’Connell and Troncoso, 2013). But a successful company may finance radical innovation from its own funds. This should not be interpreted as saying that large corporations will always be more likely to innovate than smaller firms. Large corporations innovate, but only if they manage to overcome familiarity, maturity and other traps (Ahuja and Lampert, 2001). Firm size affects how a wide range of factors relate to innovation adoption (Sawang and Unsworth, 2011). Because the Chilean domestic market is small, corporate success in Chilean wine is defined as success in export markets (Richards, 2006; Visser and de Langen, 2006; Overton et al, 2012; Farinelli, 2013). Successful exporters, precisely as a result of being that, may be better at attracting investment (Shaver, 2011). Exports and innovation may be positively associated, even after controlling for firm size. They are both related to higher productivity and product upgrading, with some firms self-selecting into both exports and innovation (Caldera, 2010; van Beveren and Vandenbussche, 2010; Cassiman and Golovko, 2011). So, there would be two reasons to expect a positive relationship between exports and innovation. First, firm size makes access to investment funds easier (size is effectively proxied by exports if the domestic market is small). Second, exports may independently affect innovation after controlling for firm size. Thus, our first hypothesis is:

**H1: Firms which are successful exporters are more likely to engage in LC innovation.**

According to Nerkar (2003), knowledge creation is a path-dependent, evolutionary process that combines new knowledge with older knowledge accumulated over long periods. The temporal dimension may give older companies a competitive advantage. This is confirmed by Rothaermel and Boeker (2008) in the context of company alliances. They emphasize the contribution made by older firms in alliances between old and new firms. The role of company age is partly confirmed by Kotha, Zheng and George (2011), who make the point that sometimes pathologies of aging are difficult to overcome. They identify non-monotonic or inverted-U-shaped relationships: a moderate age, as opposed to too young or too old, would be optimal. According to Withers, Drnevich and Marino (2011), company age affects innovation differently depending on the degree of development of the respective firm’s innovation capabilities. Innovation by young firms may depend on factors such as cooperation, export potential or market uncertainty (Audretsch, Segarra and Teruel, 2014). In Chile, some successful wine exporters are young, but others are very old. Among the top 25 Chilean wine exporters, 11 firms were founded before 1900, and eight in the 1980s and 1990s (Farinelli, 2013, pp. 3-4). Our Hypothesis 2 is:

**H2: Older firms are more likely to engage in LC innovation.**

Recruiting talented workers, and keeping them, may have positive effects on innovation activity by the recruiting firm (Rao and Drazin, 2002; Franco and Filson, 2006). Keeping their knowledge workers may be particularly difficult for employers (Alvesson, 2000). Some of the knowledge required for LC innovation in Chile may be local and tacit, and therefore difficult to transmit, except by migration by the knowledge worker himself or herself from his or her old job to a new one (Hojman, 2006, 2007). Chilean oenologists exhibit very high turnover rates. Winemakers in Chile tend to migrate frequently from one job to the next (Richards, 2006; Tapia, 2013). Even the most talented winemaker may take years to become familiar with a particular local production area (Morande and Maturana, 2010). It may be easier for a firm to keep the best among its highly qualified knowledge workers, if adequate commitment-based human resource practices are in place. Previous empirical work shows that the presence of such practices is positively related to several forms of innovation (Ceylan, 2013). Hypothesis 3 operationalises these aspects in the context of LC innovation in Chile:

**H3: Companies employing a senior expert winemaker who has been with the firm for a long time are more likely to engage in LC innovation.**

Many authors argue that knowledge networks have favourable effects upon innovation. Knowledge would flow more smoothly between organisations in the presence of substantial stocks of social capital (Powell and Grodal, 2005; Dhanaraj and Parkhe, 2006). Innovation in the wine industry would especially benefit from networks (Chiffoleau, 2005; Rebelo and Muhr, 2012). This would also apply in Chile (Visser and de Langen, 2006), although considering separately the network of firms from the network of their respective knowledge workers may offer results which are not fully compatible (Hojman, 2006, 2007). It has also been claimed that the relationship between network activity and innovation may be non-monotonic or inverted-U-shaped. The positive effect of social capital or social networks may be subjected to diminishing returns, and their impact on innovation may become eventually negative (Molina-Morales and Martinez-Fernandez, 2009). A non-monotonic, inverted-U shape may also characterise the relationship between a network’s internal trust and performance (Chung and Jackson, 2013). Network performance may be related to network size and to the presence or absence of connector firms (Kajikawa, Takeda, Sakata and Matsushima, 2010). Our Hypothesis 4 is:

**H4: Firms which are members of stronger knowledge networks are more likely to engage in LC innovation.**

Hypothesis 3 explored the possible consequences of a key employee’s lack of inter-firm mobility on (or long-term retention of this key employee by) the employer firm. But inter-firm mobility may also have effects, possibly negative, on companies which are affected by the loss of their key workers (Wezel, Cattani and Pennings, 2006; Aime, Johnson, Ridge and Hill, 2010). The negative impact on the firm could be even worse if the leaving employee becomes an entrepreneur, his or her own boss (Campbell, Ganco, Franco and Agarwal, 2012). Understandably, firms unable to retain key workers are keen to minimise the resulting damage, although options in different countries vary according to legal institutions and other considerations (Business Doctor, 2013; Chynoweth, 2013; *The Economist*, 2013). Following the boom in Chilean wine exports in recent decades, many key employees have left their traditional employers, either to work with more dynamic firms or to start their own businesses (Richards, 2006; Ross, 2006). On the other hand, there is some evidence that hiring patterns may be affected by mimetic isomorphism: recruiters tend to hire someone who is like themselves (Williamson and Cable, 2003). This may encourage stagnation and inertia rather than innovation. Keeping the ‘wrong’ employee, and hiring more of the same, may be bad for business (Akgun, Lynn and Byrne, 2006; Yang, Chou and Chiu, 2014). Therefore, it is a delicate balance, but if we assume that the positive effects are stronger than the negative ones:

**H5: A firm which is able or willing to keep its expert winemakers, or which is a net gainer of expert winemakers over time, is more likely to engage in LC innovation.**

