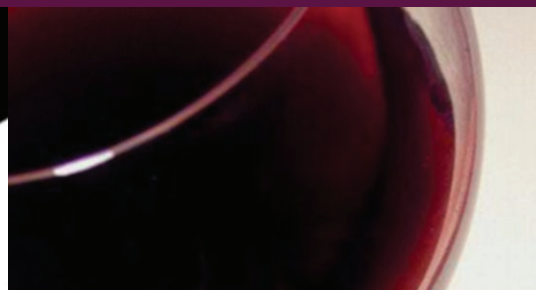




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The Influence of Country of Origin on the Perception of Wine Personality

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Abstract. This study examines how the country of origin (COO) influences consumers' perceptions of wine product personality, using Aaker's (1997) five-dimensional framework: Sincerity, Excitement, Competence, Sophistication, and Ruggedness. An online survey of 848 UK consumers assessed perceptions of wines from France, Romania, the United States, and China – countries differing in winemaking tradition, historical depth, production scale, regulatory frameworks, market maturity, and international visibility. Results reveal significant cross-country differences in perceived product personality, showing that COO shapes symbolic and emotional perceptions beyond quality judgments. French wines scored highest on Sophistication, Sincerity, Excitement, and Competence, reflecting prestige and heritage, while Chinese and Romanian wines received lower overall scores, indicating less established identities. U.S. wines held an intermediate position, noted for Competence and Ruggedness. Consumer involvement intensified ratings across all dimensions, yet country rankings remained consistent, underscoring the robustness of COO-based associations. These findings demonstrate that COO influences not only perceived quality but also the products' symbolic and emotional characteristics. By conceptualizing product personality at the country level, the study provides a framework linking geographical cues to anthropomorphic perceptions. The results offer actionable insights for marketers and producers leveraging COO in international positioning and storytelling strategies.

Keywords: wine, product personality, wine personality, brand personality framework, country of origin.

1. INTRODUCTION

Wine is one of the most differentiated products in the food market [1], and its perceived quality is influenced not only by its sensory attributes but

also by its symbolic and cultural value. Unlike many fast-moving consumer goods, wine consumption is often associated with tradition, lifestyle, identity, and social status [2,3], making it particularly sensitive to external cues such as origin and reputation.

Country of origin (COO) is one of the main extrinsic cues influencing consumer buying decisions of foreign products [4]. It is well known from the literature that COO plays a central role in shaping consumer perceptions of wine [5], where COO is closely linked to concepts such as terroir, heritage, and authenticity. As a result, consumers often rely on origin as a heuristic when evaluating wine, particularly in situations of uncertainty or limited product knowledge [6]. Wines from different countries therefore tend to evoke distinct associations, expectations, and mental images.

While previous studies have extensively examined the impact of COO on perceived quality, purchase intentions, and willingness to pay [7,8], less attention has been given to its role in shaping the symbolic and emotional dimensions of wine perception, such as personality. The concept of brand personality, introduced by Aaker [9], refers to the extent to which consumers attribute human characteristics to brands and provides a valuable framework for understanding how products are perceived beyond their functional attributes. In the context of wine, this concept can be extended to product personality, as wine – due to its strong symbolic and cultural embeddedness – can be perceived in human-like terms even in the absence of a clearly defined brand.

Given the critical role of country of origin (COO) in shaping consumer perceptions, this study aims to explore its impact on the perception of wine personality. Specifically, it seeks to examine how COO influences the human-like traits and characteristics that consumers attribute to products. While many models have traditionally focused on measuring brand personality, several authors have argued that products themselves may also embody personality traits [10–12]. Unlike brand personality, which is brand-specific, product personality reflects perceived traits of a product category itself, independent of branding. This distinction is particularly important for wine, where consumers rely on origin-level cues such as tradition, terroir, and country reputation rather than individual brands to form personality impressions. Therefore, building on Aaker's [9] framework, our intention was to measure the personality of the product rather than the brand, emphasizing COO-based symbolic associations.

The UK is the world's second-largest wine market by value and the fifth largest by volume [13]. Its market size in 2025 was estimated at USD 27.23 billion and was projected to reach USD 37.00 billion by 2034 [14]. The great

majority of wine consumed in the UK market is imported. This high dependence on imported wine makes the UK a particularly relevant context for studying country-of-origin effects, as consumers are regularly exposed to wines from a wide range of producing countries and are therefore more likely to rely on origin-based cues when forming perceptions. Wines from certain countries are more strongly represented in the UK market, particularly those from well-established producers such as France and the United States. In contrast, wines from less internationally recognised wine-producing countries, such as Romania, have a more limited presence and are typically found in specialist retailers rather than mainstream distribution channels. This reduced visibility may contribute to weaker and less clearly defined consumer perceptions. The disparity is even more pronounced for wines from emerging regions such as China, which remain highly underrepresented in the UK market, likely resulting in even less developed and more ambiguous consumer perceptions.

1.1 Country of Origin (COO) effects

The global market is a dynamic and highly competitive arena, characterized by a vast array of products originating from various regions worldwide. Among the numerous factors influencing consumer decisions, the country of origin (COO) stands out as pivotal determinant. These factors extend beyond mere geographic labelling, shaping perceptions of quality, symbolic meaning, and the perceived identity of products. Understanding how COO shapes the perception of product or brand personality is essential for producers, marketers, and policymakers, as it offers guidance on how products can be positioned and differentiated in a competitive and increasingly interconnected market. This study therefore focuses on wine, a product category where symbolic and cultural cues strongly influence consumer perception, to examine COO effects at the product personality level.

The concept of country of origin (COO) has long been recognized as a key factor in shaping consumer perceptions and purchasing behaviour. COO describes the influence of a product's manufacturing location on consumer attitudes, quality judgments, and brand evaluations [15,16]. Consumers frequently rely on COO as a heuristic to gauge the quality, authenticity, and value of a product, particularly when product-specific attributes are unavailable or difficult to evaluate [17–19]. Research shows that consumers typically view products from developed countries as superior in quality to those from less developed economies [20,21]. Furthermore, consumers evaluate products more favourably when they origi-

nate from countries with a positive image, indicating that country-of-origin perceptions can shape perceived product quality [22]. However, these perceptions are not limited to quality – they also encompass symbolic traits, such as perceived sophistication, competence, or excitement, which contribute to a product's personality.

The strength of COO effects differs across markets, with developed countries often exhibiting home-country bias and emerging economies favouring foreign products due to their association with prestige [23–25]. In the wine sector, COO effects interact with national wine industry characteristics, including production scale, market presence, regulatory frameworks, and pricing strategies, shaping both perceived quality and product personality. Countries with long-established regulatory systems – such as the European appellation frameworks – reinforce consumer expectations regarding authenticity, quality, and heritage. In contrast, newer or rapidly expanding wine industries may focus on innovation, scale, or competitive pricing as primary positioning strategies, which in turn influence how personality traits are attributed to their wines. These industry-specific differences (e.g., production volumes, average price points, regulatory maturity, and international exposure) represent potential confounding factors in COO-based personality perceptions and are explicitly discussed in the limitations section.

1.2 Wine as a product category and COO significance

Regarding wine production, COO carries significant historical weight, with traditional winemaking nations such as France, Italy, and Spain building strong reputations for producing high-quality wines tied to their unique terroir – the interplay of soil, climate, and tradition [26,27]. These deep-rooted cultural associations not only inform perceptions of quality but also contribute to distinct consumer expectations regarding wine personality traits, such as sophistication, elegance, and refinement. Long-standing cultural associations have established a hierarchy of wine-producing countries, where consumers frequently consider wines from venerable regions as exceptional in both craftsmanship and reputation [28–30].

However, while prior research has largely focused on COO effects on perceived wine quality or brand evaluations, there remains limited understanding of how COO shapes consumers' perceptions of wine personality at the product level. Emerging wine-producing countries, such as those in South America and Oceania, are challenging these perceptions by offering innovative and high-quality products. Despite this shift, COO remains a powerful

heuristic, especially for less experienced consumers who depend on established perceptions and brand reputation when making selections [8,31,32].

The countries selected for this study – France, Romania, the United States, and China – were deliberately chosen to represent theoretically meaningful contrasts within the global wine economy, following Villanueva and Ferro's [33] classification of wine-producing nations. France exemplifies the Old World Traditional Southern European category (developed, major player) with unmatched historical depth (dating back over 2,000 years), strict appellation *contrôle* regulations, high average price points in export markets, and dominant symbolic prestige. The United States represents the Anglo-Saxon New World category (developed, major player), characterized by technological innovation, large-scale commercial production (especially California), flexible regulations, and mid-to-premium pricing. China falls into the Newest New World – Emerging Major player category, with extremely rapid recent growth in planted area and domestic consumption, but very limited export volumes, minimal presence in mature markets such as the UK, and generally lower price positioning. Romania belongs to the Old World Eastern European category (developed but non-major player), with a viticultural history extending to antiquity (Roman and medieval monastic influences), among the largest vineyard surfaces in Europe (frequently top 5–6 by area), significant production volumes (often top 10–15 globally), yet limited international brand recognition, lower average export prices, and a reputation for rustic, value-driven wines. These structural, historical, regulatory, and market-position differences allow examination of how unequal familiarity, prestige, and price anchoring may systematically shape personality attributions.

Importantly, COO impacts not only quality perceptions but also symbolic and emotional dimensions of wine consumption. Wine, deeply embedded in cultural and social contexts, often functions as a marker of identity, status, and cultural capital [32,34]. Notably, French wines are associated with sophistication and heritage, while Australian wines may be seen as innovative and approachable. These perceptions are dynamic, continuously shaped by marketing efforts, consumer trends, and global economic shifts [35]. Contemporary research has highlighted the growing importance of sustainability and ethical production practices in shaping COO perceptions, with consumers increasingly drawn to wines from countries with strong environmental regulations, such as New Zealand or South Africa [36].

Within Europe, countries such as Romania represent an interesting case in this context. Although Romania is

among the largest wine producers in Eastern Europe and possesses a long-standing viticultural tradition, its wines remain relatively underrepresented in international academic and marketing literature compared to those of Western European countries. This discrepancy between production capacity, historical depth, and global brand visibility makes Romania an ideal case for exploring how COO cues influence perceived wine personality, a perspective that extends traditional brand personality frameworks to the product level.

1.3 Brand and product personality frameworks

Beyond COO effects, brand personality serves as a pivotal factor influencing consumer perceptions across various product categories. Defined as the human-like traits and characteristics that people associate with a brand this concept was expanded by Aaker [37] who built upon her father's framework by introducing the seminal five-dimension model: Sincerity, Excitement, Competence, Sophistication, and Ruggedness [9]. This model has become fundamental to marketing research. Through anthropomorphizing, brand personality stimulates emotional attachment and guides consumer preferences [38,39]. The framework elucidates how brands establish consumer relationships by employing human metaphors, allowing consumers to envision brands as possessing distinct identities [40].

While Aaker's model is widely used, it has been criticized for its limited conceptual scope and potential cross-cultural limitations, as some traits may not translate consistently across different national contexts. Nevertheless, it remains a robust and widely validated tool for structured comparisons of anthropomorphic perceptions, particularly in categories with strong symbolic meaning such as wine, where cultural stereotypes and origin cues dominate over brand-specific imagery. Alternative frameworks focusing on product-specific traits or consumer self-congruity [41–43] could have been considered, but they generally lack a multi-dimensional structure suitable for assessing product personality at the country level.

By applying Aaker's model at the product rather than brand level, we leverage its flexibility to capture anthropomorphic perceptions in a category rich in culture, tradition, and symbolic meaning. This approach balances theoretical rigor with practical applicability, acknowledging limitations while providing a coherent foundation for the study's objectives. Within the wine industry, brand/product personality is particularly important, enabling consumers to express their self-concept or desired image through product affiliation. For

example, wines projecting sophistication and elegance resonate with consumers aspiring to convey refinement, whereas wines embodying adventurous traits appeal to novelty-seeking individuals. This alignment strengthens emotional bonds, a crucial factor in cultivating enduring loyalty [44,45].

Importantly, this section clarifies the conceptual distinction between brand and product personality: brand personality refers to perceptions tied to a specific brand, whereas product personality captures human-like traits attributed to a product category itself, independent of branding. Focusing on product personality allows us to examine how consumers attribute traits based on COO cues, such as country reputation, tradition, and terroir, rather than brand-specific marketing or imagery. Wine is particularly well suited for this analysis because consumers often rely on the country of origin as a heuristic for quality and symbolic meaning, even without familiarity with individual brands. By assessing product-level personality, we capture the broader cultural and symbolic associations consumers hold about wines from different countries, emphasizing how anthropomorphic perceptions operate at the category level.

However, while Aaker's model has profoundly influenced marketing research, critics contend that it overlooks nuances in cultural and contextual variations in brand or product perception [46]. Previous research has extended Aaker's framework by exploring the role of cultural dimensions in shaping brand personality perceptions. For example, Hennigs et al. [47] found that brand personality preferences vary by culture, suggesting that brands must adapt their strategies to align with local values. Brand or product personality embodies consumers' subjective interpretations of various traits and qualities [48], emerging from positive consumer-brand / product interactions [49].

This construct plays a dual role: it forges emotional connections that are decisive in purchase decisions [45], while offering psychological comfort through familiarity [50]. Additionally, as a core symbolic attribute [51], such personality facilitates self-expression, prompting consumers to select products that either mirror their current personality traits [51,52] or represent aspirational identities [53]. A strong alignment between consumer and product personalities leads to improved perception, greater consumer stickiness, and increased purchase intention [54,55].

The relative influence of COO and brand or product personality varies substantially across product categories. For wines specifically, these factors assume heightened importance due to their dual role as cultural artifacts representing tradition, craftsmanship, and social

symbolism. Distinct from ordinary consumer goods, wine may carry associations with luxury, connoisseurship, and ceremonial consumption - a context where COO demonstrates particular significance in luxury markets [56,57]. The importance of COO is further amplified in this context, as wine consumers tend to ascribe distinct characteristics to wines from different regions [8,35,58]. Moreover, the aforementioned personality can reinforce or challenge origin-based expectations [59,60]. This effect is especially relevant for product-level personality, where consumer impressions are often shaped more by COO cues than by specific brands.

This dynamic manifests clearly when comparing New World wines, often characterized as dynamic and cutting-edge to attract novelty-seeking consumers, with Bordeaux estates that leverage heritage narratives to embody traditional luxury values. The internationalization of wine markets has added complexity to how COO and brand/product personality shape consumer choices. With the erosion of conventional boundaries between Old World and New World classifications, the competitive landscape is being transformed by non-traditional producing nations like China and India, which deliver premium offerings at attractive price points [61,62]. Contemporary wine consumers demonstrate heightened discernment, demanding greater product integrity, supply chain transparency, and verifiable provenance [63–65]. These shifts create both opportunities and challenges, requiring wines to navigate evolving consumer preferences while maintaining distinct identities.

1.4 Research gap and objectives

Although prior research has examined COO effects in wine and the role of symbolic associations, a specific gap persists in understanding how consumers perceive product personality at the country level (rather than brand level), integrating COO cues with anthropomorphic perceptions in a culturally embedded category such as wine. This study addresses this gap by exploring how wines from countries differing in historical depth, market maturity, international visibility, production scale, regulatory frameworks, and price positioning are attributed human-like traits by UK consumers. By explicitly applying a brand personality framework at the product/category level and focusing on origin-level cues alone, the research advances existing knowledge in three main ways: (1) it extends Aaker's framework beyond brand-specific evaluations to country-level anthropomorphism, (2) it highlights the symbolic and emotional dimensions of COO in a product category where geographic identity is central, and (3) it exam-

ines the robustness of these perceptions across varying levels of consumer involvement.

In doing so, the research extends the application of brand personality frameworks to wine as a culturally embedded product category, highlighting both symbolic and emotional dimensions that have received limited empirical attention. By explicitly focusing on product-level perceptions rather than brand-level evaluations, the study clarifies how consumers interpret wine personality based on country cues alone and contributes to a deeper understanding of how geographic origin shapes the symbolic and emotional dimensions of wine consumption.

Additionally, understanding the interplay between COO and wine personality can provide strategic guidance for producers and marketers seeking to enhance product positioning, develop targeted marketing campaigns, and cater to evolving consumer expectations. To capture meaningful contrasts in the global wine landscape, the study focuses on four countries representing distinct structural positions within the global wine economy: France, Romania, the United States, and China.

France represents a historically dominant and symbolically prestigious Old World producer; the United States represents a technologically advanced New World producer with strong commercial orientation; Romania represents an established European wine-producing country with a long viticultural tradition but limited international visibility; and China represents a rapidly expanding emerging wine industry whose international image is still developing. This contrast allows the study to examine how consumers attribute personality traits to wines from countries occupying different symbolic and market positions, linking theoretical COO considerations with practical consumer perceptions.

2. METHOD

Participants were 848 adult wine consumers (UK residents) recruited via Prolific. The sample's mean age was 44.7 years (SD = 15.0, range 18–85). Women comprised 55% of respondents (45% men, <1% other), and the majority were well-educated (65% held at least a bachelor's degree). Most participants were employed (51% full-time, 16% part-time, 9% self-employed), with 11% retired, 4% students, and 6% unemployed. All participants reported drinking wine. Participants were included in the final sample after passing attention-check questions and excluding "speeders" (those with unrealistically short completion times).

Each participant evaluated four wine-producing countries – France, Romania, USA, and China. The

country classification scheme was adopted from Vilanueva and Ferro [33], an updated classification of the world of wine. In our study, France was categorized as Old World Traditional Southern European, Developed, Major player, Romania as Old World Eastern European, Developed but Non-major player, USA as Anglo-Saxon New World, Developed, Major player and China as Newest New World, Emerging, Major player. This classification captures diverse positions within the global wine landscape, including traditional versus emerging producers, developed versus emerging economies, and high- versus lower-recognition international markets. Although consumer familiarity with wines from these origins varies substantially (particularly low for China in the UK market), this design intentionally captures COO effects as heuristic and symbolic cues, including the influence of general country stereotypes when wine-specific knowledge is limited.

The country order was randomized for each participant. For each country, participants rated its perceived product personality using Aaker's five brand personality dimensions: Excitement, Sincerity, Ruggedness, Sophistication, and Competence. Each dimension was measured by three trait adjectives (e.g., Sincerity included "sincere," "honest," "wholesome"; Excitement included "trendy," "unique," "exciting"), with items drawn from Aaker's Brand Personality Scale [9]. Ratings were made on a 5-point Likert scale (1 = strongly disagree that the traits describe the country's wine image, 5 = strongly agree).

In addition, participants completed the Consumer Involvement Scale [66], indicating how personally involved they are with wine as a product category. This involvement scale included five semantic differential items ("important-unimportant," "valuable-worthless," "interesting-boring," "involving-uninvolving," "fascinating-mundane"), scored from 1 to 5, with higher scores reflecting greater involvement. Consumer involvement was included because high-involvement consumers process information more deeply (Petty & Cacioppo, 1986), pay greater attention to symbolic cues such as COO, and form stronger, more differentiated perceptions of product personality; it was therefore expected to moderate the intensity (but not necessarily the direction) of COO-based attributions.

To ensure the quality of measures, a confirmatory factor analysis (CFA) was conducted on the multi-item scales. The CFA supported a five-factor structure for brand personality (corresponding to Aaker's dimensions) and a single-factor structure for involvement. All item loadings were high and significant ($p < .001$), and model fit was acceptable (CFI = .95, RMSEA = .044). Each construct exhibited good internal reliability and convergent

Table 1. Reliability and validity of measures by country of origin (Cronbach's α , Composite Reliability, Average Variance Extracted, and Factor Loading Ranges for each latent construct).

