Innovation and Innovators in the Wine Industry of Argentina: What a Novel Dataset Reveals

Nicolás Depetris-Chauvin[1], Julio J. Elías[2], Gustavo Ferro[3], Nicolás Gatti[4], and Emiliano Villanueva[5]

Abstract

Argentina is one of the latecomers as a wine exporter among New World producers. However, its insertion in the international market is steady in volume and improving in relative prices, indicating an increasing appreciation of its quality over time. Quality is essential for differentiating products and is intimately related to innovation. We use a new, unique microdata set of wineries in Argentina to quantitatively characterize the innovators' approach to innovation. Based on the innovator type in the Argentine wine industry, we link these types with variables capturing critical decisions in the production process and variables capturing the winery's performance. We use innovator profiles defined by a questionnaire to estimate the impact of being an extremely conceptual innovator on export performance. We hypothesize that there are differences in export performance between different types of innovators. Using an Inverse Probability Weighting with Regression Adjustment (IPWRA) methodology, we find that being an extremely conceptual type of innovator is associated with larger shares of export volume and value. This research has implications for focusing on the types of innovators who succeed as international wine exporters.

JEL Codes:

Keywords: Innovation, Innovators, Wine, Exports, Argentina

1. Introduction

Wine production in Argentina has evolved from mainly producing table wine for domestic markets to becoming a relevant player in the international market, with a share in quality wine markets. A succession of innovations aimed at improving quality, carried out by entrepreneurs, winemakers, and other actors in the sector, was the driving force behind this transformation. The evolution and changes in the industry are explained by the conception and development of these innovations, which turn the wine industry into a natural laboratory for understanding the creative and innovation process (Elías et al., 2020). Our objective is to identify and estimate the impact of innovators' profiles on export outcomes.

Until the 1990s, the domestic wine market in Argentina produced significant volumes of table wine primarily for local consumption. Since then, Argentina has expanded to selling both table and quality wines overseas. Each year, Argentina produces an average of 11 million tons of wine, with 3 million tons exported. The country consistently holds a 2 percent share of global wine volumes traded and nearly 2.5 percent of global export value. This latter share has grown steadily, reflecting an improvement in the average price paid for Argentine wine in international markets. This upgrading is evident both in absolute terms and relative to the average prices of French wine exports, which are considered the epitome of quality. Argentine wine exporters include sellers of both bulk and bottled wine, but bottled varietal wine makes up more than 90 percent of export values. Bulk wine is generally cheaper than bottled wine, and among bottled wine exports, there are high-, middle-, and low-quality wines. The majority of bottled wine

[1] HES-SO, Haute École de Gestion de Genève, Geneva, Switzerland. Email: nicolas.depetris-chauvin@hesge.ch
[2] Universidad del CEMA (UCEMA), Buenos Aires, Argentina. Email: je49@ucema.edu.ar
[3] Universidad del CEMA (UCEMA) and CONICET, Buenos Aires, Argentina. Email: gaf97@ucema.edu.ar; gferro05@yahoo.com.ar
[4] Universidad del CEMA (UCEMA) and Centro de Investigación en Economía y Prospectiva CIEP-INTA, Buenos Aires, Argentina. Email: nicolasgatti1987@gmail.com
[5] Eastern Connecticut State University, Willimantic, CT, United States. E-mail: villanuevae@easternct.edu

exports from Argentina are varietals, predominantly featuring the local signature grape, Malbec, which accounts for nearly 60 percent of the country's total wine exports.

The shift of the local industry towards exports required innovation in products and processes to enhance the average quality of local wines, aiming for differentiation through quality (Elías et al., 2019; Elías et al., 2020). Innovation can mean a new idea, method, process, product, or technology, but it must be implemented to be considered an innovation. From a business perspective, innovation is a new solution to a practical problem that generates value. Innovations stem from practical needs, offer practical solutions, and, if successful, yield value (Dogru and Peyrefitte, 2022). Quality is crucial for differentiation, as higher prices are awarded for higher quality. This involves adding valuable attributes to products to make them stand out to customers. New and improved products and processes are essential for success in dynamic and competitive international markets. Argentine wineries have received growing average relative prices for their products compared to other New World producers, which can be interpreted as a market premium for quality improvements (Villanueva and Ferro, 2022).

This paper analyzes the characteristics of innovators who produce quality wine for export markets. We seek to establish links between innovators, their characteristics, and export performance. In the analysis, we use a representative sample of 230 wineries in Argentina (which accounts for approximately one-fourth of the country's wineries).

We compile the database from a survey of wineries aiming to understand why and how they innovate, generally focusing on creating new or improved products and processes. The literature breaks down the concept of innovation into sub-concepts to decrease abstraction and address measurement challenges associated with the term. These sub-concepts include function-specific variables (such as production and marketing), process versus product innovation, incremental versus radical innovation, conventional versus eco-innovation (in the context of the wine industry), and internal versus external innovation (Dogru and Peyrefitte, 2022).

We are interested in determining how the characteristics of innovators relate to their achievements (which can be measured by prices obtained, volumes produced, qualities achieved, export market performance, inputs used, and qualitative features of the wineries). We seek to understand the drivers (why?) and the patterns (how? where?) of innovation in the wine industry. We detect some patterns of innovators that respond both to economic stimulus and some personal characteristics that orient them to specific results in their search for quality (understood as a set of attributes -horizontal, vertical, or idiosyncratic- which in the mind of the customers increase their willingness to pay for the product, ceteris paribus).

We hypothesize that innovators who produce quality export wines are different from other types of producers (such as exporters of bulk wine or non-exporters). Because exporting does not mean high quality per se (part of exports is made of bulk wine), we first investigate interactions between exports and quality (which we attribute partially to innovation) to characterize exporters concerning non-exporter firms. Suppose exporter firms are different. In that case, the next stage is to investigate the features of the innovators who produced these quality improvements and who allowed an increase in the international insertion of Argentine wines.

Export activity demands more quality and differentiation than the domestic market if the winery aims to position itself in a high-price segment. Further, high quality and differentiation demand more human capital than selling simple volumes of commodity goods. We hypothesize that the features of innovative

profiles of exporters of quality wines, both conventional and environmentally friendly (organic and biodynamic) are different than the profiles of innovative winemakers focused on the domestic market or in exporting low-quality bulk wine; moreover, we are trying to assess whether the type of innovator in high-quality wine exports is predominantly "conceptual", by contrast with "experimental" innovators.

Following this introduction, the second section reviews the literature on innovation and innovators, emphasizing the wine industry. The third section presents the dataset, the methodology applied, and the models we estimate. The fourth section discusses the results, and the fifth section presents conclusions.

2. Literature review

Elías and Ferro (2018), Elías et al. (2019), and Elías et al. (2020) analyze case studies of renowned innovators in the wine industry and offer a framework to explain why innovation types are connected to innovators' characteristics. These papers study successful innovators and thus connected types of innovation and innovators in a setting based on both Romer's theories of endogenous growth (private investors seek to differentiate in a world of monopolistic competition through appropriating private costly innovation and using public free knowledge), and Galenson (2007)'s typology of innovators (distinguishing between experimental and conceptual creative minds).