The view that membership of a geographical cluster is good for its member firms has a long tradition in innovation economics (Asheim and Gertler, 2005; Todtling, Lehner and Kaufmann, 2009). On the other hand, caution has been recommended against the danger of converting the cluster concept into a ‘mesmerising mantra’ (Taylor, 2010). Whether a cluster is effective in terms of innovation in general, or good for a specific firm in particular, may depend on a number of aspects, including institutional arrangements (Sorvik, 2011) and a firm’s internal capabilities (Hervas-Oliver and Albors-Garrigos, 2009). Again, relationships may be non-linear or non-monotonic (Larraneta, Zahra and Gonzalez, 2012). The argument that cluster membership plays a positive role in innovation has been advanced for the wine industry in particular (Ditter, 2005; Rebelo and Caldas, 2013; Voronov, De Clercq and Hinings, 2013). Among wine production clusters in Chile (Visser and de Langen, 2006; Overton et al, 2012), the Colchagua Valley is the most highly developed, emblematic, and possibly the most dynamic in innovation terms. As such, it has been the subject of several studies (Giuliani and Bell, 2005; Hojman, 2006; Gwynne, 2008). The respective hypothesis is:

**H6: A firm which is a member of a dynamic geographical cluster is more likely to engage in LC innovation.**

A partnership formed by well-chosen partners may be an effective way of engaging in radical innovation. Although a reputation for product innovation is often a valuable asset (Henard and Dacin, 2010), quality-oriented firms may not be particularly keen on exploration and innovation (Sethi and Sethi, 2009). Some particular brands may not associate themselves easily with an innovation leadership image (Beverland, Napoli and Farrelly, 2010). But in the context of a partnership, a firm may be more prepared to run risks associated with innovation than it would on its own. Park and Kang (2013) argue that the benefits of alliances may have been exaggerated in the literature. Often the two partners in an alliance bring different assets and capabilities to it, for example if one of the partners is old and the other is young (Rothaermel and Boeker, 2008). Differences of characteristics between the partners could help more than similarities (Sarkar, Echambadi, Cavusgil and Aulakh, 2001). According to Rindfleisch and Moorman (2001), vertical alliances may be more effective than horizontal ones. The type of partnership link may depend on the institutional environment (Van Assche and Schwartz, 2013). Sometimes the best older partner is a foreign investor (Angeli, 2013). A local subsidiary may receive support and incentives from its international parent company which are not available to independent local firms (Un, 2011). This may also apply to LC innovation in Chile. Some of the most respected international wine and spirit companies have become quality or luxury wine producers in Chile, often in association with local partners: Antinori, Lafite-Rothschild, Lurton, Marnier-Lapostolle, Miguel Torres, Mondavi, Mouton-Rothschild. The potential gains are large. The domestic partner accesses new technology, finance and international markets. The foreign partner benefits from the local partner’s experience in access to natural resources and labour, local (sometimes tacit) knowledge, and familiarity with the macroeconomic and political economy environment. The foreign partner also benefits from the prestige of being seen by international consumers as associated with innovation (in the context of the partnership), but without any of its disadvantages (because the foreign partner’s traditional brands are left untouched). The opportunity represented by carmenere in Chile may have been particularly attractive to French potential investors, since this grape came originally from Bordeaux (Pszczolkowski, 2013). In addition to the French companies just mentioned, Massenez, Chateau Larose Trintaudon, William Fevre, Bruno Prats and Paul Pontallier, Thierry Villard, Boisset and Chateau Dassault have also invested in Chilean wine (Farinelli, 2013). Not all potential local partners are likely to benefit equally, and gains may be subjected to non-linearities and inverted-U-shaped outcomes (Blalock and Gertler, 2009; Oerlemans, Knoben and Pretorius, 2013). Partnerships in Chilean LC innovation are typically one-to-one. Either there is a partnership, or not. Our Hypothesis 7 is:

**H7: Foreign influence (expressed as foreign ownership, foreign partnership or regular consulting and support by foreign experts) is positively associated with LC innovation.**

Regardless of how good a product may be, quality by itself may be largely irrelevant or useless in the absence of international recognition. This is one of the reasons why wineries participate in prestigious international competitions (Beverland and Lockshin, 2001; Orth and Krska, 2002; Evers and Knight, 2008). Some Chilean wineries have been very successful at winning trophies and gold medals in these competitions (*Decanter*, World Wine Awards, several years). This may have brought them international recognition and additional incentives and resources to engage in innovation. Thus, Hypothesis 8 is:

**H8: Firms which are successful at winning international awards are more likely to engage in LC innovation.**

There is large diversity in terms of research methods. Our final two hypotheses caution against the danger of jumping to conclusions that may not be confirmed by alternative research methods, or for different time periods.

**H9: Different research methods may yield different empirical results.**

**H10: Different samples (applying to different periods) may yield different empirical results.**

**Empirical work: sample and data**

For empirical purposes, our central research question (how to explain LC innovation in Chile) may be approached in two different ways. Both approaches are valid but they build upon different assumptions. So, in this study we attempt both approaches and compare the results. The first approach separates Chilean wineries into ‘LC innovators’ and ‘not LC innovators’ (during the period 2001-2011). This means that a firm that went for LC in 2001 is assumed to be equally innovative as one which did it only in 2011. Both would be different, in terms of innovation or innovativeness, from a third firm which may have gone for LC in, say, 2014. This is arbitrary. Therefore, our second approach assumes that going for LC in 2001 is more innovative than going for it in 2011. There is a ranking. Going for LC in, say, 2006, would be ‘intermediate’ or ‘in-between’ the extremes in terms of innovation. The innovation gap between 2011 and 2001 would possibly be greater than the gap between, say, 2014 and 2011. These two approaches require different research methods (respectively, X2 tests of association or a binary probit multiple regression in the first approach, and ordered probit, censored or truncated models in the second approach).

The sample is formed by the total population of the 78 most important wineries in Chile. This is about a third of the total number of registered wineries in the country, but many of the smaller wineries are either just labels owned by the larger firms, or so small that no information on them exists. So in practice, for our research purposes the sample largely corresponds to the whole universe of Chile’s wineries. It includes the top 20 bottled wine exporters by value in 2007-2009, all the companies with wine production activities in Colchagua (amounting to 34), all the companies which have won at least one gold medal in the *Decanter* World Wine Awards in 2005 or 2006, or in 2009, 2010 or 2011 (37 firms), and all the LC producers (44 firms which became LC innovators between 2001 and 2012). The composition of the sample is robust to, for example, including only the top10 wine exporters, or the top 30 wine exporters, or using a different prestigious international competition as an alternative to the *Decanter* World Wine Awards, such as the International Wine Challenge. Similar samples have been used effectively in previous studies (Hojman and Hunter-Jones, 2012).