Construct (Country)	Cronbach's α	CR	AVE	Loading Range
Excitement – France	0.76	0.78	0.54	0.59–0.85
Excitement – USA	0.83	0.83	0.62	0.74–0.89
Excitement – China	0.79	0.81	0.58	0.68–0.89
Excitement – Romania	0.79	0.81	0.59	0.68–0.90
Sincerity – France	0.88	0.88	0.71	0.83–0.86
Sincerity – USA	0.91	0.91	0.77	0.85–0.89
Sincerity – China	0.91	0.91	0.78	0.87–0.90
Sincerity – Romania	0.89	0.89	0.74	0.84–0.88
Ruggedness – France	0.88	0.89	0.73	0.74–0.91
Ruggedness – USA	0.90	0.91	0.76	0.81–0.92
Ruggedness – China	0.87	0.88	0.71	0.74–0.89
Ruggedness – Romania	0.89	0.90	0.75	0.77–0.92
Sophistication – France	0.85	0.85	0.66	0.78–0.85
Sophistication – USA	0.88	0.88	0.72	0.84–0.85
Sophistication – China	0.88	0.89	0.73	0.81–0.88
Sophistication – Romania	0.87	0.87	0.69	0.78–0.87
Competence – France	0.85	0.86	0.67	0.77–0.87
Competence – USA	0.86	0.86	0.67	0.76–0.87
Competence – China	0.90	0.90	0.76	0.85–0.90
Competence – Romania	0.88	0.88	0.71	0.80–0.90
Consumer Involvement (All)	0.92	0.92	0.71	0.80–0.88

validity: Cronbach's α values ranged from .78 to .92, and all average variances extracted (AVE = .59–.76) and composite reliabilities (CR = .81–.92) exceeded recommended thresholds (e.g., $\alpha \geq .70$, AVE $\geq .50$). These results indicate that the product personality dimensions and involvement scale were measured robustly, supporting the validity of subsequent country-level comparisons (Table 1).

3. RESULTS

Overall, there were pronounced differences in how respondents perceived the wine product's personality depending on its country-of-origin. Figure 1 illustrates the mean profiles for the five personality dimensions across the four countries, highlighting the systematic impact of COO on perceived product personality. French wines were generally attributed the most positive product personality traits on four of the five dimensions (Excitement, Sincerity, Sophistication, Competence), whereas Chinese and Romanian wines tended to score lower on those traits. An exception to this pattern was the Ruggedness dimension: Romanian wines were rated highest on Ruggedness, while Chinese wines were

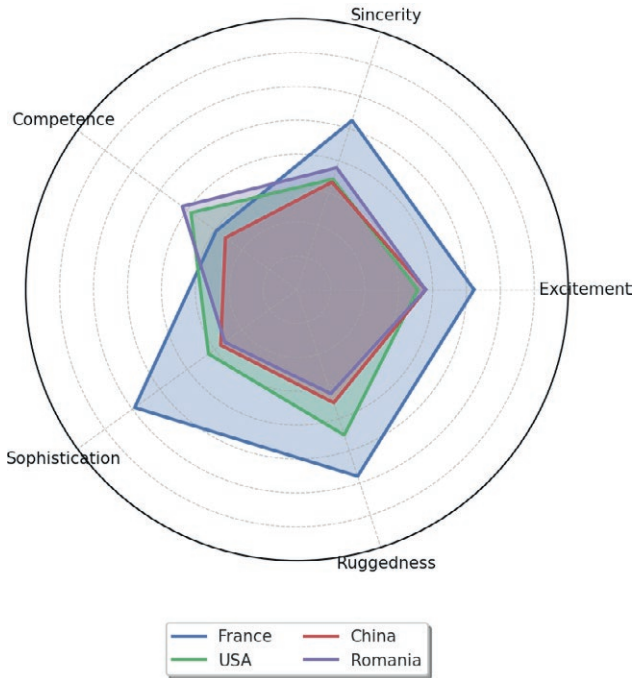


Figure 1. Brand personality perceptions across countries.

rated lowest. U.S. wines consistently fell in the middle of the profiles – generally lower than France on most refined dimensions, but higher than China or Romania on certain traits (notably Competence and Ruggedness). These patterns underscore that COO shapes both symbolic and emotional perceptions of wine, beyond objective product attributes.

Statistical analysis confirmed significant differences between countries on all five product personality dimensions. To assess these differences statistically, repeated-measures ANOVAs were conducted for each dimension (Table 2). Repeated-measures ANOVAs for each dimension revealed that Country of Origin had a significant main effect on all five Brand Personality dimensions (F tests $p < .001$ in each case), confirming the robust influence of COO on perceived wine personality. Effect sizes

were large for some dimensions (e.g., partial $\eta^2 = 0.36$ for Sophistication) and moderate for others (e.g., $\eta^2 = 0.11$ for Ruggedness).

Consumer involvement also had a significant main effect on each dimension's ratings (all $p < .001$), such that high-involvement consumers tended to give slightly higher personality ratings overall than low-involvement consumers. However, these involvement effects were relatively small in magnitude (η^2 ranging from approximately 0.01–0.02), indicating that COO remains the primary driver of perceived wine personality.

Finally, an interaction between Country of Origin and Involvement emerged for two dimensions (Excitement and Sincerity), indicating that country differences were moderated to a minor degree by involvement level. No significant interaction was found for Ruggedness, Sophistication, or Competence ($p > .05$), further emphasizing the stability of COO-based perceptions across engagement levels.

In the following, we report each dimension's results in detail, with post-hoc pairwise comparisons (Bonferoni-adjusted) to interpret specific country differences. For brevity, we focus on the key differences and effect sizes (full pairwise statistics are in Table 3).

3.1 Excitement

For the Excitement dimension, the ANOVA confirmed a significant effect of country ($F = 195.93$, $p < .001$) with a large effect size ($\eta^2 = 0.12$). French wines were perceived as the most exciting ($M = 3.61$), significantly more so than wines from the USA ($M = 2.78$), China ($M = 2.90$), or Romania ($M = 2.90$) (all $p < .001$). The mean difference between France and other countries on Excitement was substantial: for example, France vs. USA had a mean difference of +0.83 on the 5-point scale (95% CI [0.74, 0.92]), corresponding to a very large effect ($d = 0.94$). Similarly, France scored about +0.71 higher than China ($d = 0.81$) and +0.71 higher than Romania ($d = 0.81$) on Excitement (both $p < .001$).

Table 2. Repeated-Measures ANOVA results for brand personality dimensions (Country-of-Origin as within-subject factor, Involvement as between-subjects factor).

Dimension	F Country (df)	p	η^2	F Involvement (df)	p	η^2	F Country $\times$ Invol. (df)	p	η^2
Excitement	195.93 (2.79, 2362)	< .001	.120	49.87 (1, 846)	< .001	.020	4.78 (2.79, 2362)	.003**	.003
Sincerity	262.91 (2.82, 2383)	< .001	.155	48.25 (1, 846)	< .001	.019	3.12 (2.82, 2383)	.028*	.002
Ruggedness	183.65 (2.90, 2452)	< .001	.109	24.92 (1, 846)	< .001	.011	1.39 (2.90, 2452)	.244	<.001
Sophistication	869.34 (2.87, 2425)	< .001	.360	46.41 (1, 846)	< .001	.015	1.85 (2.87, 2425)	.139	<.001
Competence	428.71 (2.73, 2310)	< .001	.229	35.52 (1, 846)	< .001	.013	2.41 (2.73, 2310)	.072	.001

By contrast, the USA was rated slightly less exciting than both China and Romania. U.S. wines had a lower Excitement mean than Chinese wines by -0.12 (95% CI $[-0.23, -0.01]$, $p = .009$, $d = -0.14$), and similarly lower than Romanian wines by -0.12 (95% CI $[-0.22, -0.01]$, $p = .009$, $d = -0.13$). There was no significant difference between Excitement ratings for China vs. Romania (means ~ 2.90 for both, $p = .93$). This hierarchy indicates that French wines are strongly associated with dynamic and stimulating traits, whereas U.S. wines are comparatively moderate in perceived Excitement.

High-involvement consumers tended to rate all countries slightly higher on Excitement (overall mean difference high vs. low = $+0.27$, $p < .001$, $d = 0.31$). The Country $\times$ Involvement interaction was statistically significant for Excitement ($p = .003$), but the interaction effect was very small ($\eta^2 = 0.003$). Follow-up comparisons showed that high- and low-involvement groups differed in Excitement ratings for each country in the same direction, with high-involvement participants giving slightly higher Excitement scores for France ($+0.36$, $p < .001$, $d = 0.41$), USA ($+0.84$, $p < .001$, $d = 0.95$), China ($+0.84$, $p < .001$, $d = 0.96$), and Romania ($+0.76$, $p < .001$, $d = 0.86$). Thus, involvement influenced the level of Excitement ratings but did not substantially alter the pattern of country differences – France remained highest and USA lowest in both involvement groups, confirming that COO-driven perceptions are robust across engagement levels.

3.2 Sincerity

Ratings of Sincerity (e.g., being sincere, honest, wholesome) also differed markedly by country ($F = 262.91$, $p < .001$, $\eta^2 = 0.16$). France again received the highest Sincerity score ($M = 3.63$), significantly higher than all other countries ($p < .001$). The mean difference was $+0.91$ compared to the USA ($d = 1.03$), $+0.96$ compared to China ($d = 1.08$), and $+0.73$ compared to Romania ($d = 0.83$), reflecting large effect sizes. These large effect sizes (Cohen's $d \sim 0.8$ – 1.1) reflect a strongly established perception of French wines as sincere and trustworthy. Among the remaining countries, Romania ranked second ($M = 2.89$) on Sincerity, significantly above both the USA ($M = 2.72$, difference = 0.17 , 95% CI $[0.08, 0.28]$, $p < .001$, $d = 0.20$) and China ($M = 2.67$, difference = 0.22 , 95% CI $[0.13, 0.32]$, $p < .001$, $d = 0.25$). Notably, there was no significant difference between the USA and China on Sincerity (USA–China $M = +0.05$, 95% CI $[-0.07, 0.16]$, $p = .27$), indicating that British consumers perceive U.S. and Chinese wines as similarly low in sincere/honest personality.

In summary, the Sincerity ordering was France (highest) $>$ Romania $>$ USA = China. Consumer involvement showed a similar pattern as with Excitement: high-involvement individuals gave slightly higher Sincerity ratings overall than low-involvement (mean difference $\sim +0.26$, $p < .001$, $d = 0.30$). A small but significant Country $\times$ Involvement interaction was observed for Sincerity ($F = 3.12$, $p = .028$, $\eta^2 = 0.002$). Inspection of simple effects suggested that high vs. low involvement groups differed most strongly for U.S. wines (high $M = 2.90$ vs. low $M = 2.53$; $\Delta = 0.38$, $p < .001$), whereas their Sincerity ratings for France were more convergent (high $M = 3.78$ vs. low $M = 3.47$; $\Delta = 0.31$). Despite this interaction, the rank-order of countries on Sincerity remained the same for both involvement levels, with France highest and USA/China lowest in each group.

3.3 Ruggedness

The Ruggedness dimension (masculine, tough, outdoorsy traits) yielded a somewhat different pattern from the above: here, Romania achieved the highest scores. The ANOVA showed a significant country effect ($F = 183.65$, $p < .001$, $\eta^2 = 0.11$). Romanian wines were rated the most rugged ($M = 3.09$), significantly higher than all others ($p < .001$). In fact, every pairwise comparison between countries on Ruggedness was statistically significant ($p < .001$), indicating all four means differed from one another. Romanian wine was seen as more rugged than U.S. wine by $+0.16$ ($d = 0.17$), more than French wine by $+0.62$ ($d = 0.68$), and more than Chinese wine by $+0.79$ ($d = 0.86$). U.S. wines were the second-highest in Ruggedness ($M = 2.93$), significantly above France by $+0.46$ ($d = 0.50$) and above China by $+0.63$ ($d = 0.69$). French wines (somewhat surprisingly) scored low on Ruggedness ($M = 2.47$), although still slightly higher than Chinese wines ($M = 2.30$) by $+0.17$ ($p < .001$, $d = 0.18$).

Overall, the rank-order for Ruggedness was Romania $>$ USA $>$ France $>$ China, indicating that Romanian wine carries a comparatively stronger “rugged” or tough persona, whereas Chinese wine is perceived as the least rugged, and French wine – while superior on other traits – is relatively low on this dimension. The influence of involvement on Ruggedness ratings was significant but modest (main effect $F = 24.92$, $p < .001$, $\eta^2 = 0.011$). High-involvement consumers tended to ascribe slightly more Ruggedness to wines overall than did low-involvement consumers (mean difference $\sim +0.30$ on the 5-point scale). The interaction of Country $\times$ Involvement was not significant for Ruggedness ($F = 1.39$, $p = .24$), indicating that the pattern of country differences described

above was consistent across involvement levels. Both high- and low-involvement groups saw Romania as highest and China as lowest in Ruggedness, with France and the USA in between.

3.4 Sophistication

Sophistication (glamorous, elegant, upper-class personality) exhibited the largest country-of-origin effect of all dimensions. The ANOVA yielded $F = 869.34$ ($df = 2.87$, $p < .001$), with a very large effect size ($\eta^2 = 0.36$). As Figure 1 showed, French wines were perceived as far more sophisticated than wines from any other country. The mean Sophistication rating for France was $M = 3.96$, near the top of the scale. In contrast, the other three origins all averaged below 2.7 on Sophistication (USA $M = 2.61$, China $M = 2.39$, Romania $M = 2.32$). The differences between France and each of the others were extremely large: France was rated +1.35 higher than the USA (95% CI [1.25, 1.45], $p < .001$, $d = 1.53$), +1.57 higher than China ($d = 1.78$), and +1.64 higher than Romania ($d = 1.87$). These correspond to very large effect sizes, indicating French wine's perceived sophistication is dramatically more pronounced in consumers' minds.

Across the non-French origins, minor differences were observed: U.S. wines were seen as slightly more sophisticated than Romanian wines (difference = +0.30, 95% CI [0.20, 0.39], $p < .001$, $d = 0.34$), and also slightly more than Chinese wines (+0.22, 95% CI [0.11, 0.33], $p < .001$, $d = 0.25$). There was no meaningful difference between China and Romania on Sophistication (China was ~0.08 points higher; $p = .018$ after correction, $d = 0.09$). Overall, the rank-order for Sophistication was France $\gg$ USA $>$ (China $\approx$ Romania), emphasizing the dominance of French wines in consumers' symbolic and upscale perceptions..

High-involvement individuals tended to give slightly higher Sophistication ratings overall than low-involvement individuals (main effect $F = 46.41$, $p < .001$), but again the magnitude was small (mean difference

~+0.25). There was no significant interaction between country and involvement for Sophistication ($F = 1.85$, $p = .14$), indicating that while involvement influences the baseline rating, it does not alter the relative positioning. Thus, all groups consistently viewed French wines as the most sophisticated, with the remaining three countries clustered at the lower end of this dimension.

3.5 Competence

The Competence dimension (representing leader-like, confident, efficient traits) also showed a strong country-of-origin effect ($F = 428.71$, $p < .001$, $\eta^2 = 0.23$). France again topped this dimension ($M = 3.90$), being viewed as significantly more competent than the other origins (all pairwise $p < .001$). French wine's perceived Competence was higher than U.S. wine by +0.64 (95% CI [0.53, 0.74], $d = 0.70$), higher than Chinese wine by +1.14 ($d = 1.25$), and higher than Romanian wine by +1.28 ($d = 1.40$). These differences are substantial, particularly highlighting the contrast between France and the two non-Western producers (China and Romania).

Among the other countries, we found a clear descending order: USA was rated second in Competence ($M = 3.26$), significantly above China ($M = 2.75$) by about +0.50 ($p < .001$, $d = 0.55$). The USA was also higher than Romania ($M = 2.61$) by +0.64 ($p < .001$, $d = 0.71$). Finally, Chinese wines were seen as slightly more competent than Romanian wines (+0.14 on the scale, 95% CI [0.05, 0.23], $p < .001$), although this difference was relatively modest ($d = 0.16$). Overall, the Competence ranking can be summarized as France $>$ USA $>$ China $>$ Romania, reflecting both established reputation and perceived technical expertise.

Consumer involvement had a small but significant impact on Competence perceptions (high-involvement group means were about 0.24 points higher than low-involvement on average, $F = 35.52$, $p < .001$, $\eta^2 = 0.013$). The Country $\times$ Involvement interaction was not significant ($F = 2.41$, $p = .072$), confirming that the relative

Table 3. Pairwise comparisons of Country-of-Origin on brand personality dimensions.

Contrast (Country A–B)	Excitement Δ (d)	Sincerity Δ (d)	Ruggedness Δ (d)	Sophistication Δ (d)	Competence Δ (d)
France – USA	+0.83*** ($d = 0.94$)	+0.91*** ($d = 1.03$)	–0.46*** ($d = -0.50$)	+1.35*** ($d = 1.53$)	+0.64*** ($d = 0.70$)
France – China	+0.71*** ($d = 0.81$)	+0.96*** ($d = 1.08$)	+0.17*** ($d = 0.18$)	+1.57*** ($d = 1.78$)	+1.14*** ($d = 1.25$)
France – Romania	+0.71*** ($d = 0.81$)	+0.73*** ($d = 0.83$)	+0.62*** ($d = 0.68$)	+1.64*** ($d = 1.87$)	+1.28*** ($d = 1.40$)
USA – China	–0.12** ($d = -0.14$)	+0.05 ($d = 0.05$)	+0.63*** ($d = 0.69$)	+0.22*** ($d = 0.25$)	+0.50*** ($d = 0.55$)
USA – Romania	–0.12** ($d = -0.13$)	–0.18*** ($d = -0.20$)	+0.16*** ($d = 0.17$)	+0.30*** ($d = 0.34$)	+0.64*** ($d = 0.71$)
China – Romania	+0.00 ($d = 0.00$)	–0.22*** ($d = -0.25$)	+0.79*** ($d = 0.86$)	+0.08* ($d = 0.09$)	+0.14*** ($d = 0.16$)

ranking of countries remained consistent regardless of involvement level. In both involvement groups, France and the USA were viewed as more competent sources of wine than China or Romania, with France firmly at the top. Table 3. Pairwise Comparisons of Country-of-Origin on Brand Personality Dimensions.

3.6 Involvement effects

Across all five dimensions, high-involvement wine consumers gave significantly higher ratings than low-involvement consumers, reflecting a general tendency for more involved individuals to attribute stronger personalities to wines. However, the magnitude of this effect was relatively small (on average, high-involvement respondents' ratings were about 0.25–0.35 points higher on the 5-point scale; Cohen's $d \sim 0.3$). Importantly, there were no qualitative reversals in country rankings between involvement groups, which maintained the integrity of the COO-based comparisons.

As reported above, two interactions were statistically significant (for Excitement and Sincerity), but these were minor. In those cases, the country differences were slightly amplified for high-involvement participants. For example, the Excitement gap between France and the USA was somewhat larger in the high-involvement group ($\Delta = 0.93$) than in the low-involvement group ($\Delta = 0.74$). Similarly, high-involvement respondents perceived U.S. wines as marginally more sincere than low-involvement respondents did (narrowing the gap between USA and Romania), while both groups still rated USA and China significantly lower in Sincerity than Romania or France.