Based on the study of the careers of famous artists, Galenson (2007) distinguishes two different types of innovators in art: the conceptual, who plan in detail before making a work (build in their minds the abstract construction previously to concretize it), and the experimental, who take the major decisions while doing their job (built the concrete outcome without a model, improve it on the move, and sometimes without reaching an end). The author traced similar patterns in literature, music, business, and other disciplines. Conceptual innovations are disruptive. Most of their contributions consist of products or processes utterly different from previous ones. Conceptual innovators have precise objectives in advance and tend to plan their work. Their most significant innovation tends to appear early in their careers.

On the other hand, experimental innovators proceed tentatively, through trial and error, building improvements gradually, and tend to contribute to the final stages of their careers since their contributions are cumulative. There is no such thing as a finished project for an experimental innovator. Their skills, and therefore their work, are improved over time. Their careers usually are dominated by the same topic or problem, in search of a single objective. In contrast, for conceptual innovators, experience and habits deteriorate their ability to innovate and break existing paths (Galenson, 2010 a; Galenson, 2010 b; Galenson, 2009; Galenson, 2008; Galenson and Pope, 2013; Weinberg and Galenson, 2019).

Due to their nature, conceptual innovations are more manageable to codify and disseminate than experimental ones. A conceptual innovation is replicable because it is codified knowledge. In contrast, experimental innovations are difficult to spread as they are difficult to communicate (because they are tacit knowledge embedded in minds). Significant experimental innovations are often difficult to detect because they can occur gradually, making it hard for those involved to realize they are innovating.

None of the types of innovators are inherently more important than the other. The codification of knowledge permits a form of generalized diffusion and, eventually, the transformation of innovations in public goods (non-excludable and non-rival). Experimental innovations are not codified; they spread via human capital circulation and disseminate differently than conceptual ones.

Both theoretical and empirical work on the innovation-export link is focused on technological (product and process) innovations (Filipescu et al., 2013; Hervas-Oliver et al., 2016; Lewandowska et al., 2016). Filipescu et al. (2013) seek to understand the dynamics of firms operating abroad by considering the

mutual effect of research-and-development intensity and product and process innovations on the breadth and depth of exports. They find evidence that innovation and exports have a reciprocal causal relationship. Hervas-Oliver et al. (2016) explore whether technological innovators benefit from introducing management innovations. Technology integration, organization innovation capabilities, and positive complementarities improve performance. Lewandowska et al., (2016) link innovation, innovation cooperation, and exports. They examine complementarities between various types of innovation—product, process, and marketing innovations—showing that combining product and process innovation enhances the export intensity of new products.

As Bernetti et al. (2006) establish, average preferences have shifted from basic to higher-quality wines, a "lower quantity but better quality" market trend. The pivotal years in this change process were the 1990s when a new structure of consumer demand developed. Quality has thus become a critical issue. Globalization has facilitated the progressive easing of know-how and technology diffusion in production techniques, marketing, and commercial practices (Villanueva et al. 2021).

In a meta-analysis of 76 studies, Dogru and Peyrefitte (2022) investigate absorptive capacity, technology adoption, sustainable practices, export orientation, firm size, and firm age to explain wine innovation. They also investigate the association between innovation and financial performance. The meta-analysis reveals that absorptive capacity, technology adoption, sustainable practices, export orientation, and firm size positively correlate with innovation efforts, and innovation is positively associated with financial performance. However, they found no correlation between firm age and innovation.

Depetris-Chauvin et al. (2023) examine the sequential relationships between a manager's personality and winery and institutional level factors on organic wine production activity and winery export performance in Spain. Openness to experience, for instance, a manager's personality trait, seems to have a positive causal relationship with organic wine production. Aubert et al. (2012), Rogers (2010), and Tepic et al. (2012) focus on farmers' innovativeness. Manager's personality has been increasingly used in the broader sustainability literature (Dessart et al., 2019; Dwyer et al., 2007). Acknowledging violations of the usual assumption of rationality in human behavior, Dessart et al. (2019) distinguish three behavioral factor types: dispositional, social, and cognitive. The first comprehends personality, motivations, values, beliefs, general preferences, and objectives (Malle, 2011). The second relates to the producers' interactions with other competitors and includes social norms. The third concerns learning and reasoning, including appreciating innovation's relative costs, benefits, and risks. Personality factors are probably the most stable behavioral factors (Dessart et al., 2019), and they relate to other dispositional factors, such as resistance to change (George and Zhou, 2001) or risk tolerance (Frey et al., 2017). Personality traits consist of habitual patterns of thinking, feeling, and behaving. These relate to managers' objectives, values, and attitudes (Willock et al., 1999; Grube et al., 1994) and influence activities and performance. The Big-Five framework (McCrae and Costa, 1997) is probably the most widely accepted taxonomy of personality traits in personality psychology (Almlund et al., 2011; Shalender and Yadav, 2019). Each trait captures a unique set of psychological characteristics (Boudreau et al., 2001). They are:

1) Conscientiousness is associated with a strong sense of direction, self-discipline, persistence, and performance motivation (Bono and Judge, 2004).
2) Neuroticism relates to a poor ability to remain calm and balanced in stressful situations (McCrae and Costa, 1997).
3) Agreeableness links with tendencies to be compliant and altruistic (Judge and Bono, 2000; Berry et al., 2007).
4) Extraversion is consistent with sociability, communicativeness, and enthusiasm (McCrae and Costa, 1997).

5) Openness to experience is the tendency to be intellectually curious, open to stimuli, and creative (McCrae and Costa, 1987).

Our work connects both strands of research by examining a novel aspect of innovation and empirically analyzes the relationship between Galenson's types of innovators and export performance. We also contribute to analyzing whether personality traits and other individual characteristics are related to the innovator type, conceptual or experimental, in their wine export activity.

3. Methodology, data, and models

We use a new micro data set of wineries in Argentina to characterize the innovators' approach to innovation. A survey was distributed among all wineries in all wine regions of Argentina between August 2019 and May 2021; it was answered in person (we conducted a pilot study with 22 wineries to assess the quality and relevance of the survey instrument) or online by winery owners or managers. A thorough process was implemented to contact respondents before, during, and after they had answered the survey. Potential outliers were identified and addressed with follow-up questions with the respondents.

The survey was answered by 230 wineries, corresponding to a response rate of 26.3 percent of the total population of Argentinean wineries, a significantly high average response rate for an industrial-level survey (Baruch and Holtom, 2008; Krishnan and Poulose, 2016). Wineries were stratified geographically, and we managed to secure at least a 20 percent response rate in each Argentinean wine-producing province. The sample was also segmented by wineries' size (production in liters), and we worked closely with the implementing partners to secure a representative sample of the industry (Depetris-Chauvin and Villanueva, 2024).

Our dataset contains information on the winery profile (age, size, ownership, location, sales, the price segments in which wineries operate, exports, and other business activities), the winery's production function (differentiation in the production process, including the decision-making regarding vineyard management and the winemaking process, and the marketing process, both for entry-level and premium wines), winery capabilities (technological and human resources and their perceived level of sectorial competitiveness), export markets (performance constraints and strategies) and innovator type (innovation tests and personality traits tests).