There are two dependent variables to be explained. The first one, LC1ST, can take only two values, 1 or 0, depending on whether the respective firm makes LC wine (is a LC innovator) or not. An LC innovator is defined as a company that started making LC wine anytime between 2001 and 2012. The source is the wine yearbook *Guia de Vinos de Chile* for 2001-2010, plus other sources (Barahona, 2012; La Cav, 2012; Tapia, 2012; specialist press and winery websites) for 2011-2012. The second dependent variable, LC2ND, is the year when the company was listed by the *Guia de Vinos de Chile* (or other sources for 2011-2012) as a LC innovator for the first time (2001 = 1).

The first three possible explanatory variables, related to Hypotheses H1, H2 and H4 respectively, are the firm’s export value (EXPO56, US dollars in 2005-2006), the company age in years (AGE), and the number of its network links (NETW). The latter is defined as the total number of other companies for which the firm’s expert winemakers have worked in the past or are currently advising. For all three of these possible explanatory variables, the respective squared value was also introduced as an additional regressor, making the models quadratic (EXPOSQ, AGESQ, NETWSQ), in order to test for non-linear and non-monotonic (maxima or minima) effects. As mentioned before, several sources suggest the possibility of non-monotonic, inverted-U-shaped relationships (Molina-Morales and Martinez-Fernandez, 2009; Guiltinan, 2011; Kotha et al, 2011; Chung and Jackson, 2013; Oerlemans et al, 2013). Other possible explanatory variables that were also tested, following the hypotheses, are whether the firm employs permanently, on a long-term basis, a senior expert oenologist (PERM, H3); the extent to which the firm is a net gainer or net loser of expert winemakers (BALAN, H5); whether the firm has production activities in the Colchagua Valley or not (COLCH, H6); whether there is or has been substantial foreign ownership, foreign partnership or regular foreign consulting and advice (FOREIGN, H7); and whether the firm won a trophy or gold in the *Decanter* World Wine Awards 2005-2006 or 2009-2010-2011 (DWWA56 and DWWA901, H8). All the possible explanatory variables from PERM to DWWA901 are yes-or-not, 1-0 dummy variables.

Whether a particular hypothesis is supported or rejected is defined differently depending on the research method used. For example, H1, H2 or H4 will be confirmed if EXPO56, AGE or NETW is statistically significant, respectively, all three with positive sign, in the binary probit regressions. Non-monotonicity (a maximum or minimum) will be confirmed if the respective right-hand variable and its squared value are both significant with opposite signs. Non-linearity, but not maxima or minima, will be confirmed if either only the squared value is significant, or both the original variable and its squared value are significant with the same sign.

Apart from the sources previously mentioned, all the data except for NETW, BALAN and PERM come from published, widely available sources (*Guia de Vinos de Chile*, several years; Vial, 2005; Richards, 2006; and publicity and public relations materials from the wine producers’ associations). NETW, BALAN and PERM come from an unpublished database of about 400 Chilean and Chile-based expert winemakers, compiled and regularly updated by the author since 2001.

The descriptive statistics are presented in Tables 1 and 2.

**Empirical results: X2 tests of association**

Chi-square (X2) tests of association between the presence of LC innovation or its absence and a second attribute were performed, to examine whether these two attributes are or not independent from each other. The results from these X2 tests are presented in Tables 3 and 4. In Table 3, LC innovation and the respective second attribute are not independent from each other. Table 3 shows that there is a statistically significant association, at the 5 percent level or better, between LC innovation, on the one hand, and, respectively, the long-term presence of a senior oenologist, membership of a network with 5 or more other member firms, membership of a network with 8 or more other member firms, foreign influence, and being a gold medal winner at the *Decanter* World Wine Awards 2009-2011, on the other hand. The sign of this latter association is negative. All the other signs are positive.

In contrast, Table 4 shows that the hypothesis of independence cannot be rejected between being a LC innovator on the one hand and, on the other hand, respectively being a top exporter in 2007-2009, being established as a firm in 1990 or after, being established as a firm in 2000 or after, originating from or currently having production activities in Colchagua, being able (or willing) to keep your expert winemakers, membership of a network with 3 or more other member firms, and membership of a network with 10 or more other member firms.

**Who innovates and who does not? Binary probit regressions**

All the variables mentioned before may be used as possible explanatory variables, and their individual and joint effects on the dependent variable assessed, in multiple regression tests. Multiple regression has several advantages in relation to the previous two-attribute X2 tests. Multiple regression identifies joint effects in addition to individual (or marginal) effects, it allows to test for non-linearities, and it may provide information on multicollinearity. In multiple regressions, sensitivity to small changes in the data is lower than in the previous X2 tests. Given the size of our sample, just one misplaced observation (for example, a foreign LC innovator which is mistakenly classified as national) may alter the outcome of a X2 test, but the respective binary probit estimates would remain unchanged.

In the binary probit approach the dependent variable, LC1ST, is a dummy variable which can take only one of two values, 1 if the firm is a LC innovator, and 0 if not. The estimation method is maximum likelihood and the first order conditions are non-linear (Johnston and DiNardo, 1997; Greene, 2008).

A selection of binary probit regression results is presented in Table 5. Each column represents a different model specification, or combination of possible explanatory variables. Regression 5.6 shows the highest value in the table for the McFadden R2, which is analogous to, but not exactly the same as, the standard R2 in linear regression models (*EViews7 User’s Guide*, 2009; Greene, 2008). All quality of fit indicators in probit models, including this one, must be interpreted carefully (Hoetker, 2007). Differently from Regression 5.6, Regression 5.1 was obtained by including in the estimation only those regressors which are statistically significant at the 5 percent level or better.

Reading Table 5 row by row, PERM, NETW, NETWSQ, FOREIGN and (slightly less convincingly) DWWA901 are significant with almost systematic regularity. PERM and FOREIGN always have positive signs and DWWA901 always a negative sign. The probability of a firm being a LC innovator increases if PERM and FOREIGN are present, but it falls if DWWA901 is present. The impact of NETW (in combination with that of NETWSQ) is non-linear and non-monotonic. It is positive for lower values of NETW, then it becomes zero for a value of NETW of about 20 to 22 (according to Regressions 5.1, 5.3 and 5.6), and finally it is negative for very high values of NETW. Only one firm in the sample (n=78) has a NETW value larger than 20. So, the range of NETW that really matters is less than 20 (the NETW sample mean is 6.2). In this relevant range, the incremental impact of NETW on the probability of the firm being a LC innovator is always positive, but it keeps getting smaller and smaller as NETW increases (a ‘diminishing returns’ effect). Exports, company age, BALAN, COLCH and DWWA56 are not significant at the 5 percent level.