In essence, consumer involvement did not change which countries were seen as best or worst on each brand personality trait – it primarily influenced the intensity of all ratings, while the relative COO impressions remained consistent. This suggests that, although highly involved consumers are generally more generous in their brand personality perceptions, the underlying country-of-origin effects are robust and widely shared among UK wine consumers.

Overall, these results reinforce that France's wines are perceived as having the most exciting, sincere, sophisticated, and competent personalities, whereas Chinese wines (and to a lesser extent Romanian wines) lag on these dimensions. Romania excels only in the niche trait of Ruggedness, surpassing even France in that specific "tough" image, while the USA occupies an intermediate position, generally outperforming China and Romania on competence and ruggedness but falling short of France on prestige-related traits.

4. DISCUSSION

This research contributes to the growing body of literature examining the influence of country of origin (COO) on consumer perceptions and wine personality – a product category deeply intertwined with geographic and cultural identity (Harvey et al., 2014). In product categories with strong symbolic meaning, such as wine, discussing product personality at the category level provides deeper insight into consumers' symbolic and emotional engagement. Consequently, the role of country of origin in shaping the aforementioned personality warrants closer examination.

Interpreting Aaker's brand personality dimensions in the context of wine provides valuable insight into how consumers symbolically engage with this product category. Among consumable goods, wine, more than many other consumables, carries cultural, emotional, and experiential value, making it particularly well-suited to the application of personality-based frameworks. Several studies have examined the role of wine COO in shaping perceived brand or product personality traits using established frameworks such as Aaker's [9] five-dimensional model. Heslop et al. [67] demonstrated that COO affects only two dimensions of personality, namely Ruggedness and Creativity, and these associations are weak. Zhou & Gao [8] investigated the impact of COO perceptions on Aaker's five dimensions of wine brand personality in the Chinese market and found that COO influences Sophistication and Competence. Applying the Aaker Brand Personality Scale to assess wines from multiple countries classified as "Old World" vs. "New World" and "traditional" vs. "non-traditional", the typologies presented by Rodrigues et al. [28] provide a more nuanced understanding of COO effects on wine perception.

In addition, research on consumer involvement as a moderator complements earlier findings suggesting that involvement intensifies consumer reactions but does not significantly alter patterns of perception [66,68,69].

4.1 Differences in brand / product personality

The findings indicate that wine's product personality is strongly shaped by the country of origin across all five of Aaker's [9] dimensions: Excitement, Sincerity, Ruggedness, Sophistication, and Competence. Country of origin accounted for a substantial portion of the variance in personality perceptions – for example, 36% of the variance in Sophistication – highlighting the robust influence of COO-based stereotypes on consumers' symbolic associations with wine. Some countries conform to widely shared stereotypes, i.e., socially shared beliefs

about the characteristics of a particular country, which subsequently influence perceptions and judgments [70]. As stated by Heslop et al. [67], numerous studies have shown that products from low-image countries are perceived as lower quality compared to the same products from high-image countries. France is stereotypically associated with hedonism, leading to perceptions of French products as enjoyable [71], and is known as a prestigious wine producer rich in tradition [58,72,73], a finding confirmed in the present study.

French wines emerged as clear leaders, rated highest on four out of five personality dimensions. The most pronounced difference was in Sophistication, where French wines received a mean score of approximately 3.96, while wines from other countries scored below 2.7. The effect size (Cohen's $d = 1.5\text{--}1.9$) indicates that these perceptions are not only distinct but deeply entrenched in consumers' mental representations. In addition to Sophistication, France also led in perceived Sincerity, Excitement, and Competence, further reinforcing its image as the archetypal wine-producing nation.

While French wines consistently outperformed others across most product personality dimensions, notable patterns also emerged in the evaluations of wines from China, Romania, and the United States. Chinese wines were rated the lowest, generally equal to or slightly below Romanian wines on dimensions such as Sincerity, Excitement, and Sophistication. These results are somewhat consistent with Guardato et al. [7], suggesting that consumers perceive Chinese wine as underdeveloped in personality, likely due to limited historical connection to wine culture, international exposure, and scepticism regarding quality or authenticity.

Romanian wines followed a similar pattern, receiving low scores for most personality traits tested. However, these wines received the highest scores of all countries on the Robustness dimension. This indicates that consumers associate Romanian wines with masculinity, toughness, or boldness, potentially reflecting national stereotypes or rural associations, providing opportunities for niche positioning in global markets. Micu et al. [74] highlight that Romania remains relatively unknown in the global wine market, requiring strong branding strategies to enhance perceived value.

American wines occupied an intermediate position. While they did not compete with French wines, they scored higher than China and Romania, particularly in Competence, and in Ruggedness relative to Chinese wines. These findings suggest a pragmatic product image shaped by innovation and technical expertise, consistent with Villanueva and Ferro [33], who argue that the USA is known for mass production and standardization

of wine. Furthermore, "New World" producers exhibit greater market orientation, as noted by Rojas-Méndez et al. [75].

Taken together, these findings suggest that consumers do not evaluate wine solely based on intrinsic or sensory attributes, but also through a symbolic and emotional lens shaped by cultural associations. Country of origin functions almost as a brand itself, evoking human-like traits and values. France dominates symbolic and emotional traits, Romania and the USA establish distinct identities through Ruggedness and Competence respectively, while China's wine image remains underdeveloped.

4.2 The Role of Consumer Involvement in Wine Personality Perceptions

The results show that high-involvement wine consumers rated all countries more positively across all dimensions of product personality than low-involvement consumers. However, the relative ranking of countries remained unchanged: France consistently topped most dimensions, while China and Romania remained lowest, highlighting the robustness of COO-based perceptions.

This suggests that while involvement influences the intensity of responses, it does not alter the underlying perceptions consumers have about wine-producing countries. These findings underscore the persistence and strength of country-of-origin stereotypes, even among highly engaged and knowledgeable consumers. The results align with models of consumer behaviour that conceptualize involvement as a moderator, influencing evaluations without necessarily changing their direction [76–78]. In wine, a high-involvement product category, involvement reflects emotional, cognitive, and behavioural engagement, resulting in stronger, more differentiated personality assessments.

4.3 Research implications

The results of this study can be applied in practice by wine producers, marketers, policymakers, and institutions involved in promoting wine and the national image abroad. French wines, associated with Sophistication and Sincerity, can leverage narratives emphasizing tradition, craftsmanship, and premium positioning. Romanian wines, strong in Ruggedness, could adopt branding highlighting resilience, boldness, or rural authenticity. U.S. wines, high in Competence, might focus on innovation, technical expertise, and reliability. Chinese wines, currently underdeveloped in personality, may ben-

efit from campaigns enhancing heritage credibility and showcasing quality improvements.

Understanding the emotional and symbolic associations linked to wines from specific countries can also guide product storytelling, label design, and promotional campaigns. This is particularly important for high-involvement consumers, who may respond more strongly to rich narratives and detailed accounts of terroir, production methods, sustainability practices, or awards. In contrast, low-involvement consumers may rely more on simplified cues such as origin, label design, or brand / product reputation. Government agencies, export boards, and national wine associations can leverage these insights to shape country-level branding strategies, particularly in global campaigns. For countries with lower perceived wine personality traits, long-term image-building efforts are essential – including promoting quality standards, certification programs, education initiatives, and participation in international wine fairs and competitions.

It is important to note that this research was conducted among consumers in the United Kingdom, a mature wine market with a strong presence of international wines [14,79,80]. UK consumers are generally familiar with wines from a wide range of countries and may hold strong pre-existing stereotypes about origin, particularly in relation to traditional “Old World” producers versus “New World” or emerging markets. Therefore, the conclusions of this study cannot be fully generalized, especially to less developed wine markets where consumer habits, wine culture, and exposure to international products differ significantly. While the general patterns (e.g., the influence of country of origin on product personality) are likely relevant across markets, the specific country rankings and the intensity of perceptions may vary elsewhere. Consequently, practical implications should be applied with caution outside the UK, and additional market-specific studies are recommended.

Furthermore, consumer familiarity with wines from different countries may vary substantially, particularly in the case of emerging producers such as China. Personality ratings may therefore partly reflect broader country stereotypes rather than direct consumption experience. Acknowledging this, our study design and interpretation consistently emphasize the role of symbolic COO associations rather than assuming detailed prior knowledge of specific wines. This methodological alignment ensures that findings are coherent with the theoretical framework and the survey approach employed. Additionally, potential confounding effects of unequal market exposure, price anchoring, and general country image (as noted in the country selection rationale) may have influ-

enced ratings, particularly for low-familiarity origins like China; future research could control for these factors through familiarity measures or experimental designs.

5. CONCLUSIONS

This study demonstrates that the country of origin (COO) significantly influences the perceived personality of wines across all five dimensions defined by Aaker – Excitement, Sincerity, Ruggedness, Sophistication, and Competence. The results indicate that geographic origin not only signals wine quality but also serves as a powerful driver of the emotional and symbolic associations consumers form with various wines. French wines, representing the traditional category, were rated highest in Sophistication, Sincerity, Excitement, and Competence, reinforcing France’s enduring image as a leader in premium wine production. In contrast, wines from newer or less established wine countries, such as China and Romania, generally received lower scores on personality traits, suggesting a relatively underdeveloped wine personality that may pose challenges for global market positioning. The United States occupied a moderate position, reflecting its emerging yet distinct identity characterized by Ruggedness and Competence.

An important finding of this study is the role of consumer involvement: while high-involvement wine consumers tend to give stronger personality ratings overall, the relative rankings of countries remain stable regardless of involvement level. This suggests that perceptions of COO are deeply rooted and culturally informed, remaining consistent despite variations in individual consumer engagement. Consequently, marketers and manufacturers should recognize that while targeting informed consumers can enhance perceptions of wine personality, the underlying country image remains a key factor shaping consumer attitudes.

This research provides valuable guidance for wine producers and marketers aiming to leverage COO effects strategically. Highlighting personality traits that align with a country’s established image can strengthen brand / product differentiation and consumer appeal. For countries with weaker wine personalities, targeted marketing interventions – such as storytelling, quality certifications, and experiential campaigns – may help build stronger and more favourable associations.

Future studies should further explore these dynamics across diverse cultural contexts and product categories, assess the impact of digital marketing on brand / product personality formation, and adopt longitudinal approaches to capture evolving consumer perceptions.

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Mind the Gap: Exploring Perceived Importance and Performance in Regional Wine and Food Tourism Experiences

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Abstract. This paper explores visitor perceptions of wine and food tourism in the Petrich–Sandanski region of Southwestern Bulgaria, an emblematic but underexplored area within the Struma Valley wine region. The aim is to identify key strengths and weaknesses of the regional offer and derive insights to support sustainable destination development and policy design. The study applies a combination of classic and diagonal Importance–Performance Analysis (IPA) to survey data from domestic tourists in Bulgaria ($n = 177$), comparing the importance assigned to specific attributes with their perceived performance. Findings indicate consistently high evaluations across most attributes, with wine and food quality, authenticity, and atmosphere emerging as core strengths. Value for money and interpretive quality (e.g., commentary and presentation), on the other hand, perform below expectations, suggesting areas for managerial intervention. Less central attributes, such as special diet options and culinary demonstrations, were rated lower in both importance and performance, confirming their peripheral role. The high importance of GI foods, coupled with absence of certified products in the region, points to untapped potential for linking gastronomy with food heritage. The study advances the literature by integrating an innovative dual-IPA framework with a focus on domestic tourist perspectives in an emerging wine tourism destination, offering actionable insights for policy and regional development strategies.

Keywords: wine tourism, food tourism, importance-performance analysis, Bulgaria.

1. INTRODUCTION

In recent years, wine and culinary tourism have emerged as significant segments within the global tourism industry, offering travellers immersive experiences that combine cultural exploration with gastronomic indulgence [1–3]. These forms of niche tourism not only contribute to the economic vitality of rural regions but also play a pivotal role in preserving and promoting local heritage and traditions [4].

Understanding tourist perceptions and satisfaction levels is crucial for the sustainable development of wine and culinary destinations. Importance–Performance Analysis (IPA), introduced by Martilla and James [5], has been widely

adopted in tourism research as a diagnostic tool to assess service quality by comparing the importance of specific attributes to their perceived performance. This method enables destination managers to identify areas requiring improvement and to allocate resources effectively [6].

In the context of wine tourism, IPA has been utilized to evaluate various aspects such as winery services, tasting experiences, and overall visitor satisfaction (Mitchell & Hall, 2006). Similarly, in culinary tourism, IPA has been applied to assess factors influencing visitor satisfaction at food festivals and gastronomic events, highlighting the importance of food quality, authenticity, and service [7]. However, the majority of IPA applications in this field focus on well-established destinations, leaving emerging regions underrepresented.

The Petrich–Sandanski region, with the Melnik area at its heart, constitutes the core of the Struma Valley wine region, widely regarded as one of Bulgaria’s most emblematic areas of viticulture. Its strengths lie in the concentration of wineries within a compact geographical area, enabling visitors to combine multiple cellar visits in a single trip, as well as in the diversity of establishments – from small, family-run wineries to luxury estates integrating hospitality services [8]. The region’s hallmark is the indigenous Broad-leaf Melnik Vine and its cultivated varieties (Melnik 55, Melnik 1300, Ruen), which are emblematic of the terroir and provide a unique competitive advantage [9]. Over the past decade, the calendar of events has expanded, with initiatives such as the Melnik Wineries Open Doors enhancing visibility, while award-winning wines and investments in infrastructure have further strengthened its positioning. Despite these advances, challenges remain, including limited international awareness of Bulgarian wines and fragmented cooperation among local stakeholders. Overall, the Struma Valley illustrates a dynamic stage of wine tourism development: moving beyond an emerging destination towards a competitive niche, yet still requiring coordinated marketing and strategic support to reach its full potential [8].

In contrast, the development of food tourism in the region remains at a more nascent stage. While the area is characterized by a rich culinary heritage rooted in Mediterranean and Balkan traditions, local gastronomy is not yet systematically integrated into the tourism product. Restaurants and small producers occasionally emphasize regional specialties, but there are no established food routes or consistent promotion of local products under Geographical Indication (GI) labels. As such, food-related experiences are more fragmented and opportunistic compared to the relatively structured wine tourism offer.

Against this background, the present study contributes in three important ways. First, it advances the

application of IPA by focusing on wine and food tourism experiences in Southwestern Bulgaria, with particular emphasis on the destinations of Sandanski, Melnik, and Petrich. While this area represents the historical heart of Bulgarian viticulture and is increasingly recognized for its wine tourism potential, its culinary tourism offer remains fragmented and underdeveloped. By analysing both domains together, the study not only maps the current stage of tourism development in the Struma Valley but also identifies opportunities for integrated growth of wine and food experiences – a perspective rarely examined in previous research. Second, it reflects the perspective of domestic tourists, a group often overlooked in IPA-based studies that tend to privilege international visitor markets. Capturing domestic perceptions is particularly relevant in contexts where regional tourism relies heavily on local demand, and where domestic tourists may have different expectations and benchmarks of authenticity. Third, the study combines the classic and diagonal approaches to IPA, offering both a quadrant-based assessment of strategic priorities and a regression-based benchmark for identifying over- and under-performers. By integrating these perspectives, the analysis provides a more nuanced and robust diagnostic tool.

2. LITERATURE REVIEW

2.1 Food and wine tourism

Food and wine tourism is frequently classified as a niche form of tourism, attracting travellers with specific cultural, gastronomic, or lifestyle interests [10–11]. From this perspective, it complements the broader tourism industry by diversifying rural economies, extending the tourism season, and valorising local heritage [12–13]. Niche positioning has been particularly relevant in the early stages of development, when such products primarily appealed to enthusiasts seeking specialized experiences such as wine tastings, vineyard tours, or regional food festivals [3–4].

At the same time, scholars increasingly highlight the expanding scope of food and wine tourism, especially in relation to wine. Sigala & Roninson [14] emphasize the growing role of wine tourism in regional development, innovation, and destination branding, arguing that its impact extends well beyond niche markets. This reflects the dual character of wine tourism: while it retains features of a specialized product, it also attracts general leisure travelers in search of authenticity, culture, and memorable place-based encounters.

Food tourism, by contrast, presents an even more complex case. As Richard [15] notes, eating is both a

necessity and a universal cultural activity, meaning that food-related experiences occur during every journey, regardless of whether they are the primary motivation for travel. Culinary experiences can therefore be seen as both mainstream and niche: mainstream because food is an inseparable element of any trip, but niche when deliberately sought out in forms such as cooking classes, gourmet tours, or specialty festivals. This duality underscores the importance of understanding not only how tourists consume food and wine experiences, but also how destinations strategically position these offerings between specialized and mainstream markets.

Tourists engaging in food and wine experiences are often motivated by authenticity, sensory pleasure, and the desire to connect with local heritage [16]. Rather than treating authenticity as an objective feature, recent scholarship tends to conceptualize it as a perceived and relational quality of the tourist experience. In food tourism, this is evident in work linking authenticity to local food consumption, destination foodscapes, and tourists' gastronomical quests [17–19]. In wine tourism, authenticity has similarly been associated with terroir-based meanings, local atmosphere, host sincerity, and interpretive engagement with wine and place [20]. Accordingly, this study adopts an experiential understanding of authenticity, viewing it as emerging from visitors' encounters with local wines, foods, and traditions. Studies also suggest that food and wine are increasingly decisive factors in destination choice, particularly in regions that have developed strong culinary identities [15,21]. At the same time, the sector brings significant benefits to destinations, including the diversification of rural economies, the extension of tourist seasons, and the support of small and medium enterprises [22].

However, challenges persist. The rapid growth of food and wine tourism has raised concerns about carrying capacity, authenticity versus commercialization, and the environmental sustainability of wine production and gastronomic events [23–24]. These tensions are particularly evident in emerging destinations where infrastructure and service quality may lag behind growing tourist expectations.

2.2 Applications of IPA in wine and food tourism studies

The application of Importance–Performance Analysis (IPA) in wine tourism spans a period of nearly a quarter century, illustrating the method's adaptability to evolving research questions and industry contexts. The earliest study [25] focused on cellar door service quality using the SERVQUAL model, marking IPA's initial use in operational assessments within established wine regions.

Subsequent studies in the early 2000s and 2010s expanded IPA's application to include visitor segmentation [26], regional marketing alliances [27], and event experiences [28]. More recent contributions from 2016 onward reflect a shift toward strategic destination-level planning, the integration of advanced analytical frameworks (e.g., structural equation modeling, S-O-R, IPMA), and a focus on emerging markets and generational shifts [29–31]. This chronological trajectory highlights not only the growing methodological sophistication of IPA applications, but also the increasing emphasis on destination branding, visitor motivation, and experience personalization in wine tourism research.

In terms of geographic distribution, we can see a diverse range of regions, with research conducted across both mature wine tourism destinations and emerging regions. About half of the studies included in Appendix 1 are situated in internationally established wine regions such as Portugal, Australia, Canada, and the United States, where wine tourism infrastructures and branding strategies are well developed [25,29–30]. The other half focus on emerging wine tourism areas including Mexico, Greece, Croatia, and the Czech Republic, where wine tourism is still evolving as a strategic economic activity [28,32–34].