Using this data, we estimate the relationship between the innovator's approach to innovation (Experimental versus Conceptual) with individual characteristics, such as education, and the personal traits of personalities, such as self-motivation and confidence, that we capture through the survey. We constructed a taxonomy of innovator types in the wine industry of Argentina and linked them with variables capturing critical decisions in the production process and the winery's performance.

3.1 Methodology

Morgan and Winship (2014) present the counterfactual model of causality for observational data analysis and offer methods for causal effect estimation. They show least squares regression from three perspectives: (1) as a descriptive modeling tool, (2) as a parametric adjustment technique for estimating causal effects, and (3) as a matching estimator of causal effects. The latter helps to understand the others from a counterfactual perspective.

Inverse Probability Weighted Regression Adjustment (IPWRA) is an approach to estimating unbiased treatment effects when there is confounding evidence on causality. Often, the treatment is observable,

but there is no randomization, leading to issues like selection bias. If selection characteristics are observed, treatment can be conditioned on these features to yield an unbiased estimate of the treatment effect.

The IPWRA method involves several steps:

1) Estimate the selection to treatment (treatment model).
2) Predict treatment for all observations.
3) Assign the inverse probability of treatment for treated individuals and the inverse probability of not being treated for control individuals.
4) Re-estimate the outcome model using these new weights.

This method creates counterfactuals that are not observed in the data by magnifying treatment individuals who otherwise look like they would not have selected treatment, and control individuals who otherwise would have chosen treatment. The model is doubly robust: if either the treatment or outcome model is misspecified, the estimator remains consistent (Caldera, 2019).

We use the IPWRA model to evaluate how innovation profiles affect exports. The idea is to perform a doubly robust estimation of how innovators' profiles impact outcomes. First, we estimate the Average Treatment Effect (ATE), comparing outcomes of innovators considered extremely conceptual (EC) using Galenson's methodology versus the rest. The second step examines the subgroup of firms that export, using IPWRA to obtain the Average Treatment on the Treated (ATT). This analysis explores whether extremely conceptual innovators have a differential effect on their exports compared to their non-EC counterparts.

The method is designed to estimate unbiased treatment effects when there is confounding evidence of causality. In our context, the hypothesis is that Type X Innovators are more prone to increase exports than Type No-X innovators. The treatment means that the winery is run by a Type X innovator. Although treatment is observable, there is no randomization of assignment. The technique allows us to treat the phenomenon as if it had been random. We expect that within the sample, the probability of being an exporter is greater for wineries run by Type X innovators than for those not treated.

3.2 Data

The survey data allows us to differentiate between small and large wineries and characterize the innovation introduced in recent years in all the stages of the production process, from the vine to the market: vineyard work, winemaking, management, and marketing. The interviewees were asked to classify their wineries in comparison with the competition and to characterize themselves in terms of their innovative activity and personal features, trying to make an identity of innovators. These were inquired whether they plan or not before starting a project, whether their pace is gradual and cumulative or sudden and disruptive, whether they apply general or specific principles, whether they are satisfied once results are achieved or continue to experiment again and again.

The respondents were asked about their attitudes and practices when innovating and classified among five categories of innovators (see Box 1): extremely experimental (3.0 percent of the respondents), moderately experimental (18.3 percent of the sample), intermediate innovator (0.9 percent of the interviewed), moderately conceptual (37.4 percent of the sample), and extremely conceptual (the remaining 40.4 percent of the sample). After exploring significant relationships among these categories

with explanatory variables, we rearranged the former classification, merged the first four (59.6 percent of the sample) into the category, which we renamed as "non-extremely conceptual" (non-EC) and compared them against the "extremely conceptual" (EC; see Appendix A which relates the self-reported personal characteristics of the innovators and their correlations with the EC condition).

BOX 1: Innovator Type (as it was included in Section 5 of the Survey)

1. Planning. When you start a project, do you first plan it out, step by step, or do you jump in and improvise as you go along?

Advance Planning ☐ Improvise ☐

2. Starting. In thinking back on the best-received change you ever made in things or procedures in your part of the world (including career, workplace, school, and home, but excluding self-improvement), did it start with a bright idea that you put into practice, or did you achieve it by trial and error without knowing in advance what the change would be?

Bright idea ☐ Trial and error ☐ No change of mine was ever well received ☐

3. Principles or specifics. When you need to make a change or otherwise do something new, do you choose how to act by thinking first about how general principles apply to the situation or by first examining the details of the situation?

General principles ☐ Specifics ☐

4. Ending. When a project nears an end, are you ready to wrap it up and move on, or do you want to keep making improvements?

Move on ☐ Keep improving it ☐

5. In retrospect. After a project ends, are you often satisfied with it or more likely to be dissatisfied with it?

Satisfied ☐ Dissatisfied ☐

Processing: +2 or -2 if you chose the first or the second option in Q1 to Q5, and +0 if you chose the third option in Q2.

The respondent is classified as an innovator type: extremely experimental (< 1 point), moderately experimental (1 ≤ points ≤ 3), intermediate innovator (5 points), moderately conceptual (7 ≤ points ≤9), and extremely conceptual (> 9 points).

Source: Test Designed by Colin Stewart

Table 1 defines the variables we use for our empirical study and shows the main statistics of the sample. To obtain a measure of physical capital, we use the physical capital from each firm to create an index that helps reduce the analysis's dimensionality. Instead of including all the dummies about physical capital, we just used the index; we estimated it using the first component of a Principal Component Analysis (PCA) (See Appendix B for details).

Table 1: Variable Definitions

Variable	Interpretation
ProdinL	Wine production (M liters)
export_volume1	Exports in volume (% of volume of production)
export_value1	Exports in value (% of value of production)
export_labels	Number of labels exported
export_countries	Number of countries exported
SA	Firms is a corporation (SA) (=1, if yes)
Winemaker_experience	Winemaker years of experience
Vineyardmanager_experience	Vineyard manager years of experience
Marketing_experience	Marketing manager years of experience
Sales_experience	Sales manager years of experience
Open_to_new_experiences	Open to new experiences (1 to 5)
Undisciplined	Undisciplined (1 to 5)

Large	Firms of more than 30 hectares (=1, if >30)
Grapesvinified	Number of grapes vinified
n_wine_varieties	Types of wines produced
Value10	Sells in the Value segment (=1, if yes)
Premium1040	Sells in the Premium segment (=1, if yes)
Luxury40100	Sells in the Luxury segment (=1, if yes)
Iconic100	Sells in the Iconic segment (=1, if yes)
Labor	Number of workers
capital_index	Capital Index (From 0 to positive values)
Ownedforeign	Owned by foreigner (=1, if yes)
Ownwineryabroad	Own a winery abroad (=1, if yes)
Innovator	Extremely Conceptual innovator runs the firm = 1

Source: Authors' elaboration.

Table 2 presents the descriptive statistics for the whole sample, exporters, EC, and non-EC. The wineries of our whole sample export, on average, almost 40 percent of their production in value and 35 percent in volumes, indicating that, on average, exports are more valuable than sales in the local market. As we stated, when filing the module regarding the type of innovator who is running the winery, 40 percent of the sample is categorized as ECs. Firms are organized in several juridical forms, and 61 percent are corporatized as limited liability partnerships ("sociedades anónimas" or SA). The sample shows the coexistence of long-standing firms with new ones. On average, firms export to 8 countries, ranging from 0 to 100 countries in the most significant case. Almost eight different grapes are vinified on average, again with an ample range and dispersion within firms. On average, a similar number of labels are exported by the firm.