**An alternative approach with explicit roles for time and path dependence**

In this section a completely different approach is presented. This approach deals with questions that could not be addressed before using either X2 association tests or binary probit regressions. This new approach is time-explicit and path-dependent. By adding a temporal dimension explicitly, we are able to relate the particular time (year) when the LC innovation was introduced, to whether the respective company is foreign-influenced (foreign-owned, totally or partially, or it benefits from substantial foreign expertise). Table 6 shows the respective years when the 39 LC wines which were introduced in the market in 2001-2011 (by 33 firms) appeared for the first time. For example, the three companies with LC wines listed in the 2001 edition of the *Guia de Vinos de Chile* are all foreign-influenced as defined above. Then, three additional firms had their respective LC wines listed for the first time in the 2003 edition of the *Guia de Vinos de Chile*. Two of these companies were foreign. In the 2005 edition, two out of four new LC offers came from foreign firms, and in the 2006 edition, two out of five. In contrast, in the most recent period considered, new LC wines in the market after 2008, only four came from foreign firms, as opposed to 16 which did not. Year after year, the proportion of foreign-influenced firms among the LC innovators gradually declines.

A new X2 test of association may be run with this information. The first attribute in the test is whether a new LC wine was in the market in 2006 or before, or it was introduced only in 2008 or after (no new LC wines were introduced in 2007). The second attribute in the test is whether the respective winery is foreign-influenced or not. The respective X2 test value is 7.8, against a critical value of the test, one degree of freedom, p=0.01, equal to 6.6. The hypothesis that these two attributes are independent must be rejected. The firms that were making LC wines in 2006 or before were mostly foreign (nine out of 15), but, overwhelmingly, firms which did this only in 2008 or after were not (16 out of 20). So, although there were some exceptions, foreign firms started this innovation and national companies followed.

Another key finding is that a large proportion of these new LC wines (11 out of 39) had been sold, before they became ‘luxury’ wines, at a lower price. They had been listed in previous editions of the *Guia de Vinos de Chile*, in lower price brackets. By definition, only when the price increased to or above 50 US dollars was the respective wine considered ‘luxury’. Eight out of these 11 ‘price-risers’ appeared in the market, at the higher price, only in 2008 or after (the sample is too small for X2 tests). As many as nine out of the 11 price-risers came from national companies. Thus, the pattern seems to be that foreign companies led in the introduction of the LC innovation. Then, after one or more years of this demonstration effect, national firms followed. But some among the latter discovered that they did not really need to engage in new design and new production. They were already making a wine that was in their view perfectly appropriate. All they had to do now was to increase its price. In some cases quality may also have been improved, but not so much that it made sense to develop a new brand (Klink and Athaide, 2010).

This raises three important theoretical points, regarding respectively the definition of leaders and followers in LC (and other) radical innovation, pricing strategy, and marketing strategy. A ‘follower’ in the previous paragraph (one of the 11 price-risers) is a follower only in the sense that it is following the ‘leader’ towards a higher price bracket, or market segment, but not in the sense that it is adopting a new production technology that was first developed or introduced by the ‘leader’. It is perfectly possible that the ‘follower’ might have been making and started selling its new product chronologically before the ‘leader’ did. Except that the ‘follower’ was originally selling it at a lower price.

The second question, or family of questions, concern pricing strategy. Is the higher price unambiguously a better strategy? If yes, was the ‘follower’s old pricing strategy (a lower price) always suboptimal? Or did it become suboptimal only after the ‘leader’ created a new market by going for the higher price? To what extent, if any, were the old and the new pricing value-informed (Ingenbleek, Frambach and Varhallen, 2010; Guiltinan, 2011)? These questions suggest that business models which are alternative to the LC innovation model may also be popular (although we do not know if efficient in the long term). After all, some successful wineries with production in Chile, both Chilean and foreign, have not adopted the LC innovation approach (or at least not yet).

The third question is about marketing. Maybe the most significant contribution that the ‘leader’ is making is not in production or pricing, but in marketing? Maybe selling the new LC wine is more difficult than making it? Many, or most, national firms may not have had the international marketing advantages of the foreign investors or the national-foreign partnerships, at least not until they learned relevant lessons from foreign investors or their partners. Incidentally, this would not be the first lesson learned by Chile’s national wineries from foreigners. Previously they had learned, first, that the carmenere grape was worth serious consideration, at the same level as other highly regarded Bordeaux wine grape varieties, and second, that it was not absurd or extortionate to ask US 50 dollars or more for a bottle of top quality wine made from this grape.

This time-explicit, path-dependent, non-econometric approach also offers insights regarding the role of expert winemakers. According to Table 7, most firms making a LC wine (at least 20 out of the 33 companies) employed an expert winemaker who had previously worked for another firm which also made an LC wine. For each combination of winemaker / first employer / second employer (that is, for each row in Table 7), the LC wine made by the first employer always appeared in a previous edition of the *Guia de Vinos de Chile*, as compared with the LC wine made by the second employer, which appeared in a latter edition of the *Guia*. At least 20 key winemakers, possibly more, can be identified in these progressions (see the left-hand column in Table 7). A total of 27 firms out of the 33 appear in Table 7 as either first or second employers (there are only six exceptions, three of them foreign, out of 33 companies). Each of these 27 firms was: a) a first employer of a key expert winemaker who then moved to a job with a second LC making employer; or b) a second employer of a key expert winemaker who had previously been employed by another LC making firm; or c) both.

There are proportionally more foreign-influenced firms among first employers, and proportionally more national firms among second employers. This was to be expected considering what we already knew from Table 6.

Winemakers tend to learn something new in every job, and they carry their new knowledge with themselves to their next job (Hojman, 2006, 2007; Richards, 2006; Ross, 2006). There is nothing unethical or illegitimate about it. At least some of this knowledge is tacit (Asheim and Gertler, 2005; Lam, 2005; Powell and Grodal, 2005). Possibly the LC innovation at the first employer happened only thanks to the winemaker’s effort, experience and local and other knowledge. The winemaker’s contribution may have played an essential role in LC innovation. We know that knowledge is often shared by innovating companies (Saenz, Aramburu and Rivera, 2009), and that knowledge diffuses through employee mobility (Franco and Filson, 2006). Table 7 describes one of the ways how knowledge is shared among LC innovating wineries in Chile. This happens by a key expert winemaker changing jobs. The mobility of key workers between an employer and the next one has been shown to make a difference to innovation in previous studies (Rao and Drazin, 2002; Wezel et al, 2006; Aime et al, 2010; Campbell et al, 2012). LC innovation in Chile confirms these findings.