The studies encompass a wide range of wine tourism formats, reflecting the sector's multi-dimensional character. Several focus on the winery experience, particularly cellar door service quality and the winescape, using IPA to evaluate tangible and intangible aspects of on-site visits [31,35]. Others examine wine-related events such as fairs and festivals, where the emphasis is on the overall visitor experience and event management [28]. At the regional or destination level, IPA is applied to explore broader themes such as destination image, visitor motivation, cooperative marketing, and intentions to visit [27,32]. A few studies also take a strategic or branding-oriented approach, investigating constructs like brand love, word-of-mouth intention, and critical success factors for regional competitiveness [29–30].

There are several conceptual frameworks used in conjunction with IPA to enhance analytical depth and managerial relevance. The SERVQUAL model remains foundational in assessing service quality at the micro (winery) level, particularly regarding staff behavior, reliability, and tangible service elements (O'Neill & Charters, 2000). At the destination scale, some studies apply the Stimulus–Organism–Response (S-O-R) model to examine how external cues (e.g., gastronomy, online reviews) influence internal states (e.g., identity) and ultimately affect tourism intention [32]. Others incorporate brand-oriented constructs such as brand love and word-of-mouth intention,

often using structural equation modeling to identify key satisfaction drivers prior to mapping performance [29]. In one case, a neural network-based IPA model was used to combine stated and derived importance, providing a more nuanced analysis of event quality [28]. Additionally, studies focusing on generational cohorts or visitor segments use factor analysis and segmentation theory to structure IPA around relevant tourist profiles [26,34].

Studies applying Importance–Performance Analysis (IPA) in food tourism research appeared almost a decade later than in wine tourism and show a gradual but steady integration of the method into the evaluation of food-related tourism experiences. The earliest publications, such as Smith and Costello's [7] study of a U.S. culinary event, focused primarily on operational aspects and event management, similar to early wine tourism studies centred on service quality at cellar doors [25]. Over time, food tourism research using IPA diversified both methodologically and thematically, paralleling developments in wine tourism. In the 2010s, studies in regions such as South Korea, Kenya, and Taiwan applied IPA to assess hygiene, service quality, and menu diversity in both festivals and accommodation contexts, emphasizing visitor satisfaction and foodservice delivery. In recent years, much like wine tourism research, food tourism studies have increasingly incorporated experiential, emotional, and identity-based dimensions, often combining IPA with methods such as structural equation modelling (SEM) or asymmetry analysis [36–37]. This evolution reflects a broader trend in both fields: a shift from basic performance diagnostics to more strategic and behaviour-oriented assessments, aligned with the growing recognition of food and wine as key components of destination image, branding, and visitor loyalty.

Unlike wine tourism research, the geographical distribution of IPA studies in food tourism reveals a strong emphasis on Asia, particularly East and Southeast Asia, with notable contributions from South Korea [38], [39], Thailand [36–37], Taiwan [40], and China [41]. These countries account for over half of the studies summarized in Appendix 2 and reflect the region's proactive positioning of food as a core component of tourism development and cultural branding. In contrast to wine tourism, which features a more balanced representation between mature regions (e.g., USA, Portugal, Australia) and emerging destinations (e.g., Mexico, Croatia, Czech Republic), food tourism IPA research is more concentrated in emerging or rapidly developing tourism markets, where local cuisines are leveraged to enhance destination competitiveness. A smaller number of studies originate from Western contexts, such as the United States [7], or from non-Western destinations with grow-

ing food tourism sectors, such as Kenya [42] and Mediterranean countries like Turkey [43], where food tourism is increasingly integrated into the broader hospitality offer. Compared to wine tourism, which often focuses on internationally recognized regions, food tourism studies tend to spotlight regional or subnational destinations and urban gastronomic initiatives, such as Phuket's designation as a Creative City of Gastronomy [37]. This highlights a strategic use of IPA to support culinary identity formation, infrastructure development, and service enhancement in diverse food tourism contexts, particularly in places seeking to consolidate their position on the global gastronomic map.

The reviewed IPA studies in food tourism reflect a diverse range of research foci, covering both micro-level experiences (e.g., restaurants, cooking classes, hotel dining) and macro-level food tourism settings (e.g., regional cuisine, food festivals, culinary identity). Several studies concentrate on food service quality in accommodation or restaurant contexts, examining tourists' perceptions of hygiene, menu variety, service speed, and presentation [39–40,43]. Others explore culinary events and festivals, where IPA is used to assess visitor satisfaction with the overall experience, including access, pricing, and food diversity [7]. A notable trend in more recent research is the shift toward experiential and identity-based food tourism, as seen in studies of cooking classes in Thailand [36] and gourmet consumption in urban gastronomic destinations [37]. These studies move beyond functional attributes to assess authenticity, emotional connection, and cultural learning, echoing a similar shift observed in wine tourism research. Additionally, some studies adopt a comparative focus, such as Su's [40] analysis of individual versus packaged tourists in Taiwan, reflecting interest in segmentation and personalized service in culinary experiences. Overall, the foci range from basic service evaluation to strategic experience design, underlining the versatility of IPA in capturing different layers of the food tourism experience.

While many food tourism IPA studies rely on the traditional importance–performance matrix, several incorporate theoretical frameworks and segmentation approaches to enhance analytical depth. Earlier studies tend to focus on basic service delivery models, analysing attributes such as sanitation, taste, and staff courtesy without explicit conceptual scaffolding [39,41]. However, more recent research demonstrates a stronger theoretical orientation. For instance, Kim and Lee [44] apply a typology based on four consumer attitude profiles – convenience-stable, value-oriented, adventurous-aggressive, and traditional-active – to interpret IPA clusters in regional food tourism. Pratt et al. [36] integrate IPA with

Importance–Response Performance Analysis (IRPA) and Impact–Asymmetry Analysis (IAA) to identify not just priority areas but also asymmetric effects on satisfaction, while Sangkaew et al. [37] combine structural equation modelling (SEM) with IPA to link food-related perceptions to behavioural intentions. These hybrid methods mirror trends in wine tourism research, where models such as S-O-R (stimulus-organism-response) and brand love are increasingly used. Additionally, segmentation plays a prominent role, as in Su's [40] study of tourist typologies and Obonyo et al.'s [42] analysis of hotel manager perspectives on food service attributes. This demonstrates a broader movement toward targeted, theory-informed applications of IPA, supporting more nuanced recommendations for experience design, destination marketing, and hospitality management.

The reviewed literature underscores the evolution and versatility of IPA as a tool for evaluating wine and food tourism experiences across a wide range of geographic and thematic contexts. Studies have moved from early assessments of service delivery and operational quality toward more complex applications that incorporate branding, motivation, and segmentation frameworks. However, several research gaps remain. First, few studies integrate both wine and food tourism experiences in a single IPA framework, despite the increasing interdependence of these domains in visitor experiences and regional branding strategies. Second, while destination-level studies are gaining momentum, there is limited research applying IPA in smaller, emerging wine and culinary regions – particularly in Eastern Europe. Most notably, Bulgaria remains underrepresented in this body of work, with no known IPA applications in the country's wine or food tourism contexts. This is especially relevant in regions such as Sandanski and Petrich, where wine tourism is relatively well-developed, anchored by the emblematic town of Melnik, one of Bulgaria's most recognized wine destinations. In contrast, gastronomic tourism in the region is still emerging, with untapped potential to contribute to regional identity and visitor experience. By applying IPA to explore visitor perceptions of both wine and food tourism offerings in this cross-border context, the current study addresses these gaps and supports more integrated, evidence-based destination development strategies.

3. MATERIAL AND METHODS

This study employs a quantitative research design to assess visitor perceptions of wine and food tourism in the cross-border region of Sandanski and Petrich in Southwestern Bulgaria. The region was selected due

to its prominence as a wine tourism destination, centred around the town of Melnik, one of Bulgaria's most emblematic wine-producing areas, and its underdeveloped, yet promising, potential in gastronomic tourism. While wine-related experiences are well-structured and increasingly visible in national promotional efforts, food tourism remains fragmented, presenting opportunities for strategic development based on visitor feedback.

3.1 Research methods

Importance–Performance Analysis (IPA) was employed to evaluate visitor perceptions of wine tasting experiences in the Petrich–Sandanski region. Widely applied in tourism and hospitality research [25,28,33], IPA serves as a diagnostic tool for identifying areas where performance aligns with, exceeds, or falls short of visitor expectations. By comparing the importance that tourists assign to different service attributes with their perceived performance, the method highlights both core strengths to preserve and weaknesses requiring managerial attention.

3.2 Survey design

A structured questionnaire was developed based on previous IPA studies in food and wine tourism and adapted to the regional context. The present paper draws on the items relevant to wine and food experiences, which formed part of a larger study on regional tourism development. Respondents were asked to evaluate 11 attributes of the wine tasting experience, including wine quality, authenticity, variety, ambience, staff professionalism, accompanying food, and value for money. They also assessed 10 attributes of the culinary experience, such as the quality and presentation of food, authenticity of dishes, variety, atmosphere of the dining setting, professionalism of staff, opportunities to learn about local gastronomy, the use of local or seasonal products, availability of special diet options, value for money, and the possibility to pair food with regional wines. Each attribute was measured on two 5-point Likert scales:

- Importance (1 = “Not important at all” to 5 = “Extremely important”)
- Performance (1 = “Very poor” to 5 = “Excellent”)

3.3 Data collection

Data were collected through an online survey conducted between April and May 2025. A snowball sam-

pling method was used, with the questionnaire distributed via social media platforms and online travel and gastronomy forums. Participation was limited to Bulgarian visitors who had previously visited the region, verified by a screening question ("Have you visited the region before?"). A total of 202 questionnaire responses were collected. After data screening, 177 responses were retained as valid and included in the analysis. For the purposes of this study, only responses to the IPA-related questions were analysed.

The questionnaire included two sets of Importance-Performance Analysis (IPA) items: one focused on wine tourism experiences, the other on food tourism. These items were selected based on a comprehensive literature review of prior IPA applications in wine and food tourism [7], [25], [29], [37], and reflect key elements influencing visitor satisfaction and loyalty, such as product quality, authenticity, service, setting, and emotional engagement.

3.4 Analytical procedure

The analysis followed three steps:

1. Calculation of mean scores for each attribute (importance and performance).
2. Classic IPA (grand mean method): The overall mean of all importance and performance ratings was used as cross-hair values to form the four quadrants (Keep up the Good Work, Concentrate Here, Possible Overkill, Low Priority). Attributes were then positioned accordingly.
3. Diagonal IPA (regression-based method): To address the correlation between importance and performance, a regression line was estimated with importance as the predictor of performance. Residuals were calculated to assess whether each attribute was performing above or below expectations given its level of importance. Attributes with negative residuals were considered under-performers, and those with positive residuals over-performers.

3.5 Reliability and validity

The wine-tourism attributes were adapted from prior IPA studies in wine tourism and organized to reflect the principal domains that recur in the literature. Specifically, the final set includes: (1) **core product attributes** (*quality of wines tasted, variety of wines*), consistent with earlier emphasis on wine quality and offer composition [30,34]; (2) **authenticity and territorial distinctiveness** (*unique/local grape varieties*), in line with studies highlighting local atmosphere, destination identity, and

place-based differentiation [26,29,32]; (3) **interpretive and service-related attributes** (*professional commentary*), consistent with prior attention to staff knowledge, professionalism, and learning about wine [25,28,33]; (4) **experiential setting** (*atmosphere and setting*), aligned with scenic beauty, destination image, and winescape attributes reported in earlier research [26], [30–31]; (5) **complementary and social dimensions** (*accompanying food, opportunity for discussion, duration of tasting*), which reflect the increasingly experiential and relational character of winery visits [28–29]; and (6) **practical and evaluative dimensions** (*possibility to purchase, accessibility and signage, value for money*), which correspond to infrastructure, convenience, and value considerations frequently included in destination-oriented IPA studies [30–31,33].

The selection of food-tourism attributes was likewise informed by earlier IPA research and structured around the key evaluative dimensions most frequently identified in the literature. The final set includes: (1) **core product attributes** (*quality of food, variety of dishes*), consistent with earlier emphasis on taste, freshness, food quality, and menu variety [38–40]; (2) **authenticity and cultural distinctiveness** (*authenticity and traditional character*), in line with studies highlighting authenticity, cultural connection, and local culinary identity [36–37,41]; (3) **interpretive attributes** (*presentation and explanation*), corresponding to educational value, food explanation, and menu presentation [36,43]; (4) **experiential setting** (*atmosphere and setting*), aligned with dining environment and aesthetic or environmental aspects of the experience [37,40,43]; (5) **heritage-linked local product opportunities** (*GI food opportunities*), reflecting the broader literature on local specialties and culturally distinctive foods [41,44]; (6) **economic evaluation** (*value for money*), consistent with prior attention to price and price fairness [7,37,39]; and (7) **experience diversification attributes** (*special diet options, culinary demonstrations/classes*), which reflect nutritional variety and the participatory turn in gastronomic tourism [36,39].

In the study, authenticity was operationalized as a visitor-perceived quality of the wine and food tourism experience, reflected in attributes associated with local distinctiveness, traditional character, and connection to place. This was captured through the items *unique/local grape varieties* in the wine-tourism scale and *authenticity and traditional character* and *GI food opportunities* in the food-tourism scale. This approach is consistent with prior research that conceptualizes authenticity in food and wine tourism through place-linked products, local culture, and experiential cues rather than as a fixed inherent property of the destination [17–18,20].

The questionnaire included parallel sets of attributes measuring both the *importance* and *performance* of wine and food tourism experiences. To assess the internal consistency of these scales, Cronbach's alpha was calculated. The coefficients indicated excellent reliability: wine tourism (Performance $\alpha = 0.97$; Importance $\alpha = 0.94$) and food tourism (Performance $\alpha = 0.93$; Importance $\alpha = 0.90$), confirming that the attributes capture coherent dimensions of visitor perceptions and provide a reliable basis for subsequent IPA analysis.

3.6 Methodological reflection

The results indicated consistently high mean scores across attributes, ranging from 3.8 to 4.6. This "ceiling effect" is frequently observed in wine tourism research, where visitors generally report high levels of satisfaction. While such clustering suggests a strong baseline performance, it compresses the scale and makes absolute differences appear modest. The value of IPA in this context lies in revealing relative misalignments between importance and performance. Even small gaps are strategically relevant, as they indicate areas where expectations are not fully met. For example, "value for money" emerged as a critical under-performer despite receiving relatively high-performance scores, while more subtle discrepancies were identified in wine variety and professional commentary. To capture these nuances more effectively, the study applied both the classic IPA and the diagonal IPA approaches, ensuring a more robust and comprehensive interpretation of visitor perceptions.

4. RESULTS

The socio-demographic profile of the respondents offers background information for interpreting the survey results, though it should be noted that the sample is not representative of all wine/food tourists in the region. Most participants fell into the 45–64 age group (around 60%), followed by 26–44 years (27%), with smaller shares under 25 and over 65. Women accounted for 71% of respondents, while men and those preferring not to disclose their gender were less represented. In terms of education, the largest proportion reported higher education (bachelor's or master's degree), though respondents with secondary and doctoral qualifications were also present. Income levels were concentrated in the 1,600–2,500 BGN range (44%), with additional groups in both lower and higher income brackets.

Beyond the socio-demographic characteristics, the survey also explored respondents' general attitudes

toward wine and food tourism. Around 40% reported that they often or always include wine and culinary experiences in their travels, while another 35% indicated that they sometimes do so, suggesting that gastronomy is a recurring but not universal element of leisure activities. When asked to assess their own knowledge of wine and gastronomy, the majority positioned themselves at a moderate level (scores 3–4 on the five-point scale), with only a small minority declaring very high expertise. At the same time, the perceived role of food and wine in travel decisions was rated highly: nearly 70% considered such experiences important or very important in shaping their travel choices. These findings indicate that food and wine tourism hold a meaningful place in the preferences of the surveyed visitors, providing a relevant context for the subsequent Importance–Performance Analysis.

4.1 Wine tourism experiences: descriptive statistics and IPA results

4.1.1 Descriptive statistics of wine tourism attributes

To evaluate visitor perceptions of the wine tasting experience in the Petrich–Sandanski region, respondents rated 11 attributes on two dimensions: importance and performance. Table 1 presents the mean values for each attribute.

Overall, the results show that all attributes received relatively high scores, with mean values clustered between 3.8 and 4.6 on the five-point scale. This pattern reflects a generally positive evaluation of wine tourism in the region, with only subtle differences across attributes. In terms of importance, the highest ratings were given to: *quality of wines* ($M=4.55$), *value for money* ($M=4.47$), and *uniqueness of local grape varieties* ($M=4.45$), highlight particular emphasis on authenticity and product quality, along with the economic dimension of the experience.

On the performance side, the top-scoring attributes were: *possibility to purchase wines on site* ($M=4.44$), *quality of wines* ($M=4.28$), and *uniqueness of local grape varieties* ($M=4.28$). At the lower end of the spectrum, attributes such as *opportunity for discussion with the wine guide and other participants* ($M=3.84$ performance) and *duration of the tasting* ($M=3.89$ performance) received slightly lower ratings, though still above the scale midpoint. The findings suggest that wineries in the region are already performing strongly in areas central to the visitor experience. At the same time, there are areas with room for improvement, particularly in terms of interaction and experiential depth. Standard deviations were generally modest, indicating a relatively consistent pattern of responses across most attributes.

Table 1. Descriptive statistics (wine tourism attributes, n=177).

Attribute	Importance (M)	Importance (SD)	Performance (M)	Performance (SD)
Quality of wines tasted	4.55	0.88	4.28	0.96
Variety of wines	4.25	0.98	4.06	1.02
Unique/local grape varieties	4.45	0.95	4.28	0.96
Professional commentary	4.22	1	3.99	1.13
Atmosphere and setting	4.24	1	4.16	1.03
Accompanying food	4.19	1.01	3.84	1.16
Opportunity for discussion	3.9	1.19	4.01	1.13
Duration of tasting	4.12	0.97	3.89	1.12
Possibility to purchase	4.41	0.92	4.44	0.92
Accessibility and signage	4.21	1.03	4.22	0.99
Value for money	4.47	0.88	4.1	1.08

The results indicate that, while the region is perceived positively overall, subtle gaps between importance and performance exist. These will be further explored through the IPA quadrant analysis in the next section.

4.1.2 Classic IPA (wine tourism)

The classic IPA grid (Figure 1) distinguishes clearly between core strengths, one critical weakness, and several lower-priority attributes.

The “*Keep up the Good Work*” quadrant features three key strengths: *wine quality, local grape varieties, and purchase options*. These attributes score highly on both importance and performance, marking them as pillars of the regional wine experience. Maintaining excellence here is crucial, as they form the core of the destination’s competitive positioning and directly influence tourist satisfaction. These attributes combine product excellence, authenticity, and logistical convenience, and are already performing well in areas that visitors consider highly important. They should therefore remain central pillars of the regional wine tourism offering.

The “*Concentrate Here*” quadrant contains a single but critical weakness: *value for money*. Its very high importance combined with comparatively lower performance suggests a clear mismatch between visitor expectations and perceived benefits.

The “*Possible Overkill*” quadrant includes *atmosphere* and *accessibility*. Both attributes perform strongly but are of comparatively lower importance to visitors. This suggests that further investments in these areas may yield limited marginal benefits. Their current high performance already contributes to a pleasant and welcoming experience, but additional emphasis may not significantly enhance satisfaction relative to other areas that require more attention.