The average firm employs 96 workers, and the largest one employs 3000, producing 4.1 million liters per year on average, with a maximum of 312 million liters per year. Forty-nine percent of the wineries own 30 hectares of land or more. The wine business is predominantly for nationals: only 13 percent of the wineries are owned by foreigners, and 4 percent of the wineries owned a winery abroad. However, internationalized wineries are overwhelmingly focused on quality wines. The wineries tend to diversify their product lines. There are wineries focused on Iconic, Luxury, Premium, or Value segments (the categories the survey admits); however, on average, they produce and sell several qualities. Concerning personal features of the owners-managers interviewed, almost 90 percent (4.43 on a 1-5 index) defined themselves as "open to new experiences," and less than 20 percent (1.88 on a 1-5 index) characterized themselves as "undisciplined."

At first sight, watching the different subsamples, the statistics reveal differences among the whole sample and the subsample of exporters, and between the subsamples of EC and non-EC running wineries.

Table 2: Descriptive statistics (whole sample, exporters, EC innovators, non-EC innovators)

Variable	Obs	Mean	Std. dev.	Min	Max
Whole Sample (N = 230)					
ProdinL	230	4.10	24.83	0.00	312
export_volume1	230	35.04	34.57	0	100
export_value1	230	39.67	37.06	0	100

export_labels	230	7.75	11.54	0	56
export_countries	230	7.90	15.43	0	100
SA	230	0.61	0.49	0	1
Winemaker_experience	230	19.08	9.82	0	57
Vineyardmanager_experience	230	16.92	11.68	0	72
Marketing_experience	230	9.44	9.24	0	57
Sales_experience	230	10.95	10.27	0	57
Open_to_new_experiences	230	4.43	0.85	1	5
Undisciplined	230	1.88	1.12	1	5
large	230	0.49	0.50	0	1
Grapesvinified	230	7.69	5.96	1	50
n_wine_varieties	230	3.20	1.25	1	6
Value10	230	0.67	0.47	0	1
Premium1040	230	0.76	0.43	0	1
Luxury40100	230	0.31	0.46	0	1
Iconic100	230	0.13	0.33	0	1
labor	230	95.92	327.32	0	3000
capital_index	230	6.53	2.20	0	10.85
Ownedforeign	230	1.13	0.33	1	2
Ownwineryabroad	230	1.04	0.20	1	2
innovator	230	0.40	0.49	0	1

Variable	Obs	Mean	Std. dev.	Min	Max
Exporters (N = 164)					
ProdinL	164	5.61	29.28	0.00	312
export_volume1	164	49.15	31.33	5	100
export_value1	164	55.64	32.18	5	100
export_labels	164	10.87	12.37	0	56
export_countries	164	11.08	17.29	0	100
SA	164	0.74	0.44	0	1
Winemaker_experience	164	19.77	9.37	0	57
Vineyardmanager_experience	164	19.47	11.46	0	72
Marketing_experience	164	11.38	9.56	0	57
Sales_experience	164	13.63	10.44	0	57
Open_to_new_experiences	164	4.46	0.76	1	5
Undisciplined	164	1.92	1.16	1	5
large	164	0.64	0.48	0	1
Grapesvinified	164	8.66	6.54	1	50
n_wine_varieties	164	3.43	1.18	1	6
Value10	164	0.63	0.48	0	1
Premium1040	164	0.87	0.34	0	1
Luxury40100	164	0.42	0.50	0	1
Iconic100	164	0.17	0.38	0	1
labor	164	127.51	383.11	0	3000

capital_index	164	6.97	2.13	0	10.85
Ownedforeign	164	1.17	0.38	1	2
Ownwineryabroad	164	1.06	0.24	1	2
innovator	164	0.46	0.50	0	1

Variable	Obs	Mean	Std. dev.	Min	Max
Extremely conceptuals (N = 93)					
ProdinL	93	2.34	7.10	0.00	40
export_volume1	93	44.35	34.76	0	100
export_value1	93	50.97	37.70	0	100
export_labels	93	8.95	12.20	0	56
export_countries	93	9.35	16.18	0	100
SA	93	0.71	0.46	0	1
Winemaker_experience	93	18.46	8.65	0	40
Vineyardmanager_experience	93	16.41	9.72	0	40
Marketing_experience	93	10.86	8.64	0	38
Sales_experience	93	11.39	8.55	0	38
Open_to_new_experiences	93	4.30	1.01	1	5
Undisciplined	93	1.77	1.01	1	5
Large	93	0.53	0.50	0	1
Grapesvinified	93	7.81	5.38	2	42
n_wine_varieties	93	3.37	1.17	1	6
Value10	93	0.65	0.48	0	1
Premium1040	93	0.84	0.37	0	1
Luxury40100	93	0.38	0.49	0	1
Iconic100	93	0.12	0.32	0	1
labor	93	99.24	331.57	2	3000
capital_index	93	6.72	2.31	0	10.85
Ownedforeign	93	1.15	0.36	1	2
Ownwineryabroad	93	1.04	0.20	1	2
innovator	93	1.00	0.00	1	1

Variable	Obs	Mean	Std. dev.	Min	Max
Non-EC (N = 137)					
ProdinL	137	5.29	31.63	0.00	312
export_volume1	137	28.72	33.10	0	100
export_value1	137	32.01	34.71	0	100
export_labels	137	6.93	11.04	0	50
export_countries	137	6.91	14.87	0	95
SA	137	0.54	0.50	0	1
Winemaker_experience	137	19.50	10.54	0	57
Vineyardmanager_experience	137	17.26	12.86	0	72
Marketing_experience	137	8.48	9.54	0	57
Sales_experience	137	10.66	11.32	0	57
Open_to_new_experiences	137	4.53	0.71	1	5

Undisciplined	137	1.95	1.18	1	5
large	137	0.47	0.50	0	1
Grapesvinified	137	7.61	6.34	1	50
n_wine_varieties	137	3.09	1.29	1	6
Value10	137	0.69	0.46	0	1
Premium1040	137	0.71	0.46	0	1
Luxury40100	137	0.27	0.45	0	1
Iconic100	137	0.13	0.34	0	1
labor	137	93.67	325.61	0	2800
capital_index	137	6.40	2.11	0	10.47
Ownedforeign	137	1.11	0.31	1	2
Ownwineryabroad	137	1.04	0.21	1	2
innovator	137	0.00	0.00	0	0

Source: Authors' elaboration.

In Table 3, we present the sample of 230 firms, dividing it between non-EC and EC innovators, taking afterward the mean differences and their significance, considering p-values between 0.00 and 0.10 (in bold letters in the Table). There are statistically significant differences between the average export volumes (44 percent against 29 percent) and values (51 percent against 32 percent) of firms run by EC concerning those run by non-EC. Also, there are statistically significant differences between corporatized firms among those run by EC innovators (71 percent against 54 percent when run by non-EC), years of marketing experience (greater under EC), openness to new experiences (in this case, lower under EC), and the mean share of wineries selling Luxury and Iconic wines is greater under EC than under non-EC innovators running wineries (84 against 71 percent, and 38 against 27 percent, respectively).