**Who innovates first, and who follows? Ordered probit, censored and truncated regression models**

Some of the insights discussed above may be examined more formally by using other types of multiple regression. The ordered probit model is an extension of the binary probit, in which several (three or more) discrete options are possible for the dependent variable (Aitchison and Silvey, 1957; Johnston and DiNardo, 1997; Greene, 2008). This is highly relevant to us, since we are interested in explaining why a firm would choose to go for LC innovation in, for example, 2003 rather than 2001, or 2005 rather than 2003, etc (or not go for it at all). In another type of multiple regression, the censored model, there are observations for which the values of all the possible explanatory variables are available, but the respective value of the dependent variable is not (McDonald and Moffitt, 1980). This is again directly applicable to LC innovation in Chile. Those firms which had not gone for LC innovation by 2011, or 2012, may choose to go for it any time in the future, but we do not know exactly when. This is so, despite the fact that we have all the data on the respective possible explanatory variables. Finally, in the truncated model there are no censored observations. The estimation uses only those observations for which all the data, including the dependent variable values, are known. Estimation is again not linear but maximum likelihood.

A selection of the best fits using the ordered probit, censored and truncated regression models is presented in Table 8 (with data for the period 2001-2011). In order for these results to be compatible with the binary probit results presented in Table 5, the estimated coefficients in Table 8 should have the opposite signs. This is because in the binary probit the options for the dependent variable were either 1 (meaning a LC innovator) or 0 (meaning not). A higher value of LC1ST (1 instead of 0) was ‘better’ because it meant innovation. By contrast, the dependent variable in Table 8 is the year when a firm was first listed by the *Guia de Vinos de Chile* as a LC innovator (LC2ND: 1, 2, 3, etc for 2001, 2002, 2003, respectively). Thus, in the ordered probit, censored and truncated models, higher values of the dependent variable mean that the firm went for the LC innovation relatively more recently. A lower value of LC2ND (1 instead of 2) is ‘better’ because it means earlier innovation.

In the ordered probit model (Regression 8.1), the probability that the firm is among the very first pioneers in LC innovation increases with PERM and FOREIGN, and it declines with DWWA901. These results are fully compatible with those from the binary probit model. Non-linear, non-monotonic effects are generated by NETW and NETWSQ, again similarly to the binary probit. In contrast (this was not present in the binary probit), the probability that the firm is among the very first LC innovators declines as BALAN increases. By definition, a higher BALAN means that the firm is good at keeping its expert winemakers. The firm is a net gainer of specialist oenologists. But, in the ordered probit model (see Regression 8.1), a high BALAN increases the probability that the firm will go for the LC innovation very late or not at all. Keeping your winemakers seems to be bad for innovation, maybe because conservative attitudes develop and groupthink and collective beliefs that encourage rigidities prevail. As a result, there may not be sufficient unlearning (Akgun et al, 2006; Yang et al, 2014).

Very similar results emerge from the censored model (Regression 8.2). In particular, BALAN is again significant with the same sign as in the ordered probit (Regression 8.1). The better a firm is at keeping a larger number of its winemakers, the longer it takes to engage in LC innovation.

The truncated model (Regression 8.3) confirms this BALAN effect, but in other respects it shows very different results. Again, as in 8.1 and 8.2, a high BALAN helps to push LC innovation far into the future. On the other hand, and for the first time in these econometric tests, COLCH increases the probability that LC innovation will take place sooner rather than later and, again for the first time, the impact of exports is both significant and non-monotonic.

These truncated model results (and the BALAN results from the ordered probit and censored model) are unusual. They conflict in several ways with results from previous research methods, reported before. It is possible that these unusual results may have been generated by special features of the sample period (2001-2011). In order to check this, new data were collected for LC innovation in 2012 (the sources are Barahona, 2012; CAV, 2012; and Tapia, 2012). This is not a sample size increase. The sample size is the same as before, 78 (the total number of firms being researched). But now inclusion of the year 2012 has increased the number of LC innovators in the sample (by including the 2012 LC innovators), and reduced the number of firms which were still not LC innovators by the end of the period. In the respective truncated regressions, which consider only observations for which all the data are available, the period 2001-2011 (Regression 8.3) uses 27 data points. That is the number of companies which had engaged in LC innovation by the end of 2011. For the period 2001-2012, the number of usable observations has increased to 41 (Table 9, Regression 9.3).

The best ordered probit, censored and truncated model estimates for 2001-2012 are presented in Table 9. Some of the unusual results reported in Table 8 for the period 2001-2011 have been reversed, but others are still present. The significant roles detected by the truncated model in Table 8 (Regression 8.3) for exports, BALAN and COLCH either have disappeared (exports and COLCH, see Regression 9.3 in Table 9) or are now significant only at the 10 percent level (BALAN). On the other hand, the truncated model is consistent in that in both periods it challenges all of our previous results regarding PERM and DWWA901. To a lesser degree, the truncation model also challenges our previous results on exports and BALAN. Regardless of period, the largest source of different results (in relation to other research methods) is the truncation model. This may be related to the fact that the truncation model uses only ‘successful’ observations (LC innovators). It is the only research method (together with the non-econometric, time-explicit, path-dependent approach) which ignores completely all the ‘failures’ (i.e. firms which by 2011 or 2012 were not LC innovators). In the truncation model, the sample-period-robust probability of becoming an early LC innovator increases with FOREIGN and falls with BALAN.

**Discussion and conclusions**

All the results for Hypotheses H1 to H8, for all the research methods used, are summarised in Table 10. Each row represents a hypothesis and each column represents a research method. Table 10 also confirms our last two hypotheses, H9 and H10. Both different research methods (applied to the same period) and different periods may generate different empirical results.