Finally, five attributes fall within the “*Low Priority*” quadrant: *wine variety, professional commentary, food pairing, opportunity for discussion, and tasting duration*. These attributes receive only moderate importance ratings and exhibit relatively modest performance levels. While they are not currently major drivers of visitor satisfaction, they nonetheless represent areas where incremental improvements could enrich the offer, especially if the region aims to attract more experienced wine tourists or strengthen its educational and interactive components. However, they do not require immediate resource allocation.

Overall, the classic IPA highlights a relatively balanced offering with strong performance in core product attributes. However, the perceived value-for-money gap stands out as a critical issue for destination managers to address.

4.1.3 Diagonal IPA (wine tourism)

To refine the analysis, a diagonal IPA approach was applied, using regression to model the relationship between importance and performance. This method evaluates whether each attribute performs above or below expectations given its importance level. The results presented in Figure 2 confirm several findings from the classic IPA while also revealing subtler performance gaps.

The regression line in the diagonal IPA represents the level of performance that would normally be expected for each importance rating. Attributes positioned above the line can be interpreted as over-performing, while those below the line indicate under-performance relative to visitor expectations.

Consistent with the classic IPA, *value for money* is one of the most expressed under-performers, confirm-

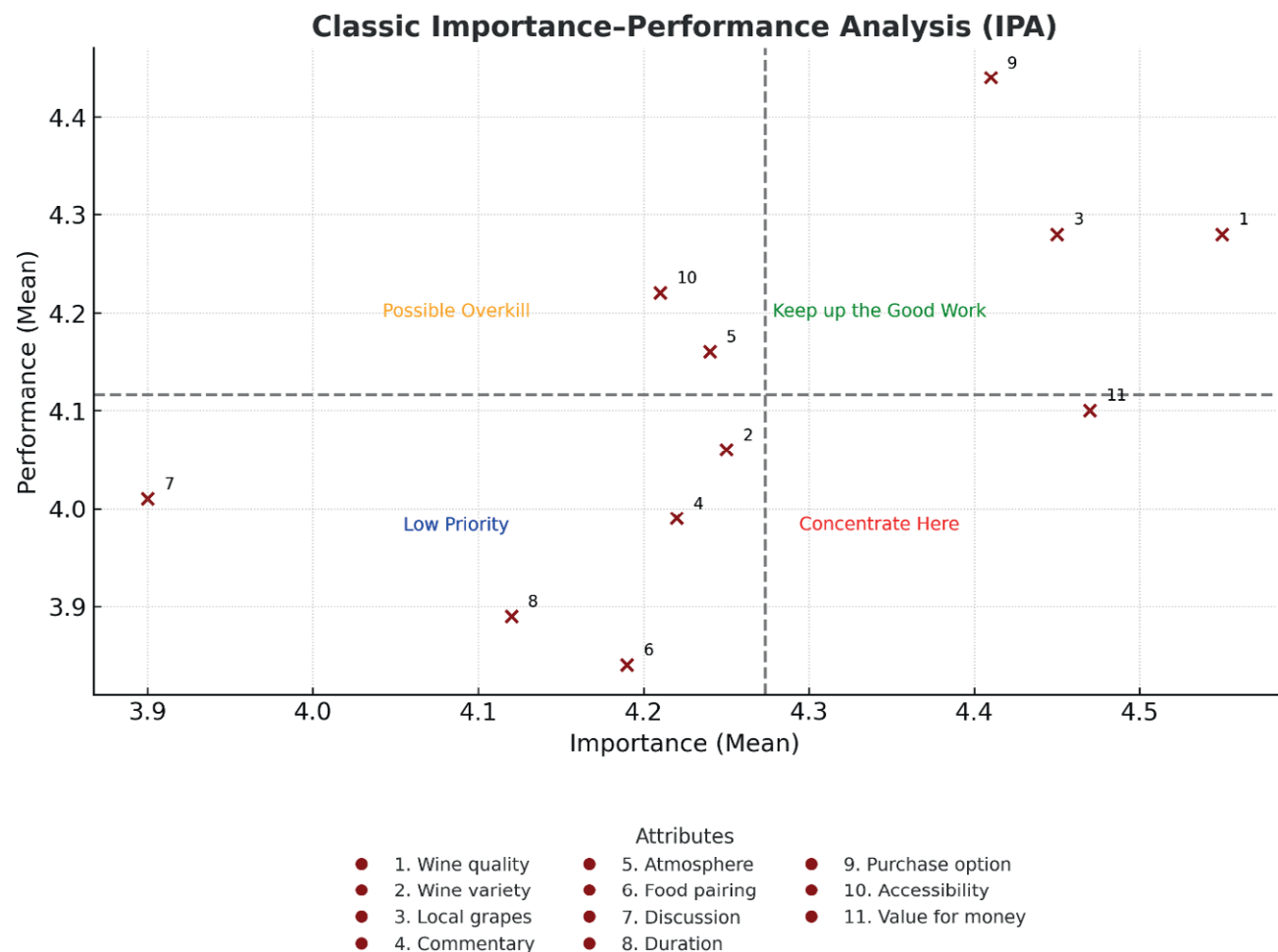


Figure 1. Classic IPA grid for wine tourism attributes (n=177).

ing it as a pressing weakness in the regional wine tourism offer. The diagonal IPA, however, also identifies several additional attributes that fall below expected performance levels: *wine variety*, *professional commentary*, *food and wine pairing*, and *tasting duration*. Although some of these did not emerge as priorities in the classic analysis, their position below the regression line indicates that, given their importance, visitors expect higher performance than they currently receive. These represent hidden weaknesses that may subtly reduce the overall experiential quality, especially for more experienced or curiosity-driven wine tourists.

In contrast, *wine quality*, *local grape varieties*, *atmosphere*, *purchase options*, *accessibility*, and *the opportunity to discuss* appear above the regression line. This suggests that wineries are exceeding visitor expectations in these areas, which can be considered key differentiators and sources of competitive advantage. These strengths

reinforce the region’s authentic character and contribute meaningfully to positive visitor impressions.

Overall, while the classic IPA highlights core strengths and the primary weakness of value for money, the diagonal IPA sharpens the diagnosis by revealing additional experience gaps in interpretation, pairing, and diversity of wines. Simultaneously, it underscores the importance of preserving the strong performance of attributes linked to authenticity, quality, and accessibility, which collectively define the region’s competitive position.

4.1.4 Comparative interpretation of IPA approaches

The application of both the classic and diagonal IPA approaches provides complementary insights into visitor perceptions of wine tourism in the Petrich–Sandanski region. Both methods converge in identifying *value for money* as the critical weakness, underlining its strategic

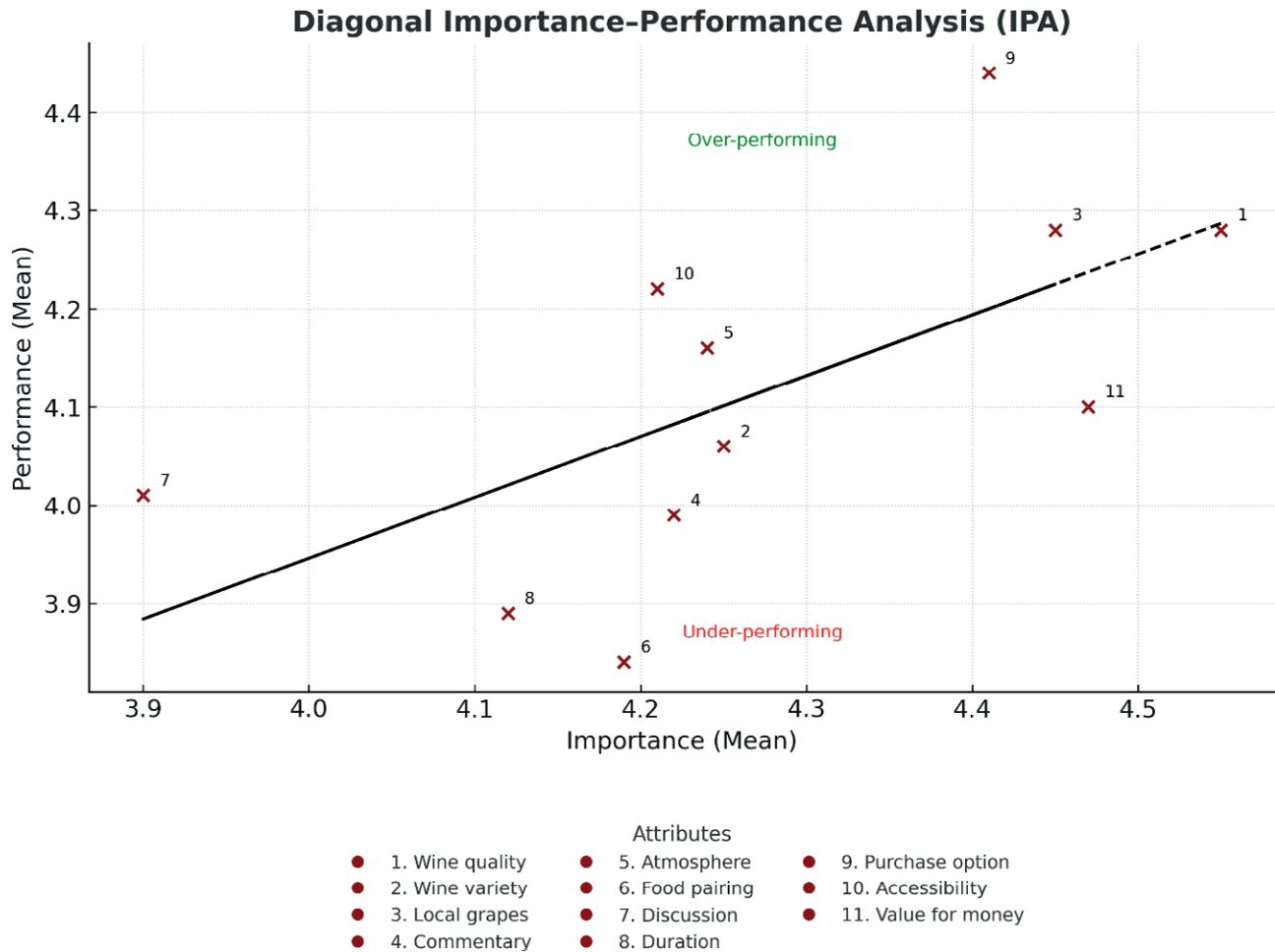


Figure 2. Diagonal IPA grid for wine tourism attributes (n=177).

importance for managers. This attribute combines very high importance with comparatively lower performance, and thus represents a clear area where improvements are needed to safeguard visitor satisfaction and loyalty.

The two methods also agree on the region's *core strengths*. The *quality of wines*, *authenticity through unique grape varieties*, and the *opportunity to purchase wines on-site* are consistently positioned as strong performers in areas of high importance. These attributes form the backbone of the wine tourism experience and should be protected as central elements of destination branding and development. At the same time, the diagonal IPA reveals additional insights not evident in the classic grid. Specifically, *variety of wines* and *professional commentary* emerge as *hidden under-performers*. While their importance was rated moderately in the classic IPA, the regression-based approach shows that visitors expect more from these elements given their relevance to the overall tasting experience. Addressing these gaps could

enhance the perceived sophistication and educational value of the offer.

4.2 Food tourism experiences: descriptive statistics and IPA results

4.2.1 Descriptive statistics of food tourism attributes

The descriptive results for food tourism indicate that respondents generally evaluated both the importance and performance of culinary experiences in the Petrich-Sandanski region highly, with mean values clustering around 4 and above (Table 2). Among the performance ratings, the highest scores were assigned to *food quality* ($M = 4.40$) and *authenticity of dishes* ($M = 4.28$), confirming that visitors strongly value the sensory and cultural dimensions of the regional cuisine. *Atmosphere and setting* ($M = 4.18$) and *presentation and explanation of dishes* ($M = 4.05$) also received favorable evalu-

Table 2. Descriptive statistics (food tourism attributes, n=177).

Attribute	Importance (M)	Importance (SD)	Performance (M)	Performance (SD)
Quality of food	4.63	0.77	4.23	0.91
Authenticity and traditional character	4.39	0.93	4.1	0.96
Variety of dishes	4.32	0.9	3.99	0.92
Presentation and explanation	4.04	1.1	3.41	1.25
Atmosphere and setting	4.46	0.86	4.02	1.03
GI food opportunities	3.99	1.13	3.41	1.27
Value for money	4.43	0.9	3.9	1.07
Special diet options	3.51	1.41	3.23	1.33
Culinary demonstrations/classes	3.44	1.34	3.08	1.36

ations, suggesting that the experiential environment contributes positively to satisfaction. On the importance side, the strongest emphasis was placed on *food quality* ($M = 4.65$), *authenticity* ($M = 4.55$), and *value for money* ($M = 4.52$), highlighting that visitors expect local food to deliver both cultural distinctiveness and a fair balance between price and quality. In contrast, attributes such as *special diet options* ($M = 3.25$) and *culinary demonstrations or classes* ($M = 3.65$) were rated lower in both performance and importance, reflecting their peripheral role in shaping overall food tourism satisfaction in the region.

4.2.2 Classic IPA (food tourism)

The results of the classic IPA grid provide a detailed view of how the different elements of the culinary experience align with visitor expectations (Figure 3).

Attributes such as *food quality*, *authenticity*, and *value for money* are positioned in the “Keep up the Good Work” quadrant, confirming them as core strengths that strongly contribute to satisfaction and should be maintained as priorities. *Atmosphere and setting* also falls into this quadrant, underlining the importance of providing a pleasant and culturally coherent environment for dining and tasting experiences. In contrast, *special diet options* and *culinary demonstrations or classes* appear in the “Low Priority” quadrant, reflecting both limited importance and relatively modest performance; while these may enhance niche experiences, they are not critical for the majority of visitors. Interestingly, *presentation and explanation of dishes* occupies a position closer to the “Concentrate Here” quadrant, suggesting that while performance is acceptable, the importance attached by visitors warrants greater investment in staff training and storytelling to enrich the experiential and educational value of food tourism.

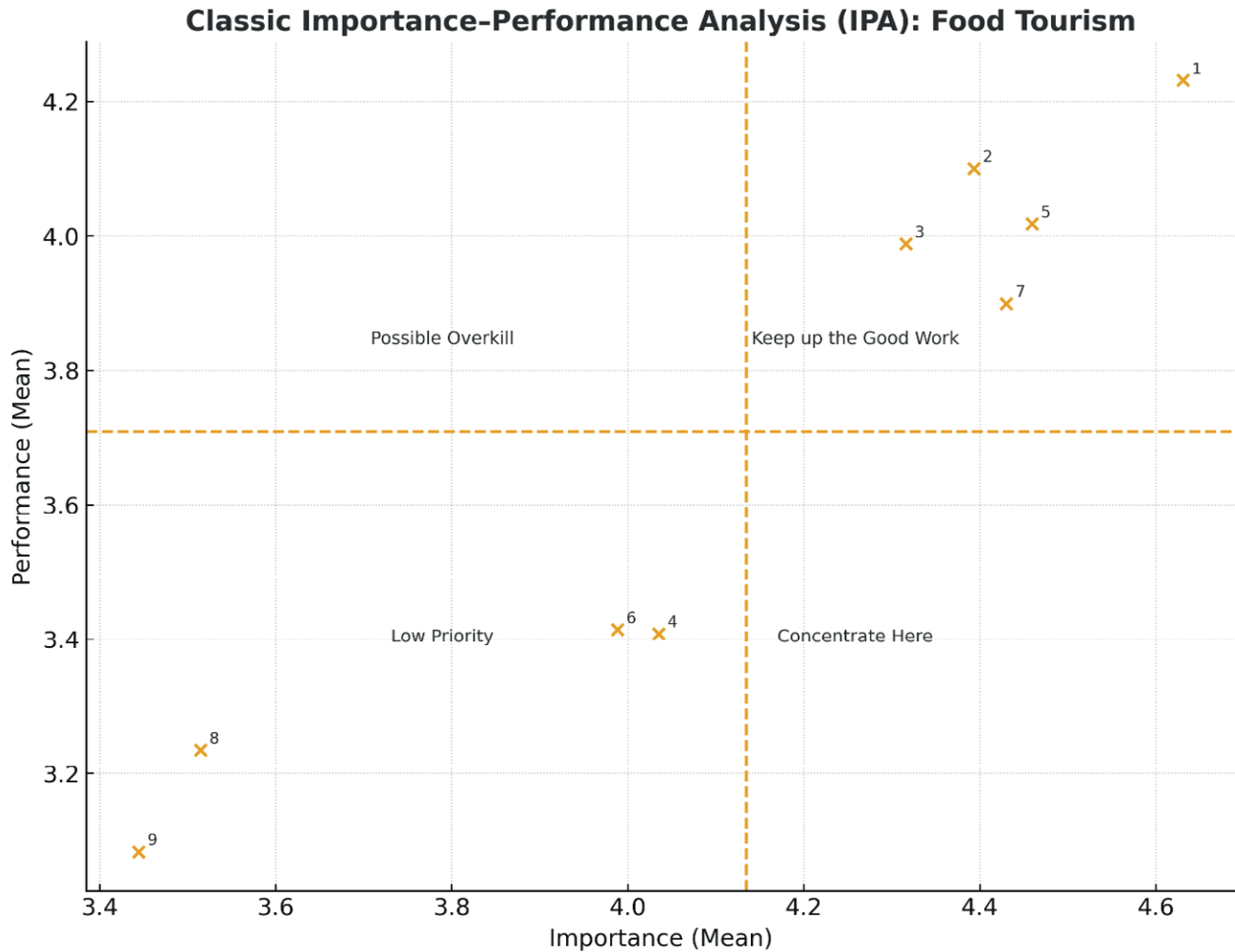
4.2.3 Diagonal IPA (food tourism)

The diagonal IPA also reveals important nuances in visitor perceptions (Figure 4). Attributes such as *food quality* and *authenticity of dishes* clearly over-perform, with satisfaction levels exceeding expectations. These findings reaffirm them as core strengths and distinctive anchors of the regional culinary experience. *Atmosphere and setting* fall into a borderline zone, suggesting the need for careful monitoring and potential improvement.

In contrast, several attributes fall below the diagonal, indicating relative under-performance. The *opportunity to try foods with geographical indications (GI products)*, for example, performs below expectations, suggesting that visitors’ interest in certified local foods is not fully met. Given the limited presence of officially registered GI products in the Petrich–Sandanski region, this may reflect either visitors’ misperceptions about what constitutes GI food or the insufficient visibility of local specialties. This underscores the potential for developing and communicating authentic regional products under the GI framework. *Presentation and explanation of dishes* also remains an area of weakness, pointing to the need for stronger interpretive and storytelling skills among staff. Finally, *value for money* continues to underperform across both wine and food experiences, confirming a recurring challenge for the destination, while *special diet options* and *culinary demonstrations or classes* occupy a peripheral position with limited perceived importance.

Overall, the findings from both IPA approaches confirm that food tourism in the Petrich–Sandanski region is evaluated positively, with consistently high ratings for quality, authenticity, and atmosphere. The classic IPA highlights these attributes as core strengths that should be preserved, while the diagonal IPA confirms that their performance broadly matches visitor expectations.

A more nuanced picture emerges for *value for money*: although it appears in the “Keep up the Good



1. Food quality 2. Authenticity 3. Dish variety
 4. Presentation/explanation 5. Atmosphere/setting 6. GI food options
 7. Value for money 8. Special diet options 9. Demos/classes

Figure 3. Classic IPA grid for food tourism attributes (n=177).