Table 3: EC and non-EC firms versus the whole sample (N = 230) and only exporters (N = 164)

Variable	NonEC means	EC means	Mean Differences	p-value
ProdinL	5.29	2.34	-2.95	0.38
export_volume1	28.72	44.35	**15.63**	**0.00**
export_value1	32.01	50.97	**18.96**	**0.00**
export_labels	6.93	8.95	2.01	0.20
export_countries	6.91	9.35	2.44	0.24
SA	0.54	0.71	**0.17**	**0.01**
Winemaker_experience	19.50	18.46	-1.04	0.43
Vineyardmanager_experience	17.26	16.41	-0.85	0.59
Marketing_experience	8.48	10.86	**2.38**	**0.06**
Sales_experience	10.66	11.39	0.73	0.60
Open_to_new_experiences	4.53	4.30	**-0.22**	**0.05**
Undisciplined	1.95	1.77	-0.17	0.25
Large	0.47	0.53	0.06	0.38
Grapesvinified	7.61	7.81	0.19	0.81
n_wine_varieties	3.09	3.37	0.28	0.10
Value10	0.69	0.65	-0.05	0.45
Premium1040	0.71	0.84	**0.13**	**0.02**

Luxury40100	0.27	0.38	**0.11**	**0.09**
Iconic100	0.13	0.12	-0.01	0.77
Labor	93.67	99.24	5.57	0.90
capital_index	6.40	6.72	0.32	0.28
Ownedforeign	1.11	1.15	0.04	0.36
Ownwineryabroad	1.04	1.04	0.00	0.98

Source: Authors' elaboration.

3.3 Models

We estimate two logit models. The Average Treatment Effect (ATE) model compares outcomes from EC firms versus the rest for the whole sample. In contrast, the Average Treatment on the Treated (ATT) model explores whether EC exporting firms have a differential effect over their exporter non-EC counterparts.

4. Results: Presentation and Discussion

We estimated two logit models: the first is the Average Treatment Effect model, which compares outcomes attained by Extremely Conceptual innovators, versus the rest in the whole sample. The other model is the Average Treatment of the Treated model which explores whether the firms run by Extremely Conceptual innovators have a differential effect over their counterparts in the exporters' subsample.

Table 4 shows the logit models on extremely conceptual innovators versus the rest. Equation 1 considers the whole sample, while Equation 2 only firms that are exporting. The logit estimates indicate whether the selected explanatory variables affect the probability of being EC. The sign of the coefficients indicates whether the association is positive or negative. The estimated coefficients for the whole sample are different and sometimes statistically significant from zero, by contrast with the export firm subsample. These models are used to obtain the propensity score to adjust the model and balance observation to obtain a weighted and adjusted comparison of the outcomes presented in Table 5.

Table 4: Logit estimation of the treatment equation: EC innovators versus non-EC innovators (Dependent variable assumes the value 1 if the innovator is extremely conceptual, or 0 otherwise)

Independent variables (short name)	Full sample (N = 230) (1)	Exporter firms (N = 164) (2)
SA	1.008***	1.107**
	(0.360)	(0.447)
Winemaker_experience	-0.0102	0.00704
	(0.0164)	(0.0209)
Vineyardmanager_experience	-0.0185	-0.0316**
	(0.0131)	(0.0152)
Marketing_experience	0.108***	0.151***
	(0.0283)	(0.0368)
Sales_experience	-0.0737***	-0.124***
	(0.0256)	(0.0338)
Open_to_new_experiences	-0.401**	-0.415*
	(0.175)	(0.243)
Undisciplined	-0.185	-0.425***
	(0.136)	(0.157)

Large	-0.0336	-0.147
	(0.398)	(0.452)
Grapesvinified	-0.0361	-0.0432
	(0.0300)	(0.0331)
n_wine_varieties	0.242*	0.262
	(0.139)	(0.193)
Labor	0.000409	0.000838
	(0.000574)	(0.000622)
capital_index	-0.0221	-0.192*
	(0.0904)	(0.105)
Ownedforeign	0.419	0.737
	(0.496)	(0.532)
Ownwineryabroad	-0.921	-1.002
	(0.800)	(0.916)
Constant	0.974	2.819*
	(1.052)	(1.539)
Wald Test χ^2_{18}	29.99***	28.89**
Pseudo R^2	0.0976	0.1481
Observations	230	164

Source: Authors' elaboration.

In Table 5, we present the differences in outcomes by innovator profiles. We first compare all the innovators using the ATE estimator. These EC innovators sell less percentage of their production in the domestic market and more to export markets, both in volume and value. The results also show that there are no differences in the total number of export destinations (0.14), and although not statistically significant, EC innovators export almost two labels more than non-EC ones. Lastly, being an EC or non-EC innovator does not show any difference in the probability of selling in the highest-value luxury or iconic market segments.

Secondly, we compare the non-EC and EC innovators among export firms using the ATT estimator. The EC innovators running exporting firms sell relatively less to the domestic market both in volume and value and have a higher share of the value of their production that is exported compared to non-EC innovators running firms that also export. Other coefficients reveal no statistically significant differences among the type of innovators (countries, labels, export volume, selling in luxury or iconic segments, production).

Table 5: ATE and ATT effects of being an EC innovator on selected outcomes.

Variable (short name)	Domestic sales value percentage	Domestic sales volume percentage	Export countries	Export labels	Export value percentage	Export volume percentage	Selling in the luxury or Iconic segment (=1, if yes)	Production
ATE	-11.30***	-9.410**	0.140	1.812	15.55***	9.879***	-0.0498	-2.921
sd	(4.056)	(3.739)	(0.847)	(1.418)	(4.061)	(3.681)	(0.0540)	(1.986)
ATT	-9.422*	-8.617**	0.710	-0.0865	13.55***	7.277	-0.123	-4.739
sd	(4.916)	(4.278)	(1.475)	(1.725)	(4.804)	(4.508)	(0.0798)	(3.579)

Source: Authors' elaboration.

Concerning personality traits, and based on self-declared features, EC innovators seem introverted persons, not very social, focused on their thoughts, and not open to experiment. These features are presented in the Appendix under a correlation table which relates the condition of EC innovator type together with auto-reported personality traits.

5. Conclusions

Over the past three decades, the Argentine wine industry has undergone significant transformations. Initially focused on the domestic market with a primary production of table wines, the industry shifted towards international markets, improving the quality of its wines and gaining global recognition. This transition was driven by several interconnected factors, including local market development, macroeconomic conditions, changes in international wine markets, and entrepreneurial innovation.

During the 1980s, a steady decrease in domestic wine consumption prompted Argentine producers to seek new markets abroad. In the 1990s, favorable macroeconomic conditions, such as appreciated real exchange rates and increased openness of the economy, facilitated the incorporation of modern imported capital goods and the hiring of international experts. These changes were further supported by a significant devaluation of the real exchange rate at the beginning of the 2000s, which allowed Argentine wines to be sold abroad at competitive prices while enhancing their quality. Additionally, the increasing importance of New World wines in international markets created opportunities for Argentine producers to establish themselves globally. Entrepreneurial innovation played a crucial role in this process, driving improvements in wine quality and enabling product differentiation.