LC innovation in Chile is explained by several factors. In the multiple regression models, these factors include foreign influence (H7 is supported by all the research methods without exception), the long-term presence of a senior expert winemaker (H3 is supported by all the research methods except the truncated model) and, surprisingly or at least unexpectedly, the failure to win top awards in prestigious international competitions (not only is H8 rejected, but DWWA901 is significant with the ‘wrong’ sign in most cases). Membership of a knowledge network (H4) may also play a positive role in Chilean LC innovation, although this depends on the research method, time period and network size. LC innovation in Chile is not explained by winery size (H1), winery age (H2), the ability to hire, keep or let go of large numbers of expert winemakers (H5, except in the truncated model), or membership of the most dynamic wine-producing geographical cluster (H6). According to the non-econometric, time-explicit, path-dependent approach, the foreign influence role declined from fundamental to minor in the period 2001-2011, expert winemakers took their knowledge with themselves as they migrated between successive employers, and some wineries became ‘LC innovators’ just by increasing prices of wines they were making already. The multiple regression and non-econometric approaches offer explanations which are different, but not contradictory.

Many of our results, both methodological and substantive, are likely to apply to radical innovation from other emerging wine regions. Possibly the only aspect that is unique to Chile is that the opportunity for radical innovation emerged with the rediscovery of carmenere. Apart from that, LC innovation in Chile resulted from a combination of crucial factors which are potentially replicable in many wine regions around the world, with different grape varieties (Anderson, 2010, 2014). In Chile, economic and political conditions were present for this opportunity to be embraced by both highly respected European and US quality wine companies, and Chilean wineries. Foreign-Chilean partnerships typically developed with different contributions from each partner but highly positive synergies. The relevant knowledge, or part of it (some of this knowledge being tacit), was accumulated, enriched and applied by key expert winemakers. This knowledge was carried from their old firms to their new employers each time winemakers changed jobs. Firms which failed to participate in LC innovation in Chile did it, not because they were too small or too large, or too young or too old, or because they were located away from the most dynamic geographical cluster. None of this mattered. However, failure to retain the long-term services of a senior expert winemaker was unambiguously damaging.

The role played by foreign influence was always positive, regardless of the research method used. In contrast, the role played by key expert winemakers is complex. They carry their knowledge with themselves, from employer to employer. The continued presence of a key expert winemaker over several years in the same winery unequivocally helps LC innovation. However, sometimes accumulating experts, rather than letting them go, is negative for LC innovation in the respective company. Moreover, once we start looking at the previous work experience of a team of experts, some experience is good but too much experience is not much better, and it could even make things worse. Winning gold medals in prestigious international competitions did not help LC innovation. On the contrary, its role was significantly negative. Possibly some companies chose between devoting efforts either to international competitions or to LC innovation, but not both. Maybe they could not afford it. Or maybe they took the view that, if their products were good enough to win gold medals, why innovate? Regarding pricing strategies, signalling quality may require substantially higher prices. All these insights may be relevant to other wine regions around the world.

Methodologically, both different research methods and different periods of study may generate conflicting results. More than half of the truncated model results were different from the results obtained when applying other methods. Using a slightly different period reversed results from the ordered probit and censored regression models. The time-explicit, path-dependent, non-econometric approach generated insights which would have been impossible to reach with the regression models. It is convenient, or essential, to check the results obtained with a particular research method against alternative methods.

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**Table 1**

**Descriptive statistics: mean, median, maximum, minimum, standard deviation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Mean | Median | Maximum | Minimum | Std. Dev. |
|  |  |  |  |  |  |
| AGE | 40.75 | 19.00 | 187.00 | 6.00 | 45.53 |
| BALAN | -0.041 | 0.00 | 4.00 | -7.00 | 2.24 |
| COLCH | 0.429 | 0.00 | 1.00 | 0.00 | 0.50 |
| DWWA56 | 0.250 | 0.00 | 1.00 | 0.00 | 0.44 |
| DWWA901 | 0.429 | 0.00 | 1.00 | 0.00 | 0.50 |
| EXPO56 | 11.89 | 2.70 | 159.80 | 0.00 | 24.69 |
| FOREIGN | 0.268 | 0.00 | 1.00 | 0.00 | 0.47 |
| LC1ST | 0.482 | 0.00 | 1.00 | 0.00 | 0.50 |
| LC2ND \* | 8.09 | 10.00 | 12.00 | 1.00 | 3.38 |
| NETW | 6.20 | 6.00 | 25.00 | 0.00 | 4.62 |
| PERM | 0.446 | 0.00 | 1.00 | 0.00 | 0.50 |

\*These descriptive statistics for LC2ND are calculated only on the subsample formed by firms which had become LC innovators by 2012 (43 observations). For the rest of the sample, by definition in the absence of LC innovation no value of LC2ND exists. Allocating an arbitrary value of zero would generate the wrong ordering and therefore biased and misleading estimates in the ordered probit model.

COLCH, DWWA56, DWWA901, FOREIGN, LC1ST and PERM are 1-0 dummy variables.

**Table 2**

**Descriptive statistics: correlations**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 \* | 10 | 11 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| AGE |  | -0.32 | 0.02 | 0.28 | 0.08 | 0.55 | -0.31 | 0.17 | 0.16 | 0.37 | 0.31 |
| BALAN |  |  | -0.03 | 0.09 | 0.00 | 0.01 | 0.10 | -0.06 | 0.21 | 0.03 | 0.23 |
| COLCH |  |  |  | 0.08 | -0.24 | -0.10 | -0.12 | -0.04 | -0.04 | -0.01 | 0.02 |
| DWWA56 |  |  |  |  | 0.33 | 0.34 | -0.26 | -0.06 | -0.01 | 0.22 | 0.23 |
| DWWA901 |  |  |  |  |  | 0.24 | -0.12 | -0.26 | 0.20 | -0.11 | 0.17 |
| EXPO56 |  |  |  |  |  |  | -0.22 | -0.07 | 0.21 | 0.38 | 0.26 |
| FOREIGN |  |  |  |  |  |  |  | 0.14 | -0.36 | -0.16 | -0.14 |
| LC1ST |  |  |  |  |  |  |  |  | -0.60 | 0.25 | 0.28 |
| LC2ND \* |  |  |  |  |  |  |  |  |  | 0.01 | 0.02 |
| NETW |  |  |  |  |  |  |  |  |  |  | 0.26 |
| PERM |  |  |  |  |  |  |  |  |  |  |  |

\*All the correlation coefficients between LC2ND and another variable are calculated only on the subsample formed by those firms which were LC innovators by 2012 (43 observations).