Work” quadrant of the classic IPA, indicating solid absolute performance, it falls below the regression line in the diagonal analysis, signalling that performance is *lower than expected given its high importance*. This makes value for money a *latent under-performer*, deserving strategic attention even if not visibly problematic in the classic IPA.

The clearest and most consistent weakness across both approaches concerns the *presentation and explanation of dishes*, which underperforms relative to expectations and shows only moderate absolute performance. Improving the interpretive dimension of the culinary

experience therefore offers the greatest potential for enhancing visitor satisfaction.

The position of *GI foods* differs somewhat across the two IPA approaches: in the classic IPA they fall within the “low priority” quadrant due to their lower overall importance, whereas the diagonal IPA reveals that, for the level of importance they *do* hold, performance is below the expected benchmark. This suggests that while GI foods are not yet decisive for the wider visitor base, there is a latent unmet expectation among those who value local or distinctive products, likely linked to misconceptions about GI certification or

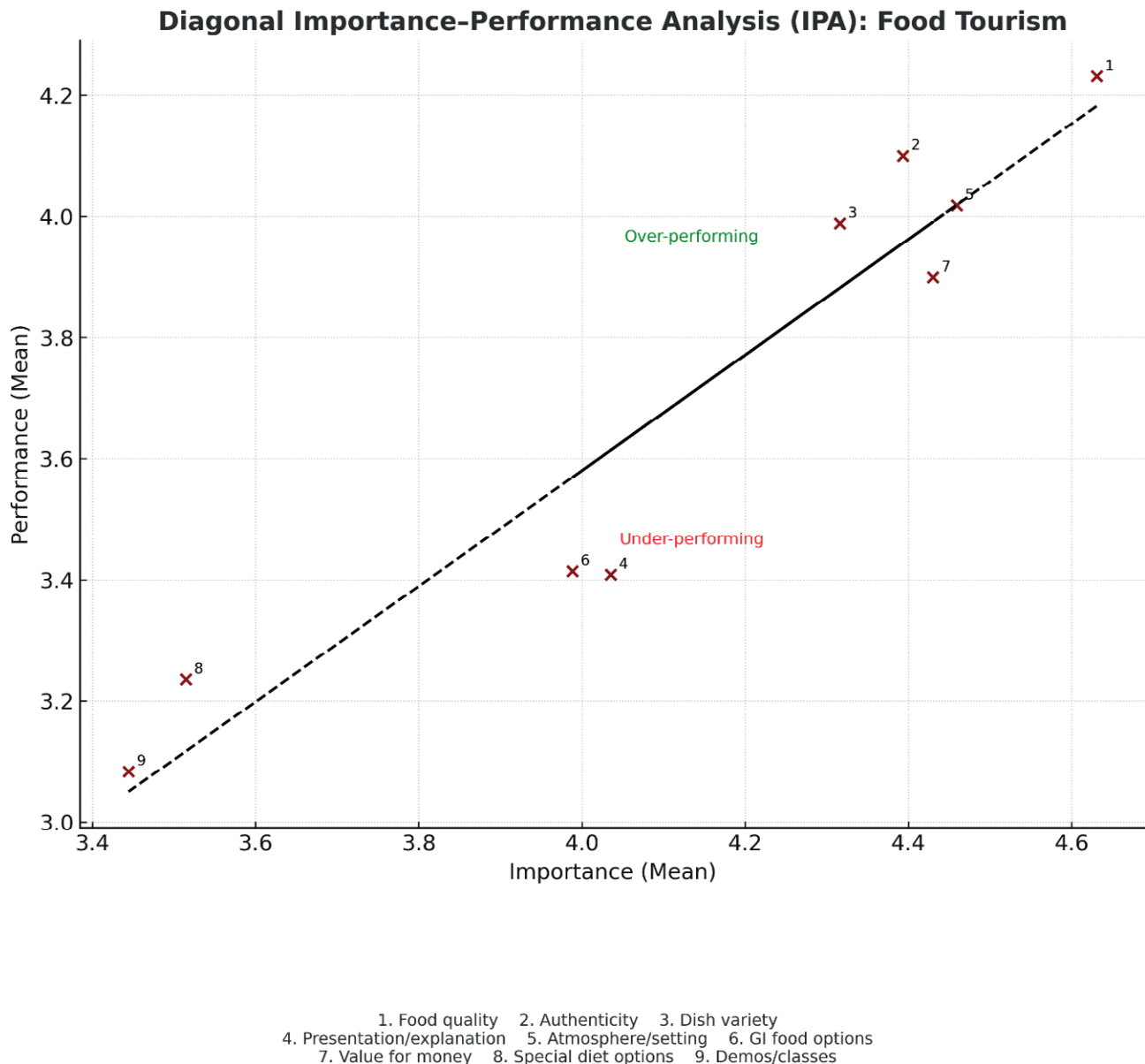


Figure 4. Diagonal IPA grid for food tourism attributes (n=177).

limited visibility of authentic regional specialties. This creates a strategic opportunity to strengthen the connection between gastronomy and local food heritage through clearer communication and potential product development. By contrast, special diet options and culinary demonstrations/classes remain peripheral, suggesting limited strategic relevance for the mainstream visitor market at present.

5. DISCUSSION

The combined IPA analyses of wine and food tourism in the Petrich–Sandanski region reveal a generally positive visitor perception, with both domains characterized by high performance and importance values. This confirms the region’s potential as an emerging wine-and-food destination but also exposes areas requiring managerial attention.

A key finding across the two domains concerns *value for money*, although its role differs in strength between wine and food tourism. In the wine tour-

ism analysis, value for money emerges as the most pronounced weakness, under-performing in both the classic and diagonal IPA. This echoes earlier IPA-based studies in wine tourism, where pricing perceptions consistently appear as sources of dissatisfaction [28], [30], and aligns with research showing that the balance between cost and perceived benefit is a critical determinant of destination competitiveness [33]. In the food tourism analysis, value for money performs adequately in absolute terms but falls below the regression line in the diagonal IPA, suggesting that it does not fully meet expectations for an attribute of such high importance. These patterns indicate that improving value perception in the Petrich–Sandanski region will require not only transparent and consistent pricing but also a stronger communication of added experiential and cultural value.

The importance of *authenticity* emerges strongly in both wine and food tourism, echoing previous work that positions authenticity as a cornerstone of memorable visitor experiences [31], [45]. Although it does not require correction, it would benefit from strategic enhancement, particularly through improved storytelling, interpretation, and the development of clearly identifiable local products (e.g., potential GI items). Such efforts would help transform existing authentic elements into more explicit sources of competitive advantage. However, as Stergiou [34] notes, authenticity must be carefully managed to avoid commodification; in the studied region, this suggests building narratives around terroir, heritage, and tradition while retaining cultural integrity.

Another recurring weakness identified in both analyses relates to the *interpretive dimension*: the professional commentary during wine tastings and the presentation and explanation of dishes in gastronomy. Previous IPA studies in wine tourism underline the critical role of knowledgeable hosts in shaping satisfaction [25], [27]. Similarly, research on food and wine experiences stresses the importance of multisensory and educational components [46]. The Petrich–Sandanski findings thus confirm that strengthening interpretive and storytelling capacities among service providers is essential for transforming visits into learning-rich, emotionally engaging experiences.

The results concerning *GI products* deserve special attention. While respondents rated them positively, the region lacks officially recognized GI foods. This discrepancy may be explained by visitors' general association of local specialties with authenticity rather than an understanding of formal certification. Comparable insights have been reported in the Italian and Portuguese contexts, where visitors often equate local provenance with quality regardless of official labelling [26], [47]. For Petrich–Sandanski, this indicates untapped potential in

developing and promoting GI recognition for selected products, thereby strengthening links between gastronomy, heritage, and tourism.

The consistently *lower ratings of peripheral attributes*, such as special diet options and culinary demonstrations, suggest that these elements currently play a secondary role in shaping visitor satisfaction. While not immediate priorities for development, they may still enrich the offer for specific niche markets (e.g., health-conscious or experiential travellers) and provide opportunities for product diversification in the longer term.

These findings also resonate with recent qualitative research on the critical success factors of wine tourism in the Struma Valley [9]. That study identified satisfiers such as wine quality, the people dimension (hospitality and friendliness), and the winery tour experience, alongside dissatisfiers like accessibility and inadequate service. The convergence between the IPA results and qualitative insights strengthens confidence in the evidence base, showing that both methods highlight the same core strengths (wine quality, authenticity, atmosphere) and weaknesses (interpretive quality, value for money). Moreover, the qualitative perspective adds nuance by emphasizing emotional engagement and host–guest interaction, which in the IPA analysis scored lower in importance but remain central for long-term loyalty and regional reputation.

At the same time, several differences from previous research stand out. First, the overall performance values in Petrich–Sandanski are unusually high, with most attributes scoring close to or above 4, whereas earlier IPA studies [28], [30] often report a wider spread with some attributes rated much lower. This may reflect the domestic profile of respondents in the present study, who may be more positively predisposed toward local offerings. Second, while GI products are central in contexts such as Italy and Portugal [26], [47], in Petrich–Sandanski their high rating reflects perceived authenticity rather than actual GI-certified products – highlighting *potential* rather than established strengths. Third, whereas previous studies stress the importance of host–guest interaction [9], [25], [27], in this study attributes like discussion with the guide or explanation of dishes received relatively modest scores, suggesting that domestic visitors may prioritize product quality over interpersonal engagement. Finally, peripheral attributes such as special diet options and cooking classes, which are gaining importance in more mature destinations, remain clearly secondary in Petrich–Sandanski, confirming its status as an emerging destination still consolidating its core offer.

Overall, the comparison with earlier IPA studies and the integration of qualitative evidence demonstrate both

convergence and divergence. The Petrich–Sandanski region shares common challenges with other emerging destinations, particularly regarding value for money and interpretive quality, but also shows unique opportunities rooted in authenticity, grape varieties, and the potential of GI-linked gastronomy. Strategically addressing these issues will be key for positioning the region as a sustainable wine-and-food tourism destination.

6. CONCLUSION

This study applied Importance–Performance Analysis (IPA) to evaluate visitor perceptions of wine and food tourism in the Petrich–Sandanski region of Southwestern Bulgaria, one of the country's most emblematic yet underexplored destinations. Based on a survey of domestic tourists, both the classic and diagonal IPA approaches revealed consistently high ratings across most attributes, confirming the positive image of the region's gastronomic and oenological offerings. Core strengths identified include the quality of wines and food, authenticity of local products and traditions, and the pleasant atmosphere of tasting environments. At the same time, value for money and interpretive dimensions (professional commentary, dish presentation) emerged as areas requiring attention. Attributes such as special diet options and culinary demonstrations/classes were rated less important and less influential, suggesting they currently play a marginal role in shaping visitor satisfaction.

The findings extend the literature on IPA applications in tourism by demonstrating its value in an emerging destination context where attributes are evaluated positively but important weaknesses remain. Unlike more established wine and food tourism regions, Petrich–Sandanski shows an unusual convergence of high-performance scores across most attributes, underlining the need to interpret IPA results within their contextual and cultural setting. The study also contributes by combining classic and diagonal IPA, showing how the two approaches complement one another: the former highlights strategic priorities, while the latter identifies hidden under- and over-performers. Integrating these methods strengthens diagnostic validity.

For practitioners, the results underscore the importance of maintaining the region's core strengths – product quality, authenticity, and atmosphere – while addressing weaknesses that threaten long-term competitiveness. Improving perceptions of value for money requires not only pricing strategies but also the communication of experiential and cultural added value. Enhancing interpretive quality through staff training,

storytelling, and visitor engagement will help transform good experiences into memorable ones. Although not central at present, diversifying the culinary offer through dietary options or experiential activities such as cooking classes may appeal to niche markets and broaden the region's attractiveness. Finally, the paradoxical positive ratings for GI products highlight the potential for developing and promoting local specialties under official certification, thereby strengthening links between gastronomy, heritage, and sustainable tourism. From a policy perspective, the findings suggest a need for more proactive support for the integration of GI foods into the regional tourism offer. Local and regional authorities could contribute through targeted financial incentives, administrative and advisory assistance for producers involved in certification processes, and coordinated territorial marketing that more clearly links local gastronomy with regional identity. Such measures could improve both the visibility and the experiential incorporation of GI products, thereby helping to address the current gap between their recognized importance and their still limited presence within the destination experience.

Several limitations should be acknowledged. First, the sample was obtained through non-probability sampling and is skewed toward highly educated, domestic, and female respondents, with a marked concentration in the 45–64 age group. Accordingly, the findings are most representative of this particular visitor profile and should not be generalized uncritically to the wider tourist population, especially to international visitors, younger tourists, and more demographically diverse segments. In addition, these sample characteristics may have shaped the evaluation of certain attributes, particularly value for money, informational quality, and authenticity-related aspects, since middle-aged and highly educated respondents may differ in their expectations and evaluative criteria from other market segments. Second, the survey focused on a defined set of attributes derived from previous research. Although this ensured analytical consistency and comparability, it may have overlooked other potentially relevant dimensions of the visitor experience.

Future studies could build on these findings in several ways. Comparative research across domestic and international tourists would provide a fuller picture of visitor expectations and satisfaction. Longitudinal designs could assess whether perceptions shift as the region develops its wine and food tourism offer. Integrating IPA with qualitative approaches, such as in-depth interviews or netnography, would capture the emotional and narrative dimensions of experiences more fully. Finally, studies that link IPA results to behavioural outcomes such as loyalty, revisit intention, or spending

would enhance the practical utility of the method for destination managers.

In sum, the study confirms the Petrich–Sandanski region’s potential to consolidate its position as a sustainable wine-and-food tourism destination. By leveraging authenticity, improving interpretive quality, and addressing value concerns, stakeholders can shape experiences that are both memorable for visitors and beneficial for the local community.

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APPENDIX 1. APPLICATIONS OF IMPORTANCE–PERFORMANCE ANALYSIS (IPA) IN WINE TOURISM (SUMMARY BY STUDY)

Study	Wine Tourism Focus	Region	Methodology	IPA Elements
O'Neill & Charters (2000)	Winery (cellar door)	Australia (mature)	SERVQUAL + IPA	SERVQUAL-based service quality items: responsiveness, assurance, tangibles, empathy, and reliability – mean importance vs performance ratings
Williams & Dossa (2003)	Wine destination segmentation	Canada (mature)	Tourist segmentation + IPA	Experience elements segmented by tourist type: scenic beauty, friendliness, learning, recreation, and local atmosphere – mapped through IPA for generalists vs immersionists
Randall & Mitchell (2008)	Wine marketing alliance	Canada (mature)	Online survey + IPA (business partners)	Perceived benefits of a wine tourism marketing alliance: branding, visitor traffic, business image, and regional promotion – assessed through IPA
Mikulić et al. (2012)	Wine fair	Croatia (emerging)	Extended neural network-based IPA	Attributes rated by visitors and exhibitors at a wine fair, including service quality, professionalism, location, and event size – combined stated and derived importance using neural network IPA
Singh & Hsiung (2016)	Wine region experience	USA (mature)	CSFs + visitor survey + IPA	Critical success factors in wine destination: wine quality, destination image, food and lodging, infrastructure, activities, and value – ranked via IPA
Stergiou et al. (2018)	Single winery visit by Gen Z	Greece (emerging)	Factor analysis + traditional IPA grid on winescape attributes	Winescape factors: cost considerations, wine & entertainment, destination attributes, service staff, and learning about wine – identified via factor analysis and mapped via IPA
Rašovská et al. (2020)	Wine region vs others	Czech Republic (emerging)	Survey + MANOVA + IPA	19 destination attributes such as cleanliness, staff knowledge, food quality, accessibility, and crowding – contrasted across wine and non-wine regions using IPA
Dias et al. (2023)	Wine regions and cellar visits	Portugal (mature)	PLS-SEM with IPMA; constructs include brand love, wine involvement, emotional & evaluative satisfaction, WOM intention	Emotional and evaluative satisfaction, brand love, wine involvement, and word-of-mouth intentions – mapped using Importance–Performance Matrix
Dias et al. (2024)	Winery visits / wine destination experience	Portugal (mature)	Structural equation modeling + IPA (brand love framework)	Factors contributing to brand love: active participation, place identity, place satisfaction, and relationship quality evaluated via IPA
Leyva-Hernández & Toledo-López (2024)	Wine region visitation intention	Mexico (emerging)	S-O-R model + IPMA	Constructs from S-O-R model: traditional gastronomy, electronic word-of-mouth (E-WOM), destination identity, intention to visit – evaluated through IPMA

APPENDIX 2: APPLICATIONS OF IMPORTANCE–PERFORMANCE ANALYSIS (IPA) IN FOOD TOURISM (SUMMARY BY STUDY)

Study	Country/Region	Focus	Context	IPA Elements / Attributes	Methodology
Kim & Lee (2010)	South Korea (Sangju province)	Consumer perceptions of food tourism properties	Regional tourism (macro)	Attractive landscapes, accommodation price, food fame, local specialty shops, climate; Four factors identified: convenience-stable, value-oriented, adventurous-aggressive, traditional-active	Survey, factor analysis, IPA
Kang & Lee (2010)	South Korea	Wellbeing fusion menus in restaurants	Restaurant menu development (micro)	Taste, sanitation, freshness, cleanliness of dishes, diet/vegetable/nutritional variety, organic food, menu distinction, price	Survey, IPA grid analysis
Obonyo et al. (2013)	Kenya (Western Tourist Circuit)	Food service attributes in gastro-tourism development	Hotel-based food services (macro)	Grouped into three: food service output, input, and process; emphasis on service delivery and quality	Survey of hotel managers, factor analysis, IPA
Pratt et al. (2020)	Thailand (Chiang Mai)	Cooking class experiences as third-generation food tourism	Experiential food tourism (micro)	Attributes include authenticity, educational value, host interaction, kitchen cleanliness, sensory engagement; compared using traditional IPA, IRPA and asymmetry analysis	Survey, IPA, IRPA, IAA
Smith & Costello (2009)	USA (international culinary event)	Customer satisfaction at a culinary event	Culinary event (macro/micro)	27 items including food/beverage price, event access, parking, food tasting; predictors of satisfaction	MANOVA, regression, IPA
Hwang (2019)	South Korea (Daegu Chimaek Festival)	Festival attributes in a food & beverage event	Food festival (macro)	Hygienic environment, taste & variety, food quality & service, purchase convenience; mapped across 22 detailed attributes	Survey (n=322), factor analysis, IPA
Su (2013)	Taiwan	Dining attributes for individual vs packaged tourists	Tourist dining experience (macro)	Hygiene, service quality, food quality, restaurant cleanliness, dining environment; quadrant comparison for tourist types	Survey (n=435), t-tests, IPA
Yurcu et al. (2020)	Turkey (Alanya)	Food service characteristics in accommodation enterprises	Hotel dining services (macro)	Cleanliness, speed, staff courtesy, menu presentation, service equipment, music/image; grouped into maintain/improve/low-priority zones	Survey (n=382), IPA
Zhao & Wang (2017)	China (Heilongjiang Province)	Tourist satisfaction with local cuisine (Longjiang cuisine)	Local culinary identity (macro)	Taste, aroma, freshness, nutritional value, food explanation, utensils, cultural depth; grouped in dominant/maintain/repair/vulnerable zones	Survey (n=180), IPA with quadrant analysis
Sangkaew et al. (2023)	Thailand (Phuket, Creative City of Gastronomy)	Tourists' perception of gourmet consumption	Urban culinary destination (macro)	Attributes include food authenticity, price fairness, cultural connection, aesthetic appeal, behavioral intentions	Survey, SEM + IPA



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Cross-Cultural Motivations for Non-Alcoholic Wine: Health, Halal, and Market Trends

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Abstract. Purpose: This paper examines cross-cultural motivations for non-alcoholic wine, focusing on how health and Halal-related attributes are cognitively translated into values and purchase intentions in Non-Muslim and Muslim-majority markets amid declining alcohol consumption. Design/methodology/approach: A sequential mixed-methods approach combines Means–End Chain (MEC) laddering interviews (n = 48) with PLS-SEM analysis of survey data (n = 350) across seven countries, integrating cultural, institutional, and behavioral perspectives within an a priori conceptual framework. Findings: In Muslim-majority contexts, Halal certification operates as a key institutional legitimacy cue linking product attributes to faith-based values, with brand trust mediating its effect on purchase intention. In Non-Muslim markets, health motivation and sensory acceptance dominate decision-making, while Halal certification shows no significant influence. Mediation results further indicate that health motivation partially transmits the effect of sensory acceptance on personal values. Originality: By embedding institutional legitimacy and cultural conditioning within MEC pathways, this study connects qualitative value structures with quantitative validation, addressing the fragmentation between health- and Halal-focused research streams. Research implications: Producers should adopt dual strategies, emphasizing health attributes in Non-Muslim markets and certified Halal legitimacy in Muslim-majority contexts.