In this evolving landscape, export-oriented wineries in Argentina distinguished themselves from those focused solely on the domestic market. Achieving and maintaining quality through valuable attributes became essential for differentiation. Since international markets are more competitive and differentiated, innovation emerged as a key factor for success. Innovators, therefore, became central to the industry's progress.

Our empirical results provide insights into the innovation patterns and characteristics of innovators in the Argentine wine industry. Examining the connection between innovator profiles and export performance at the firm level, we found that 40 percent of the innovators surveyed were classified as extremely conceptual (EC) according to Galenson’s methodology. This type of innovator is more prevalent among exporting firms compared to non-exporting ones.

The findings indicate that EC innovators have a significant impact on export performance. Wineries managed by EC innovators are more oriented towards international markets and achieve higher export values than those managed by non-EC innovators. Specifically, these EC-run wineries sell a smaller percentage of their volume and value domestically compared to non-EC-run wineries. Moreover, within the subset of export-oriented wineries, those led by EC innovators achieve higher export values than their non-EC counterparts.

However, two cautionary notes should be considered: the sample is cross-sectional, limiting the ability to perform dynamic analysis, and the survey respondents may not always be the same individuals responsible for past innovations.

References

Almlund, M., Duckworth, A. L., Heckman, J. and Kautz, T. (2011). Personality psychology and economics. Handbook of the Economics of Education, Vol. 4, pp. 1-181, doi: 10.1016/B978-0-444-53444-6.00001-8.

Akcigit, U., Caicedo, S., Miguelez, E., Stantcheva, S., and Sterzi, V. (2018). Dancing with the Stars: Innovation Through Interactions. NBER Working Paper No. 24466.

Aubert, B.A., Schroeder, A. and Grimaudo, J. (2012). IT as an enabler of sustainable farming: an empirical analysis of farmers' adoption decision of precision agriculture technology. Decision Support Systems, Vol. 54, pp. 510-520, doi: 10.1016/j.dss.2012.07.002.

Baruch, Y., and Holtom, B. C. (2008). Survey Response Rate Levels and Trends in Organizational Research. Human Relations, 61, 1139-1160. https://doi.org/10.1177/0018726708094863

Bernetti, I., Casini, L., and Marinelli, N. (2006). Wine and globalisation: changes in the international market structure and the position of Italy. British Food Journal 108(4): 306-315.

Berry, C. M., Page, R. C. and Sackett, P. R. (2007). Effects of self-deceptive enhancement on personality–job performance relationships. International Journal of Selection and Assessment, Vol. 15 No. 1, pp. 94-109, doi: 10.1111/j.1468-2389.2007.00374.x.

Bono, J. E. and Judge, T. A. (2004). Personality and transformational and transactional leadership: a meta-analysis. Journal of Applied Psychology, Vol. 89 No. 5, p. 901, doi: 10.1037/0021-9010.89.5.901.

Boudreau, J. W., Boswell, W. R. and Judge, T. A. (2001). Effects of personality on executive career success in the United States and Europe. Journal of Vocational Behavior, Vol. 58 No. 1, pp. 53-81, doi: 10.1006/jvbe.2000.1755.

Caldera, S. (2019). Techniques for Robustness and Threats to Inference: Inverse Probability Weighted Regression Adjustment. Mimeo.

Depetris-Chauvin, N. and Villanueva, E. C. (2024). Anatomy of Exporting Wineries of Argentina. International Journal of Wine Business Research. Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/IJWBR-08-2023-0049

Depetris-Chauvin, N., Fernandez-Olmos, M., Hu, W. and Malorgio, G. (2023). A behavioural perspective of organic wine production decisions: an application to the Spanish wine industry. British Food Journal, Vol. 125 No. 12, pp. 4396-4414. https://doi.org/10.1108/BFJ-11-2022-1019

Dessart, F. J., Barreiro-Hurlé, J. and van Bavel, R. (2019). Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review", European Review of Agricultural Economics, Vol. 46 No. 3, pp. 417-471, doi: 10.1093/erae/jbz019.

Dogru, A., and Peyrefitte, J. (2022). Investigation of Innovation in the Wine Industry via Meta-Analysis. Wine Business Journal, 5(1). https://doi.org/10.26813/001c.31627

Dwyer, J., Ingram, J., Mills, J., Taylor, J., Blackstock, K., Brown, K., Burton, R., Dilley, R., Matthews, K. and Schwarz, G. (2007). Understanding and influencing positive environmental behaviour among farmers and land managers–a project for Defra by CCRU/MLURI. Food and Rural Affairs, HMSO, London.

Elías, J. and Ferro, G. (2018). Innovators and Innovations in High Quality Wines of Argentina, CEMA Working Papers: Serie Documentos de Trabajo. 651, Universidad del CEMA.

Elías, J. J., and Ferro, G. (2019). Evolución Reciente del Mercado Mundial de Vinos y el desempeño de Argentina. Serie Documentos de Trabajo UCEMA 701.

Elías, J., Garcia Negro, A., Ferro, G. and De Salvo, C. P. (2020). Knowledge and Innovation Analysis in the Wine Industry in Argentina. In Environment, Rural Development and Disaster Risk Management Division. Inter-American Development Bank.

Filipescu, D. A., Prashantham, S., Rialp, A. and Rialp, J. (2013). Technological Innovation and Exports: Unpacking Their Reciprocal Causality. Journal of International Marketing, Vol. 21 No. 1, pp. 23–38.

Frey, R., Pedroni, A., Mata, R., Rieskamp, J. and Hertwig, R. (2017). Risk preference shares the psychometric structure of major psychological traits. Science Advances, Vol. 3 No. 10, e1701381, doi: 10.1126/sciadv.1701381.

Galenson, D. W. (2007). Old Masters and Young Geniuses: The Two Life Cycles of Artistic Creativity. Princeton University Press.

Galenson, D. W. (2010 a). Understanding Creativity. Journal of Applied Economics, Taylor and Francis Journals, vol. 13(2), pages 351-362.

Galenson, D. W. (2010 b). Innovators: Filmmakers. NBER Working Papers 15930, National Bureau of Economic Research, Inc.

Galenson, D. W. (2009). Innovators: Songwriters. NBER Working Papers 15511, National Bureau of Economic Research, Inc.

Galenson, D. W. (2008). The Greatest Architects of the Twentieth Century: Goals, Methods, and Life Cycles. NBER Working Papers 14182, National Bureau of Economic Research, Inc.

Galenson, D. W. and Pope, C. L. (2013). Experimental and Conceptual Innovators in the Sciences: The Cases of Darwin and Einstein. Historical Methods: A Journal of Quantitative and Interdisciplinary History, Taylor and Francis Journals, vol. 46(2), pages 102-112.

George, J. M. and Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: an interactional approach. Journal of Applied Psychology, Vol. 86 No. 3, p. 513, doi: 10.1037/0021-9010.86.3.513.

Grube, J. W., Mayton, D. M. and Ball-Rokeach, S. J. (1994). Inducing change in values, attitudes, and behaviors: belief system theory and the method of value self-confrontation. Journal of Social Issues, Vol. 50 No. 4, pp. 153-173, doi: 10.1111/j.1540-4560.1994.tb01202.x.