COLCH, DWWA56, DWWA901, FOREIGN, LC1ST and PERM are 1-0 dummy variables.

**Table 3**

**X2 tests of association: LC innovation is not independent from a second attribute but, on the contrary, there is a statistically significant association between them**

|  |  |  |
| --- | --- | --- |
| The other attribute | X2 test value | Sign |
|  |  |  |
| Long-term presence of a senior oenologist | 5.6 | Positive |
| Member of a network with 5 or more other member firms | 7.8 | Positive |
| Member of a network with 8 or more other member firms | 5.6 | Positive |
| Foreign ownership, partnership or expertise | 4.6 | Positive |
| Gold winner at the *Decanter* World Wine Awards, 2009-2011 | 10.7 | Negative |

The critical values of the test are: (one degree of freedom, probability level p=0.05) = 3.8; (p=0.01) = 6.6; (p=0.005) = 7.9.

**Table 4**

**X2 tests of association: hypotheses that cannot be rejected of independence between being or not a LC innovator, and another attribute**

|  |  |
| --- | --- |
| The other attribute | X2 test value |
|  |  |
| Being among the top 20 exporters in 2007 – 2009 | 1.2 |
| Company established in 1990 or after | 0.0 |
| Company established in 2000 or after | 0.0 |
| Born or with current production activity in the Colchagua Valley | 0.9 |
| A net loser (or a net gainer) of expert oenologists | 2.1 |
| Member of a network with 3 or more other member firms | 2.3 |
| Member of a network with 10 or more other member firms | 1.3 |

Critical value of the test (one degree of freedom, probability level p=0.05) = 3.8

**Table 5**

**Who innovates and who does not? Binary probit regressions**

**Dependent variable: LC1ST (1: LC innovator; 0: not LC innovator)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Regr 5.1 | Regr 5.2 | Regr 5.3 | Regr 5.4 | Regr 5.5 | Regr 5.6 |
|  |  |  |  |  |  |  |
| C | -1.048\*  (-2.39) | -0.848  (-1.40) | -1.787\*\*  (-3.47) | -1.435\*  (-2.54) | -1.224\*  (-2.00) | -1.563\*  (-2.39) |
| EXPO56 |  | -0.021  (-1.04) |  | -0.0002  (-0.02) |  | -0.034  (-1.37) |
| EXPOSQ |  | 0.0002  (1.54) | 5.4E-05  (1.25) |  |  | 0.0003  (1.81) |
| AGE |  |  | 1.7E-05  (0.003) |  | -0.023  (-0.98) | -0.011  (-0.57) |
| AGESQ |  |  |  | 3.0E-05  (0.94) | 0.0002  (1.22) | 8.4E-05  (0.75) |
| PERM | 0.887\*  (2.45) | 1.286\*\*  (3.17) | 1.363\*\*  (3.13) | 1.051\*  (2.39) | 1.293\*\*  (2.82) | 1.615\*\*  (3.36) |
| NETW | 0.197\*  (2.34) | 0.195\*  (2.10) | 0.307\*\*  (3.03) | 0.271\*\*  (2.95) | 0.282\*\*  (3.10) | 0.355\*  (2.29) |
| NETWSQ | -0.009\*  (-2.02) | -0.009  (-1.93) | -0.015\*  (-2.41) | -0.013\*\*  (-3.07) | -0.014\*\*  (-2.60) | -0.017  (-1.49) |
| BALAN |  | -0.146  (-1.57) | -0.147  (-1.51) |  |  | -0.167  (-1.76) |
| COLCH |  | -0.299  (-0.71) |  | -0.266  (-0.64) |  | -0.090  (-0.19) |
| FOREIGN | 0.895\*  (2.36) | 0.817  (1.89) | 1.137\*  (2.56) | 1.000\*  (2.26) | 1.059\*  (2.43) | 1.049\*  (2.34) |
| DWWA56 |  | 0.016  (0.03) |  |  | -0.796  (-1.49) | -0.329  (-0.63) |
| DWWA901 | -0.907\*\*  (-2.68) | -1.109\*\*  (-2.62) | -0.784  (-1.95) | -0.716  (-1.72) | -0.594  (-1.56) | -0.681  (-1.50) |
|  |  |  |  |  |  |  |
| McFadden R2 | 0.234 | 0.276 | 0.305 | 0.281 | 0.303 | 0.334 |
| Akaike info criterion | 1.223 | 1.369 | 1.285 | 1.317 | 1.239 | 1.387 |
| LR statistic | 22.90 | 22.96 | 23.63 | 21.83 | 27.17 | 25.91 |
| Prob (LR statistic) | 0.0004 | 0.0109 | 0.0026 | 0.0052 | 0.0007 | 0.0110 |
| n | 71 | 60 | 56 | 56 | 65 | 56 |

Standard errors are robust. The z statistics are in parentheses.

\*: p < 0.05; \*\* : p < 0.01

**Table 6**

**LC innovation leaders and followers (or ‘leaders’ and ‘followers’), according to the year when their LC wines were listed in the *Guia de Vinos de Chile* for the first time, and according to whether a) foreign ownership, partnership or expertise is involved, and b) the respective wine had been listed before in a lower price bracket**

|  |  |  |
| --- | --- | --- |
| *Guia de Vinos de Chile*, publication year | Number of LC wines listed for the first time (\*) | How many are made by foreign-owned or foreign-influenced firms? |
|  |  |  |
| 2001 | 3 | 3 |
| 2003 | 3 | 2 |
| 2005 | 4 (2) | 2 |
| 2006 | 5 (1) | 2 |
| 2008 | 4 (1) | 1 |
| 2009-2011 | 20 (7) | 4 |
| 2009-2011, all previously listed at lower prices | (7) | (1) |
| 2009-2011, not listed before at a lower price | 13 | 3 |

(\*) In parentheses, the number of wines which had been listed in previous editions of the *Guia* in a lower price bracket.