Keywords: non-alcoholic wine, health motivation, halal certification, cross-cultural marketing, brand trust, muslim markets.

1. INTRODUCTION

The non-alcoholic wine industry is booming, fueled by changing consumer preferences in two key segments: health-conscious Non-Muslim markets and Halal-focused Muslim-majority ones. In places like Germany, Denmark, and Sweden, the “sober-curious” movement is driving demand for low-calorie, wellness-aligned alternatives to alcohol [1]. Meanwhile, in Malaysia, Indonesia, the UAE, and Iran – home to part of the 2.0 billion global Muslim population [2] – Halal certification is essential for compliance with Islamic dietary laws [3].

This paper uses Means-End Chain (MEC) theory and Partial Least Squares Structural Equation Modeling (PLS-SEM) in a mixed-methods design. Qualitative ladder interviews first uncovered attribute-consequence-value links, then quantitative surveys from 350 respondents validated these across cultures. Non-Muslim consumers focus on health and sensory aspects, while Muslim ones emphasize Halal legitimacy. These insights offer practical guidance for branding, trends, and regulations, supporting inclusive market growth.

2. LITERATURE REVIEW

2.1 Non- alcoholic wine market trends

Global alcohol consumption is declining, boosting non-alcoholic beverages as healthier options [4]. In Non-Muslim markets like Germany and Sweden, consumers seek low-calorie, heart-healthy wines that mimic traditional sensory experiences [1,5,16]. The market is projected to hit \$7.64 billion by 2035 at a 10.4% CAGR, with sparkling segments leading [6,7]. In Muslim-majority areas, Halal certification drives demand, with the Halal market reaching \$1.9 trillion by 2027 [8]. Challenges include regulatory bans, like Iran's "wine" terminology restriction [9].

2.2. Theoretical foundations

This study adopts Means-End Chain (MEC) theory as the central analytical spine [10], using attribute-consequence-value ladders to model how consumers cognitively translate product features into higher-order goals. Cultural dimensions [11] operate upstream of these ladders by shaping which attributes become salient in the first place: in Muslim-majority contexts, high uncertainty avoidance elevates Halal certification as a primary cue, whereas in Non-Muslim contexts, individualism amplifies health and sensory attributes. Institutional Theory [12] explains how Halal certification functions

as a legitimacy signal that reduces perceived risk and enables trust, thereby entering MEC ladders as a critical consequence node. The Theory of Planned Behaviour (TPB) [13] provides the downstream behavioral mechanism, linking these culturally conditioned value structures to purchase intention. In this way, culture conditions institutional meaning, institutional legitimacy feeds cognitive value chains, and these chains ultimately drive planned behavior. Rather than treating the theories additively, the framework specifies a sequential process from cultural context to institutional signals, from cognitive ladders to intention formation.

From this integrated framework, specific hypotheses can be derived regarding cross-cultural consumer behavior. In Muslim-majority contexts, where uncertainty avoidance is high and Halal certification functions as a key institutional signal [3, 11, 12], we hypothesize that Halal legitimacy will be a stronger driver of purchase intention than in Non-Muslim contexts (**H1**). Furthermore, we expect brand trust to mediate this relationship more strongly for Muslim consumers, as certification from trusted bodies (e.g., JAKIM) builds credibility that directly facilitates purchase decisions (**H2**).

Conversely, in Non-Muslim contexts characterized by individualism, health and sensory attributes align with personal wellness goals [1, 11, 14]. We therefore hypothesize that health motivation (**H3**) and sensory acceptance (**H4**) will have stronger effects on purchase intention for Non-Muslim consumers than for Muslim consumers. Brand trust is likewise expected to mediate these relationships more strongly in Non-Muslim markets, where brand reputation serves as a key heuristic for product quality in the absence of religious certification (**H5**).

These hypotheses provide a testable, a priori structure for the empirical analysis that follows, linking the theoretical constructs to measurable behavioral intentions across cultural groups.

Table 1. Key Constructs from Literature

Construct	Definition	Relevance to Study
Halal Legitimacy	Perception of product's Halal certification	Gatekeeper in Muslim markets
Health Motivation	Choosing non-alcoholic wine for health reasons	Drives secular market adoption
Sensory Acceptance	Acceptance of taste and aroma	Influences satisfaction
Social & Symbolic Fit	Fit in social and symbolic contexts	Enhances social acceptance
Brand Trust	Trust in brands offering non-alcoholic wine	Influences purchase intention
Personal & Cultural Values	Alignment with personal/cultural values	Shapes consumer preferences

2.3 Research gaps

Prior studies have often treated health and Halal motivations in isolation, with health-focused research dominating Non-Muslim contexts (e.g., emphasizing cardiovascular benefits and sensory mimicry in Western markets) and Halal compliance studies confined to Muslim-majority settings (e.g., focusing on certification as a regulatory hurdle) [3, 14]. This fragmentation persists due to disciplinary boundaries – consumer behavior research in wine economics has prioritized health-driven trends in affluent, individualistic societies [5], while Islamic marketing literature has emphasized religious legitimacy without cross-cultural quantification [3, 12]. This mixed-methods approach addresses these gaps by testing MEC ladders via PLS-SEM across groups, bridging qualitative depth with quantitative generalizability. Health benefits dominate Non-Muslim research, Halal in Muslim-focused work [3].

2.3.1 Detailed expansion

2.3.1.1 Quantitative cross-cultural studies

Qualitative research provides valuable context but often lacks the statistical rigor needed to generalize findings across diverse populations. By employing a mixed-methods approach, this study first analyzes MEC ladders qualitatively to uncover cultural meanings and then applies PLS-SEM to test these ladders quantitatively across seven countries.

2.3.1.2 Health benefits and market trends

In Non-Muslim markets, research emphasizes the health benefits of non-alcoholic wine, including low-calorie content and cardiovascular advantages [14]. These attributes align with the “sober-curious” movement, driving adoption among health-conscious consumers. This study extends this focus by comparing these motivations with those in Muslim-majority markets.

2.3.1.3 Halal certification in muslim-majority markets

In Muslim-majority markets, Halal certification enters consumer decision-making primarily as a legitimacy cue, linking product attributes to higher-order values such as faith and belonging. Within the MEC framework, Halal functions less as a technical standard and more as a symbolic assurance that enables trust and value alignment, ultimately shaping purchase intention [3,12]. This

study therefore models Halal legitimacy as a core cognitive attribute in Muslim contexts and empirically tests its downstream effects on behavioral intention.

2.4 Cultural context

Muslim-majority countries (e.g., Malaysia 61% Muslim) rely on Halal for trust and avoidance of uncertainty [11]. Non-Muslim ones (e.g., Sweden 80% Non-Muslim) prioritize individual health and sensory fit. In this study, ‘Non-Muslim’ refers specifically to respondents who self-identified as non-religious or agnostic in the survey, distinguishing them from other non-Muslim religious affiliations.

2.4.1 Muslim- majority countries

In Muslim-majority countries, cultural and religious norms play a pivotal role in shaping consumer behavior. For instance, Malaysia, Indonesia, the United Arab Emirates (UAE), and Iran have substantial Muslim populations, with Malaysia being approximately 61% Muslim, Indonesia around 87-90%, the UAE about 76% of the total population or 85% of citizens, and Iran nearly 99% [2]. From a cultural perspective, Muslim-majority countries tend to exhibit higher levels of uncertainty avoidance, which increases sensitivity to product authenticity and religious alignment [11]. This cultural orientation amplifies the salience of legitimacy cues in consumption decisions, distinguishing these markets from more individualistic Non-Muslim contexts.

2.4.2 Non- Muslim-majority countries

Conversely, Non-Muslim-majority countries such as Germany, Denmark, and Sweden emphasize individualism and personal preferences. In these countries, approximately 25% of the population in Germany, 12% in Denmark, and 29% in Sweden identify as unaffiliated [2]. Individualism, another cultural dimension identified by Hofstede (2001), drives a focus on personal health and sensory experiences. Consumers in these markets prioritize health benefits, such as low-calorie content and potential cardiovascular advantages, as well as sensory satisfaction, including taste and aroma.

The “sober-curious” movement, which values mindful drinking and healthier lifestyle choices, has gained significant traction in these Non-Muslim markets. This movement underscores a shift towards products that align with wellness-oriented values, making non-alco-

holic wines an attractive option for health-conscious consumers. The sensory experience of non-alcoholic wines, which closely mimics traditional alcoholic wines, also plays a crucial role in their acceptance. Sensory mimicry ensures that consumers do not compromise on taste and aroma, making non-alcoholic wines a viable alternative for social and celebratory occasions.

2.4.3 Divergent adoption patterns

The cultural differences between Muslim-majority and Non-Muslim-majority countries are reflected in the dataset and explain the divergent adoption patterns of non-alcoholic wines. In Muslim-majority markets, Halal certification is a prerequisite for product acceptance, and variations in certification processes can pose challenges for producers. For example, different countries may have distinct Halal certification standards, requiring producers to navigate complex regulatory landscapes to ensure compliance [3].

In contrast, Non-Muslim-majority markets prioritize health benefits and sensory satisfaction. Producers in these markets must focus on developing products that meet consumer expectations for taste, aroma, and health benefits. Marketing strategies in Non-Muslim markets often emphasize the health and sensory advantages of non-alcoholic wines, positioning them as part of a broader wellness lifestyle.

Understanding the cultural context is essential for developing effective marketing strategies and ensuring the successful adoption of non-alcoholic wines. In Muslim-majority countries, the emphasis on Halal certification underscores the importance of religious compliance and trust. In Non-Muslim-majority countries, individualism drives a focus on health benefits and sensory satisfaction. By addressing these cultural differences, producers can tailor their products and marketing efforts to meet the distinct needs and preferences of consumers in each market, contributing to the sustainable expansion of the non-alcoholic wine industry.

2.5 Regulatory context

Separately from cultural motivations, the regulatory environment for non-alcoholic wine varies substantially across Muslim-majority countries, with fragmented Halal certification systems and inconsistent labeling requirements [9,15]. These institutional differences create operational barriers for producers and complicate cross-border market access, independent of consumer-level value structures.

2.5.1 Variations in halal certification standards

Halal certification standards differ significantly between countries, creating a fragmented regulatory environment. For instance, Malaysia's JAKIM (Jabatan Kemajuan Islam Malaysia / Department of Islamic Development Malaysia) and the UAE's ESMA (Emirates Authority for Standardization and Metrology) each have their own unique requirements and processes for certifying products as Halal. Additionally, the Gulf Standardization Organization (GSO) 2055-2 standard, which outlines general requirements for Halal certification bodies, is recognized across all Gulf Cooperation Council (GCC) member states – United Arab Emirates, Saudi Arabia, Qatar, Kuwait, Bahrain, Oman – and Yemen [15]. This standard is critical for businesses aiming to access these markets, which have a growing demand for certified Halal products. According to the Director of the Halal Trade and Marketing Centre in the UAE (T. Guerrero, personal communication, 2024),

for a beverage to be considered Halal in the UAE, it must contain less than 0.5% alcohol, and only products with 0.0% alcohol can be labeled as “alcohol-free” as per UAE law.

The GCC's Halal food and beverage market is valued at about \$60 billion, or 4.7% of the global total. Due to agricultural limitations, the region imports nearly 70% of its food and beverages [8]. The UAE serves as a strategic hub for Halal product production, distribution, and marketing, not only for the GCC but also for neighboring countries like Turkey, India, and Egypt. For example, companies like Red Bull have established operations in the Dubai Airport Free Zone, leveraging its facilities and tax incentives to serve the region's 57 million inhabitants, predominantly Muslim consumers [8]. These variations and opportunities necessitate producers to navigate a complex web of regulations, which can be both time-consuming and resource-intensive.

2.5.2 Iran's terminology ban

Iran, with its significant Muslim population, has implemented a ban on the use of the term “wine” for non-alcoholic products. This regulatory measure requires producers to use alternative labels, such as “grape beverage” or “fruit juice,” to comply with local regulations [9]. The Iran National Standards Organization (2024) has clarified this stance in response to inquiries about Halal certification for non-alcoholic wine, stating:

In the Islamic Republic of Iran, the term 'wine' is strictly defined as an alcoholic beverage, and 'non-alcoholic wine' holds no recognized status under national standards. According to SMIC1, titled Halal Food Production, the manufacture, distribution, and consumption of any product labeled as wine, even if it contains no alcohol, is deemed incompatible with the standard's principles. Furthermore, in accordance with SMIC24, Clause 4-2-6, any Flavouring agents which mimic non-halal products are considered as non-halal even it is produced from halal material, example: different pig meat flavours, liquor and champagne flavours... etc. For the production of Halal beverages, adherence to national standards is mandatory to ensure that both the production process and the final product are devoid of any religious ambiguities. In the event that the term 'wine' is replaced with 'fruit juice,' the product must fully comply with national standards specific to fruit juices to be eligible for Halal certification."

To obtain Halal certification for a non-alcoholic beverage like German non-alcoholic wine in Iran, producers must follow a rigorous process overseen by INSO or an accredited Halal certification body. This typically involves submitting detailed documentation of ingredients, production processes, and supply chains to ensure no haram (forbidden) substances, such as alcohol or non-Halal animal derivatives, are present. The production facility must be inspected to verify compliance with Halal standards, including the absence of cross-contamination with non-Halal substances and adherence to strict hygiene protocols. Additionally, the product must be labeled appropriately (e.g., as "fruit juice" rather than "wine") and meet Iran's national standards for fruit juices, as outlined by INSO. Certification bodies accredited by INSO or recognized international organizations, such as those aligned with SMIC standards, conduct audits to ensure compliance. Such terminology bans and certification requirements are not unique to Iran; other countries with strict Islamic laws also prohibit the use of terms traditionally associated with alcoholic beverages, complicating the marketing and labeling of non-alcoholic wines.

2.5.3 Impact on market expansion

These regulatory differences and terminology bans create significant barriers for producers aiming to enter or expand within Muslim-majority markets. The lack of harmonized standards means that producers must often tailor their products and marketing strategies to meet the specific requirements of each country, increasing costs and complexity. This fragmentation also limits the potential for economies of scale, as producers cannot standardize their products across multiple markets.

2.5.4 Need for harmonized standards

To facilitate market expansion and enable producers to effectively target the 2.0 billion Muslim consumers, there is a pressing need for harmonized Halal certification standards and clear, consistent regulations. Harmonization would simplify the certification process, reduce compliance costs, and enhance consumer trust by ensuring uniformity in product standards. Clear regulations would also help producers navigate the complex landscape more efficiently, ultimately promoting the growth and acceptance of non-alcoholic wines in Muslim-majority regions.

The regulatory context for non-alcoholic wine is marked by significant variations in Halal certification standards and terminology requirements, creating substantial challenges for producers. Harmonizing these standards and establishing clear, consistent regulations are essential steps towards facilitating market expansion and ensuring the successful adoption of non-alcoholic wines in Muslim-majority regions. By addressing these regulatory complexities, producers can better navigate the evolving landscape, ultimately contributing to the sustainable growth of the non-alcoholic wine industry.

3. METHODOLOGY

3.1 Research design

A sequential mixed-methods design was used: qualitative MEC laddering interviews (n=48, even across seven countries) built HVMs, informing a quantitative survey analyzed via PLS-SEM (n=350).

3.1.1 Qualitative phase – laddering interviews

In the qualitative phase, we conducted laddering interviews with 48 consumers, evenly distributed across the seven countries included in the study: Germany, Denmark, Sweden, Malaysia, Iran, Indonesia, and the United Arab Emirates. Participants were selected based on their prior consumption of non-alcoholic wine and their willingness to participate in an in-depth interview. Using Means-End Chain (MEC) theory, the interviews elicited links between product attributes (e.g., Halal certification, sensory quality), consequences (e.g., trust, health motivation, social symbolism), and values (e.g., faith, wellness, belonging). For example, a typical laddering chain in a Muslim-majority context might start with the attribute "Halal-certified label," leading to the consequence "ensures religious compliance and reduces doubt," and culminating in the value "strengthens faith

and community belonging.” Interviews were audio-recorded, transcribed, and coded independently by two researchers using content analysis, with inter-coder reliability assessed via Cohen’s kappa ($\kappa = 0.82$). Cut-off levels for HVM construction were set at a minimum of 4 mentions per link to ensure meaningful representation, following established MEC guidelines. Discrepancies in coding were resolved through discussion. These data were analyzed to construct Hierarchical Value Maps (HVMs), which visually depict the cognitive structures underlying consumer motivations. The constructs and pathways identified in this phase were used to design the questionnaire for the quantitative survey.

3.2 Data collection

To ensure cultural sensitivity in data collection, we adapted the survey questions to account for cultural nuances. For example, in Muslim-majority countries, questions related to Halal certification were framed to align with religious contexts. Measurement invariance across groups was assessed using the MICOM (Measurement Invariance of Composite Models) procedure in SmartPLS 4, confirming configural invariance and partial metric invariance, which supports valid multi-group comparisons.

The quantitative data were analyzed using PLS-SEM in SmartPLS 4, with 5,000 bootstrap resamples for significance testing. Mediation effects were tested via bootstrapping, revealing partial mediation in key paths (e.g., health motivation partially transmits the effect of sensory acceptance on personal values, as indicated by significant indirect effects with 95% CIs not crossing zero).

3.2.1 Survey administration

The questionnaire was distributed through online panels, targeting adults aged 18 to 66. This age range was chosen to capture a broad spectrum of consumer preferences and behaviors, reflecting the diverse demographics of non-alcoholic wine consumers. The online panel approach ensured a wide reach and facilitated the collection of data from a geographically dispersed sample. However, this method may introduce limitations related to sample selection bias. It potentially overrepresents individuals who are digitally literate and underrepresents those with limited internet access. This is particularly true in rural or lower-income areas of Muslim-majority countries, such as Indonesia.