Hervas-Oliver, J.-L., Ripoll-Sempere, F. and Moll, C.B. (2016). Does management innovation pay off in SMEs? Empirical evidence for Spanish SMEs. Small Business Economics, Vol. 47 No. 2, pp. 507–533.

Judge, T. A. and Bono, J. E. (2000). Five-factor model of personality and transformational leadership. Journal of Applied Psychology, Vol. 85 No. 5, p. 751, doi: 10.1037/0021-9010.85.5.751.

Krishnan, T. N., and Poulose, S. (2016). Response Rate in Industrial Surveys Conducted in India- Trends and Implications. IIMB Management Review, 28, pp. 88-97. https://doi.org/10.1016/j.iimb.2016.05.001

Lewandowska, M.S., Szymura-Tyc, M. and Golebiowski, T. (2016). Innovation complementarity, cooperation partners and new product export: Evidence from Poland. Journal of Business Research, Vol. 69 No. 9, pp. 3673–3681.

Malle, B. F. (2011). Attribution theories: how people make sense of behavior. Theories in Social Psychology, Vol. 23, pp. 72-95.

McCrae, R. R. and Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers", Journal of Personality and Social Psychology, Vol. 52 No. 1, p. 81, doi: 10.1037/0022-3514.52.1.81.

McCrae, R. R. and Costa, P. T. Jr (1997). Personality trait structure as a human universal. American Psychologist, Vol. 52 No. 5, p. 509, doi: 10.1037/0003-066X.52.5.509.

Morgan, S. L., and Winship C. (2014). Counterfactuals and Causal Inference Methods and Principles for Social Research. Cambridge University Press. https://doi.org/10.1017/CBO9781107587991

Rogers, E. M. (2010). Diffusion of Innovations. 5th ed., Free Press, New York.

Romer, P. (1990). Endogenous Technological Change. Journal of Political Economy 98(5), 71-102.

Shalender, K. and Yadav, R.K. (2019). Strategic flexibility, manager personality, and firm performance: the case of Indian Automobile Industry. Global Journal of Flexible Systems Management, Vol. 20 No. 1, pp. 77-90, doi: 10.1007/s40171-018-0204-x.

Tepic, M., Trienekens, J.H., Hoste, R. and Omta, S.W.F. (2012). The influence of networking and absorptive capacity on the innovativeness of farmers in the Dutch pork sector. International Food and Agribusiness Management Review, Vol. 15, pp. 1-34.

Villanueva, E., Depetris-Chauvin, N., and Pinilla, V. (2021). The wine industry: drivers and patterns of global transformation. The Oxford Handbook of Industry Dynamics. https://doi.org/10.1093/oxfordhb/9780190933463.013.38

Villanueva, E. C., and Ferro, G. (2022). An update of the worlds of wine: the emerging countries' influence. International Journal of Economics and Business Research, 23(1), 113-129.

Weinberg, B. A. and Galenson, D. W. (2019). Creative Careers: The Life Cycles of Nobel Laureates in Economics. De Economist, Springer, vol. 167(3), pages 221-239.

Willock, J., Deary, I. J., Edwards-Jones, G., Gibson, G. J., McGregor, M. J., Sutherland, A., Dent, J. B., Morgan, O. and Grieve, R. (1999). The role of attitudes and objectives in farmer decision making: business and environmentally-oriented behaviour in Scotland. Journal of Agricultural Economics, Vol. 50 No. 2, pp. 286-303, doi 10.1111/j.1477-9552.1999.tb00814.x.

Appendix A: Personal features of the Extremely Conceptual innovators of the sample

Table A1. Attitudinal variables names and labels

Variable name	Variable label
Who_does_not_like_change	Who_does_not_like_change (From 1: strongly disagree to 5: strongly agree)
Anxious	Anxious (From 1: strongly disagree to 5: strongly agree)
Unfriendly	Unfriendly (From 1: strongly disagree to 5: strongly agree)
Extroverted	Extroverted (From 1: strongly disagree to 5: strongly agree)
Undisciplined	Undisciplined (From 1: strongly disagree to 5: strongly agree)
Likable	Likable (From 1: strongly disagree to 5: strongly agree)
Conventional1	Conventional1 (From 1: strongly disagree to 5: strongly agree)
Responsible	Responsible (From 1: strongly disagree to 5: strongly agree)
Calm	Calm (From 1: strongly disagree to 5: strongly agree)
Talkative	Talkative (From 1: strongly disagree to 5: strongly agree)
Disorganized	Disorganized (From 1: strongly disagree to 5: strongly agree)
Curious	Curious (From 1: strongly disagree to 5: strongly agree)
Unlikable	Unlikable (From 1: strongly disagree to 5: strongly agree)

Moody	Moody (From 1: strongly disagree to 5: strongly agree)
Shy	Shy (From 1: strongly disagree to 5: strongly agree)
Hardworking	Hardworking (From 1: strongly disagree to 5: strongly agree)
Emotionally_stable	Emotionally_stable (From 1: strongly disagree to 5: strongly agree)
Friendly	Friendly (From 1: strongly disagree to 5: strongly agree)
Quiet	Quiet (From 1: strongly disagree to 5: strongly agree)
Open_to_new_experiences	Open_to_new_experiences (From 1: strongly disagree to 5: strongly agree)

Source: Authors' elaboration.

Table A2. Correlations between extremely conceptual innovators and attitudinal self-declared attributes

	innova~r	Who_do~e	Anxious	Unfrie~y	Extrov~d	Undisc~d	Likable	Conven~1	Respon~e	Calm	Talkat~e	Disorg~d	Curious	Unlika~e	Moody	Shy	Hardwo~g	Emotio~e	Friendly	Quiet	Open_t~s
innovator	1																				
Who_does_n~e	-0.0546	1																			
Anxious	0.014	0.1224	1																		
Unfriendly	-0.1199	0.1933	0.0083	1																	
Extroverted	-0.1271	-0.0326	0.2021	-0.2087	1																
Undiscipli~d	-0.0768	0.0243	0.0926	0.1924	0.0302	1															
Likable	-0.0069	-0.0455	0.0362	-0.185	-0.2906	-0.0656	1														
Convention~1	-0.1107	0.2134	0.0347	0.0751	0.0767	-0.0001	0.179	1													
Responsible	-0.1084	0.0736	-0.0882	-0.0463	-0.2913	-0.0809	0.4322	0.2659	1												
Calm	-0.0491	0.0657	0.4076	-0.0114	0.1058	0.0247	0.2994	0.3038	0.1834	-1											
Talkative	-0.1641	-0.0456	0.1879	0.1382	0.5207	0.0349	-0.1799	0.0247	0.2311	-0.0587	1										
Disorganized	-0.0515	0.1742	0.1013	-0.0557	0.1131	0.1685	-0.0191	0.0914	0.0042	-0.0411	0.068	1									
Curious	-0.1274	-0.102	0.1872	-0.1156	-0.371	-0.041	-0.2797	-0.1007	0.3293	-0.0364	-0.1482	-0.1345	1								
Unlikable	0.0482	0.0375	0.0667	0.428	0.1507	0.2225	-0.2338	0.0026	-0.0541	-0.0849	-0.1784	0.1033	-0.1089	1							
Moody	0.0841	0.0727	0.3261	0.2931	-0.0506	0.2509	-0.2007	0.033	0.0916	-0.1847	-0.0877	0.0859	-0.0428	0.5171	1						
Shy	0.0409	0.1396	0.1119	0.1876	-0.3377	0.0845	-0.0458	0.1809	-0.1111	0.1854	-0.2763	0.1046	-0.0544	0.2901	0.2218	1					
Hardworking	-0.0545	0.0051	-0.0022	-0.029	0.1659	-0.1393	0.1622	0.1211	0.3426	0.1679	0.0292	0.0289	0.311	-0.0358	-0.0385	-0.0669	1				
Emotionall~e	-0.1052	0.0347	-0.1637	-0.0717	0.2301	-0.0612	0.3337	0.1412	0.3812	0.3878	0.0909	0.1238	0.2774	-0.1532	-0.1707	-0.0472	0.3757	1			
Friendly	-0.1271	-0.0575	-0.0017	-0.2701	-0.4143	-0.0497	0.51	0.2521	0.5249	0.2756	-0.4315	0.0225	0.3173	-0.2675	-0.1628	-0.1109	0.2944	0.4722	1		
Quiet	-0.0836	0.0665	0.2988	0.0331	0.1511	0.0291	0.3626	0.2073	0.1498	0.6266	0.0547	-0.031	0.0772	0.016	0.2301	0.1707	0.1358	0.3591	-0.3227	1	
Open_to_ne~s	-0.1303	-0.1047	0.2291	0.0703	0.3489	0.0038	0.4168	0.0609	0.4674	0.0099	0.2877	0.0631	0.5805	0.1417	0.1041	0.0906	0.2592	0.3227	-0.5536	-0.2451	1