**Table 7**

**Key expert winemakers, with the publication years when two of his or her employers, in chronological order, appear in the *Guia de Vinos de Chile* for the first time as LC innovators**

|  |  |  |
| --- | --- | --- |
| Winemaker **(not his or her real initials)** | Year the first employer is listed in the *Guia* | Year the second employer is listed in the *Guia* |
|  |  |  |
| AA | 2001 | 2009-2011 |
| AA | 2001 | 2009-2011 a |
| AA | 2001 | 2009-2011 a |
| A-A-A |  | (2005) b |
| BB | 2006 | 2009-2011 |
| CC | 2005 | 2006 |
| CC | 2005 | 2009-2011 |
| C-C-C |  | (2001) b |
| DD | 2001 | 2009-2011 |
| EE | 2003 | 2009-2011 |
| EE | 2001 | 2009-2011 |
| FF | 2003 | 2008 |
| FF | 2003 | 2009-2011 |
| FF | 2003 | 2009-2011 a |
| GG | 2003 | 2009-2011 |
| GG | 2003 | 2009-2011 a |
| GG | 2005 | 2009-2011 |
| GG | 2005 | 2009-2011 a |
| HH | 2003 | 2008 |
| II | 2003 | 2008 |
| II | 2003 | 2009-2011 |
| JJ | 2003 | 2008 |
| J-J-J |  | (2006) b |
| KK | 2005 | 2009-2011 |
| K-K-K |  | (2006) b |
| LL | 2006 | 2009-2011 |
| MM | 2003 | 2009-2011 |
| NN | 2008 | 2009-2011 |
| OO | 2005 | 2008 |
| PP | 2003 | 2008 |
| QQ | 2008 | 2009-2011 |
| RR | 2001 | 2009-2011 |
| SS | 2006 | 2009-2011 |
| S-S-S |  | (2009-2011) b |
| TT | 2003 | 2009-2011 |
| UU | 2008 | 2009-2011 |
| VV | 2009-2011 | 2009-2011 c |

a: same winemaker and same first employer, different second employer.

b: only one employer. In this particular case, the first-employer-second-employer pattern does not apply.

c: both employers in the same year.

**Table 8**

**Who innovates first, and who follows? Ordered probit, censored and truncated models, period 2001-2011**

**Dependent variable: LC2ND (year of first listing as LC innovator, 2001=1, etc)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Regr 8.1 | Regr 8.2 | Regr 8.3 |
|  | Ordered probit | Censored | Truncated |
| C |  | 18.18\*\*  (8.19) | 9.243\*\*  (4.23) |
| EXPO56 |  |  | 0.120\*  (2.20) |
| EXPOSQ |  |  | -0.00068\*  (-2.02) |
| AGE |  |  | 0.036  (1.27) |
| AGESQ |  |  | -0.00014  (-0.98) |
| PERM | -0.927\*\*  (-3.25) | -4.903\*\*  (-3.44) | -1.315  (-1.09) |
| NETW | -0.186\*  (-2.12) | -0.940\*  (-2.21) | -0.398  (-0.91) |
| NETWSQ | 0.009  (1.91) | 0.047\*  (1.98) | 0.026  (0.97) |
| BALAN | 0.134\*  (2.07) | 0.660\*  (2.02) | 0.531\*\*  (2.59) |
| COLCH |  |  | -2.039\*  (-2.20) |
| FOREIGN | -1.201\*\*  (-3.71) | -5.434\*\*  (-3.38) | -2.813\*\*  (-2.76) |
| DWW56 |  |  | -1.662  (-1.30) |
| DWWA901 | 0.698\*  (2.34) | 3.792\*\*  (2.59) |  |
|  |  |  |  |
| Pseudo-R2 | 0.148 |  |  |
| Akaike info crit | 2.686 | 3.517 | 5.360 |
| LR statistic | 28.99 | 28.74 | 13.92 |
| Prob (LR stat) | 0.0001 | 0.0001 | 0.2375 |
| n | 71 | 71 a | 27 |

a: Of which 32 are uncensored and 39 are right censored observations.

Standard errors are robust. The z-statistics are in parentheses.

**Table 9**

**Who innovates first, and who follows? Ordered probit, censored and truncated models, period 2001-2012**

**Dependent variable: LC2ND (year of first listing as LC innovator, 2001=1, etc)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Regr 9.1 | Regr 9.2 | Regr 9.3 |
|  | Ordered probit | Censored | Truncated |
| C |  | 13.38\*\*  (13.2) | 10.84\*\*  (10.52) |
| PERM | -0.941\*\*  (-3.80) | -4.081\*\*  (-3.77) |  |
| NETW |  |  | -0.388\*  (-2.02) |
| NETWSQ |  |  | 0.018\*\*  (2.71) |
| BALAN |  |  | 0.360  (1.95) |
| FOREIGN | -1.014\*\*  (-3.46) | -4.376\*\*  (-3.37) | -3.068\*\*  (-2.87) |
| DWWA901 | 0.661\*  (2.54) | 2.764\*  (2.51) |  |
|  |  |  |  |
| Pseudo R2 | 0.094 |  |  |
| Akaike info crit | 3.36 | 4.09 | 5.14 |
| LR stat | 23.38 | 23.30 | 118.40 |
| Prob (LR stat) | 0.0000 | 0.0000 | 0.0000 |
| n | 73 | 73 a | 41 |

The z statistics are in parentheses. Standard errors are robust.

a: Of which 43 are uncensored and 30 are right censored observations.

In order to address the question: ‘Do different samples, applying to different periods, yield different results?’, this table should be compared with Table 8.

**Table 10**

**Confirming or rejecting association (of either sign) between a possible explanatory variable and LC innovation (Hypotheses H1 to H8):**

**Effects of using different methods and different periods**

**[Two answers in the same cell apply to different periods, 2001-2011 and 2001-2012, respectively]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | X2 | Binary probit | Alternat, time-expl. path-dep | Ordered probit | Censored | Truncated |
| Hypothesis |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| H1 | No | No |  | No/no | No/no | Yes/no |
| H2 | No | No |  | No/no | No/no | No/no |
| H3 | Yes | Yes |  | Yes/yes | Yes/yes | No/no |
| H4 | Yes a | Yes | Yes | Yes/no | Yes/no | No/yes |
| H5 | No | No |  | Yes/no | Yes/no | Yes/yes b |
| H6 | No | No |  | No/no | No/no | Yes/no |
| H7 | Yes | Yes | Yes | Yes/yes | Yes/yes | Yes/yes |
| H8 c | Yes | Yes d |  | Yes/yes | Yes/yes | No/no |

a: For some, but not all values of the relevant variable, NETW.

b: Only at the 10 percent level.

c: ‘Yes’ in every cell in this row (except for the truncated model) means that there is significant association between DWWA901 and the dependent variable. However, its sign is negative for LC1ST and positive for LC2ND. So, H8 must be rejected.

d: Only in some specifications.

An empty cell means ‘not applicable’.