Source: Authors' elaboration.

Appendix B. Capital Index construction using Principal Component Analysis (PCA)

We use PCA to construct a capital index using physical capital information reported by firms. We use PCA to reduce the dimensionality and construct a unique measure that contemplates physical capital by the firm. We use the first component from PCA, which is positively correlated with all the different capital variables. To facilitate interpretation, we transform the component 1 score into positive values, taking the minimum value of the estimation. As a result, the prediction of our capital index goes from 0 to positive values.

Table B1. Physical capital variables

Variable names	Variable labels
Grapesortingtable	Grapesortingtable (=1, if Yes)
Grape crusher	Grape crusher (=1, if Yes)
Presser	Presser (=1, if Yes)
Tanks	Tanks (=1, if Yes)
Pumps	Pumps (=1, if Yes)
Filters	Filters (=1, if Yes)
Bottling equipment	Bottling equipment (=1, if Yes)
Automatedwinerycontrol	Automatedwinerycontrol (=1, if Yes)
Undervineweeders	Undervineweeders (=1, if Yes)
Prepruners	Prepruners (=1, if Yes)
Trimmers	Trimmers (=1, if Yes)
Sprayers	Sprayers (=1, if Yes)
Shredder	Shredder (=1, if Yes)
Pickingmachine	Pickingmachine (=1, if Yes)
Tractors	Tractors (=1, if Yes)
irrigation_eq	irrigation_eq (=1, if Yes)
Automatedvineyardcontrol	Automatedvineyardcontrol (=1, if Yes)
Cropscover	Cropscover (=1, if Yes)

Source: Authors' elaboration.

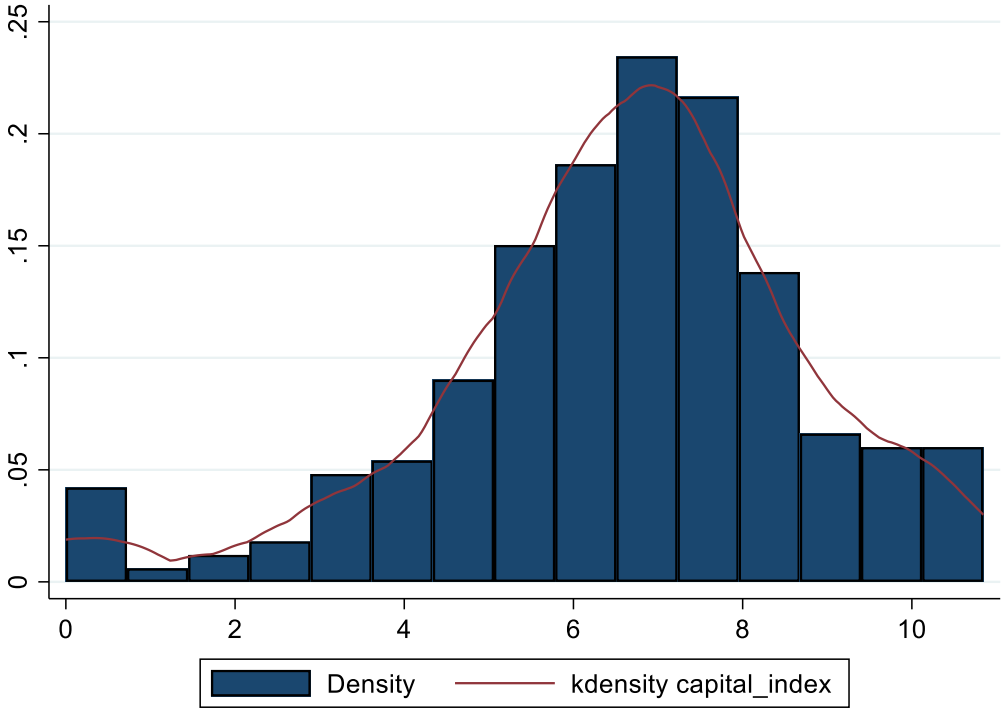
Table B2. Eigenvectors from the first five components of PCA

Variables	Component 1	Component 2	Component 3	Component 4	Component 5
Grape-sorting table	0.216	0.041	-0.168	-0.285	0.029
Grape crusher	0.174	-0.264	0.075	-0.380	-0.015
Presser	0.259	-0.379	-0.070	-0.072	0.142
Tanks	0.260	-0.366	-0.094	-0.108	0.211
Pumps	0.264	-0.420	-0.040	-0.053	0.247
Filters	0.232	-0.181	0.433	0.259	-0.281
Bottling equipment	0.200	-0.164	0.460	0.362	-0.228
Automated winery control	0.170	0.130	0.114	0.299	0.585
Undervine weeders	0.241	0.233	-0.151	-0.029	0.165
Prepruners	0.268	0.285	0.187	-0.222	0.017
Trimmers	0.229	0.234	0.146	-0.188	0.066
Sprayers	0.303	0.027	-0.328	0.194	-0.243
Shredder	0.192	0.160	0.096	-0.363	-0.281
Picking machine	0.253	0.260	0.281	-0.201	0.012

Tractors	0.293	-0.025	-0.250	0.223	-0.236
irrigation equipment	0.265	0.130	-0.233	0.097	-0.276
Automated vineyard control	0.173	0.258	0.157	0.226	0.309
Crops cover	0.186	0.171	-0.350	0.249	0.029

Source: Authors' elaboration.

Figure B1. Histogram and kernel density of the capital index variable created using PCA.



Source: Authors' elaboration.