3.2.2 Demographic information

The questionnaire included a comprehensive set of demographic questions to capture the respondents’ background and characteristics. These questions covered:

- Age: To understand the age distribution of non-alcoholic wine consumers.
- Gender: To identify any gender-specific preferences or behaviors.
- Religion: To segment respondents based on their religious affiliations, which is particularly relevant in the context of Halal certification.
- Education: To assess the educational background of respondents, which can influence consumer awareness and preferences.
- Occupation: To understand the professional background of respondents, which may correlate with lifestyle choices and purchasing power.
- Cultural Background: To capture the cultural context of respondents, which can influence their attitudes towards non-alcoholic wine.
- Prior Use: To determine whether respondents had previously consumed non-alcoholic wine.
- Use Frequency: To assess how often respondents consume non-alcoholic wine, providing insights into consumer habits.

3.2.3 Segmentation

To facilitate a detailed analysis of consumer motivations, respondents were segmented based on their religious affiliations:

- Muslim: Respondents who identified as Muslim (coded as 1) and those who did not (coded as 0).
- Non-Muslim: Respondents who identified as Non-Muslim or non-religious (coded as 1) and those who identified with other religious affiliations (coded as 0).

This segmentation allowed for a comparative analysis of consumer motivations between Muslim and Non-Muslim markets, highlighting the distinct drivers in each cultural context.

Multi-group analysis was conducted using self-identified religion, resulting in 134 Muslim and 216 Non-Muslim respondents; these group sizes are applied consistently across all MGA results.

3.2.4 Iranian data

In the case of Iran, 33 out of 50 respondents reported having consumed non-alcoholic wine previously

(Prior_Use = Yes). This finding is notable given Iran's ban on the production and sale of wine, both alcoholic and non-alcoholic. The reported consumption likely reflects experiences abroad, where Iranian consumers have access to non-alcoholic wine products. This insight underscores the potential market demand in Iran, despite the regulatory restrictions. To assess the robustness of this subgroup, we conducted a sensitivity check by re-running the PLS-SEM analysis excluding Iranian respondents with prior use; results showed minimal changes in path coefficients ($\Delta\beta < 0.04$), confirming the stability of overall findings.

The data collection process was designed to capture a comprehensive and balanced dataset, ensuring that the study could effectively explore consumer motivations across diverse cultural and religious contexts. By targeting a broad age range and including detailed demographic questions, the study aimed to provide actionable insights for producers and policymakers seeking to expand the non-alcoholic wine market sustainably and inclusively.

3.3 Questionnaire design

Section A: Demographics (A1-A9). Section B: 27 Likert items (1-5 scale) on constructs like Halal legitimacy (B1-B4), health motivation (B5-B8), etc. Attention check (B28) flagged 9 failures, retained after sensitivity check.

3.4 Data quality

No missing values. Sensitivity analysis showed $\Delta\beta < 0.03$. Demographics summarized in Table 2 (e.g., mean ages 40-49, balanced genders, education varying).

Table 2. Demographic characteristics.

Country	N	Mean age	Gender (M/F/Other)	Religion (Muslim/Secular/Other)	Education (Bachelor's+)
Germany	50	45	25/24/1	10/35/5	30
Denmark	50	42	20/29/1	5/38/7	25
Sweden	50	40	22/27/1	5/40/5	35
Malaysia	50	48	20/29/1	45/3/2	20
Indonesia	50	46	25/24/1	48/0/2	25
UAE	50	47	22/27/1	43/5/2	20
Iran	50	49	20/29/1	40/8/2	15

3.4.1 Explanation of demographic characteristics

The Religion column reports counts for Muslim, Non-Muslim, and Other respondents. "Other" includes affiliations such as Christian, atheist, or unspecified religions. This segmentation focuses on the primary cultural groups relevant to the study while acknowledging diversity in religious affiliations.

- Germany: The sample included 50 respondents with a mean age of 45. The gender distribution was 25 males, 24 females, and 1 other. The religious distribution was 10 Muslim, 35 Non-Muslim, and 5 other respondents. Thirty respondents had a bachelor's degree or higher.
- Denmark: The sample included 50 respondents with a mean age of 42. The gender distribution was 20 males, 29 females, and 1 other. The religious distribution was 5 Muslim, 38 Non-Muslim, and 7 other respondents. Twenty-five respondents had a bachelor's degree or higher.
- Sweden: The sample included 50 respondents with a mean age of 40. The gender distribution was 22 males, 27 females, and 1 other. The religious distribution was 5 Muslim, 40 Non-Muslim, and 5 other respondents. Thirty-five respondents had a bachelor's degree or higher.
- Malaysia: The sample included 50 respondents with a mean age of 48. The gender distribution was 20 males, 29 females, and 1 other. The religious distribution was 45 Muslim, 3 Non-Muslim, and 2 other respondents. Twenty respondents had a bachelor's degree or higher.
- Indonesia: The sample included 50 respondents with a mean age of 46. The gender distribution was 25 males, 24 females, and 1 other. The religious distribution was 48 Muslim, 0 Non-Muslim, and 2 other respondents. Twenty-five respondents had a bachelor's degree or higher.
- UAE: The sample included 50 respondents with a mean age of 47. The gender distribution was 22 males, 27 females, and 1 other. The religious distribution was 43 Muslim, 5 Non-Muslim, and 2 other respondents. Twenty respondents had a bachelor's degree or higher.
- Iran: The sample included 50 respondents with a mean age of 49. The gender distribution was 20 males, 29 females, and 1 other. The religious distribution was 40 Muslim, 8 Non-Muslim, and 2 other respondents. Fifteen respondents had a bachelor's degree or higher.

The dataset used in this study is robust and free from missing values. The sensitivity analysis confirms

that the dataset is reliable, with negligible differences observed when comparing results from the full dataset and the subset excluding attention check failures. The demographic characteristics of the respondents provide a balanced and representative sample across the seven countries, ensuring that the study's findings are applicable to diverse cultural and religious contexts.

3.5 Analysis

To analyze the data and address the research question on cross-cultural drivers of consumer motivations for non-alcoholic wine, we employed a combination of advanced statistical techniques and theoretical frameworks. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) and Means-End Chain (MEC) theory.

3.5.1 PLS-SEM analysis

3.5.1.1 Software and model assessment

The PLS-SEM analysis was conducted using SmartPLS 4.0, a powerful tool for structural equation modeling. The model was assessed for reliability, convergent validity, and discriminant validity to ensure robust and reliable results. Prior to multi-group analysis, measurement invariance was tested using the MICOM procedure in SmartPLS, confirming partial measurement invariance (compositional invariance established, no significant differences in means or variances), allowing for valid group comparisons.

- Reliability: The composite reliability (CR) for all constructs was assessed, with values exceeding the recommended threshold of 0.7, indicating high internal consistency.
- Convergent Validity: The average variance extracted (AVE) for each construct was calculated, with values exceeding the recommended threshold of 0.5, confirming that the constructs explained a significant portion of the variance in the measured items.
- Discriminant Validity: The heterotrait-monotrait ratio (HTMT) was used to assess discriminant validity, with values less than the recommended threshold of 0.85, ensuring that the constructs were distinct from one another.

3.5.1.2 Structural paths and relationships

The structural paths within the PLS-SEM model were tested to identify significant relationships between

the constructs. The model provided insights into how different factors such as Halal legitimacy, health motivation, sensory acceptance, social and symbolic fit, brand trust, and personal and cultural values influence purchase intention.

3.5.1.3 Multi-group analysis

To identify cultural differences in consumer motivations, a multi-group analysis was conducted comparing Muslim ($n = 134$) and Non-Muslim ($n = 216$) respondents. This analysis allowed us to explore how cultural context influences the relationships between the constructs and purchase intention.

- Halal Legitimacy: In Muslim markets, Halal certification has a significant positive influence on purchase intention ($\beta = 0.31$, 95% CI [0.13, 0.49], $p < 0.001$), whereas in Non-Muslim markets the effect is not statistically significant ($\beta = 0.05$, 95% CI [-0.08, 0.18], p n.s.). This highlights the critical role of Halal certification as a context-dependent legitimacy cue in Muslim-majority countries.
- Health Motivation: In Non-Muslim markets, health motivation is a strong driver of purchase intention ($\beta = 0.55$, 95% CI [0.31, 0.79], $p < 0.001$), with a weaker but still significant effect in Muslim markets ($\beta = 0.18$, 95% CI [0.04, 0.32], $p < 0.05$). This underscores the prominence of health-related motivations in Non-Muslim markets, where consumption decisions align more strongly with wellness-oriented value systems.

3.5.1.4 MEC quantification

To further understand the underlying motivations, Means-End Chain (MEC) theory was applied. Hierarchical Value Maps (HVMs) were used to visualize the attribute-consequence-value (A-C-V) ladders, providing a detailed understanding of how product attributes translate into consumer values.

- Muslim Markets: The MEC analysis revealed that “Halal-certified” attributes lead to “Religious compliance” consequences, which in turn align with “Faith” values. For example, in Malaysia, 80% of respondents linked Halal certification to their core values.
- Non-Muslim Markets: In contrast, “Alcohol-free” attributes lead to “Health benefits” consequences, which align with “Wellness” values. For instance, in Germany, 75% of respondents linked health benefits to their purchase intentions.

The analysis using PLS-SEM and MEC theory provided a comprehensive understanding of consumer motivations for non-alcoholic wine across different cultural contexts. The multi-group analysis highlighted significant cultural differences, with Halal certification being a critical factor in Muslim-majority markets and health motivation being a key driver in Non-Muslim markets. The MEC analysis further elucidated the underlying cognitive processes, revealing how product attributes translate into consumer values. These findings offer actionable insights for producers and policymakers seeking to expand the non-alcoholic wine market sustainably and inclusively.

4. FINDINGS

4.1 Qualitative findings: MEC laddering and HVMs

Interviews showed Muslim consumers linking Halal to trust and faith; Non-Muslim ones to health and wellness. Brand trust bridged attributes to values (see Figures 1-3 for integrated HVMs). The qualitative phase also revealed mechanisms for building trust in Halal certification, such as reliance on credible institutions (e.g., JAKIM), concerns about fraud (mentioned by 15% of Muslim respondents), and the need for familiar logos and transparent information to enhance legitimacy.

4.2 Quantitative findings: PLS-SEM

The survey dataset ($n = 350$) was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The measurement model met established reliability and validity thresholds ($CR > 0.70$, $AVE > 0.50$, $HTMT < 0.85$). The structural model explained 48% of the variance in purchase intention ($R^2 = 0.48$).

Key results:

- Muslim consumers: Halal legitimacy has a significant positive effect on purchase intention ($\beta = 0.31$, 95% CI [0.13, 0.49], $p < 0.001$), with brand trust acting as a key mediator. Health motivation also contributes ($\beta = 0.18$, 95% CI [0.04, 0.32], $p < 0.05$), while sensory acceptance is not a significant direct driver in this group ($\beta = -0.09$, n.s.).
- Non-Muslim consumers: Among Non-Muslim respondents, health motivation emerges as the dominant predictor of purchase intention ($\beta = 0.55$, 95% CI [0.31, 0.79], $p < 0.001$), with brand trust mediating this relationship. Sensory acceptance does not have a significant direct effect ($\beta = 0.12$, n.s.), operating indirectly through health motivation as shown

in the mediation analysis. Halal legitimacy shows no significant influence in this group ($\beta = 0.05$, n.s.). Interpreted through Institutional Theory and MEC [10,12], this null result suggests that in secular contexts Halal certification does not function as a meaningful legitimacy signal, remaining cognitively peripheral to value formation. Instead, purchase decisions are primarily organized around wellness-oriented consequences and experiential product attributes, consistent with individualistic consumption norms [11,14].

- Multi-group analysis (MGA): Permutation tests confirmed significant cross-group differences in the effects of Halal legitimacy ($\Delta\beta = -0.26$, $p < 0.05$) and health motivation ($\Delta\beta = +0.37$, $p < 0.01$).

4.3 Mixed- methods integration

By integrating the HVMs from the laddering phase with the path coefficients from the survey, the results demonstrate that:

- Qualitative ladders revealed the structure of consumer meaning systems, while PLS-SEM quantified their predictive strength.
- The Muslim HVM (Halal legitimacy $\rightarrow$ trust $\rightarrow$ faith $\rightarrow$ purchase intention) was validated statistically.
- The Non-Muslim HVM (sensory/health attributes $\rightarrow$ wellness/social fit $\rightarrow$ identity $\rightarrow$ purchase intention) was also supported by the PLS results.
- In both groups, brand trust operated as a bridge from attribute-level evaluations to higher-order values, reinforcing the managerial importance of credible branding.

4.4 Descriptive statistics

The descriptive statistics provide an overview of the mean scores for each construct across the seven countries included in the study. These scores highlight the varying levels of importance attributed to different aspects of non-alcoholic wine consumption, reflecting cultural differences. Table 3 presents the mean scores for key constructs across the seven countries, highlighting cultural differences in consumer motivations for non-alcoholic wine.

In Muslim-majority countries (Malaysia, Indonesia, UAE, Iran), Halal Legitimacy scores are notably higher (e.g., Malaysia: $M = 4.5$), reflecting the critical role of Halal certification in product acceptance. In contrast, Non-Muslim countries (Germany, Denmark, Sweden) show higher Health Motivation scores (e.g., Denmark: M

Table 3 Mean Scores by Construct and Country.

Construct	Germany	Denmark	Sweden	Malaysia	Indonesia	UAE	Iran
Halal Legitimacy	3.2	3.0	3.1	4.5	4.4	4.3	4.2
Health Motivation	4.1	4.3	4.0	3.5	3.4	3.6	3.3
Sensory Acceptance	4.0	3.8	4.1	3.2	3.3	3.4	3.1
Purchase Intention	3.8	3.9	3.7	3.5	3.4	3.6	3.2

= 4.3), indicating a strong preference for health benefits. Sensory Acceptance scores are relatively consistent, with Sweden scoring highest ($M = 4.1$) and Iran lowest ($M = 3.1$), suggesting varying emphasis on sensory attributes. Purchase Intention scores are moderately consistent, with Germany ($M = 3.8$) showing stronger intent than Iran ($M = 3.2$), likely influenced by regulatory constraints in the latter.

Health Motivation scores are generally higher in Non-Muslim markets, reflecting a greater emphasis on health benefits. Denmark, for example, has a mean score of 4.3 for Health Motivation, indicating that health benefits are a significant driver for non-alcoholic wine consumption in this country. In contrast, Muslim-majority countries like Indonesia have lower mean scores for Health Motivation ($M = 3.4$), suggesting that while health benefits are still important, they are not as critical as Halal certification.

Sensory Acceptance scores are relatively consistent across countries, with slight variations reflecting cultural preferences. Sweden has the highest mean score for Sensory Acceptance ($M = 4.1$), indicating that sensory attributes such as taste and aroma are highly valued by consumers in this country. In contrast, Iran has the lowest mean score for Sensory Acceptance ($M = 3.1$), suggesting that sensory attributes may be less of a priority in this market.

Purchase Intention scores are also consistent across countries, with slight variations reflecting cultural differences in consumer behavior. Germany has a mean score of 3.8 for Purchase Intention, indicating a moderate level of intention to purchase non-alcoholic wine. In contrast, Iran has the lowest mean score for Purchase Intention ($M = 3.2$), suggesting that while there is interest in non-alcoholic wine, purchase intentions may be influenced by regulatory restrictions and cultural norms.

The descriptive statistics highlight significant cultural differences in consumer motivations for non-alcoholic wine. Muslim-majority countries place a higher emphasis on Halal certification, while Non-Muslim countries prioritize health benefits. Sensory acceptance and purchase intention scores are relatively consistent across countries, with slight variations reflecting cultural pref-

erences and regulatory environments. These findings underscore the importance of understanding cultural contexts in developing effective marketing strategies for non-alcoholic wine.

4.5 Measurement model

Reliable (Cronbach's α 0.77-0.88; CR 0.87-0.93; AVE 0.65-0.76; HTMT <0.85) (Table 4). Sensitivity confirmed robustness.

Discriminant validity was assessed to ensure that the constructs are distinct from one another. The results are as follows:

- Heterotrait-Monotrait Ratio (HTMT): The HTMT values were all below the recommended threshold of 0.85, ensuring that the constructs are distinct and not overlapping. This confirms that the constructs are measuring different underlying concepts.

To further validate the robustness of the measurement model, a sensitivity analysis was conducted. The analysis compared the results obtained from the full dataset of 350 respondents with those obtained from a subset of 341 respondents, excluding the 9 respondents who failed the attention check. The results showed negligible differences, with changes in the beta coefficients ($\Delta\beta$) being less than 0.03. This confirms that the dataset is robust and that the exclusion of the 9 respondents does not significantly impact the study's findings.

Table 4. Measurement Model Assessment (Composite Reliability, AVE, HTMT).

Construct	Items	CR	AVE	HTMT (max)
Halal Legitimacy	4	0.92	0.73	0.62
Health Motivation	4	0.89	0.68	0.59
Sensory Acceptance	4	0.88	0.65	0.57
Social Symbolism	5	0.91	0.71	0.64
Brand Trust	4	0.90	0.69	0.61
Personal Values	3	0.87	0.69	0.60
Purchase Intention	3	0.93	0.76	0.63

The measurement model used in this study is robust and reliable, with high internal consistency and adequate convergent and discriminant validity. The sensitivity analysis further confirms the robustness of the dataset, ensuring that the results are reliable and valid. These findings provide a solid foundation for the subsequent analysis and interpretation of the data.

4.6 Structural model

The structural model was developed to examine the relationships between the key constructs and their influence on purchase intention. The model was estimated using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. The results provide valuable insights into the factors driving consumer motivations for non-alcoholic wine across different cultural contexts.

4.6.1 Model fit and key paths

The structural model explained 48% of the variance in Purchase Intention ($R^2 = 0.48$), indicating a good fit and substantial explanatory power. The key paths vary by cultural group, as detailed in Table V, with the following highlights:

- Halal Legitimacy → Purchase Intention: In Muslim-majority contexts, the path coefficient ($\beta = 0.31$, 95% CI [0.13, 0.49], $p < 0.001$) indicates a significant positive influence of Halal Legitimacy on Purchase Intention; this effect is non-significant in Non-Muslim contexts ($\beta = 0.05$, 95% CI [-0.08, 0.18], p n.s.).
- Health Motivation → Purchase Intention: In Non-Muslim markets, the path coefficient ($\beta = 0.55$, 95% CI [0.31, 0.79], $p < 0.001$) indicates a strong positive influence of Health Motivation on Purchase Intention; the effect is weaker but significant in Muslim contexts ($\beta = 0.18$, 95% CI [0.04, 0.32], $p < 0.05$).

- Mediation Effect: Mediation analysis using bootstrapping (5,000 resamples) indicates a complementary partial mediation effect, whereby Health Motivation transmits part of the influence of Sensory Acceptance to Personal Values (indirect $\beta = 0.32$, 95% CI [0.19, 0.45], $p < 0.01$; direct $\beta = 0.21$, $p < 0.05$). Interpreted through the MEC framework [10], this pattern suggests that favorable sensory evaluations do not translate into value alignment on their own; instead, sensory acceptance becomes behaviorally meaningful when it is cognitively reframed as supporting personal wellness. Importantly, Sensory Acceptance does not exert a direct effect on Purchase Intention but operates indirectly through Health Motivation. In individualistic contexts characterized by health-oriented consumption norms [11,14], health motivation thus functions as a key consequence node linking product experience to identity-related values.

Table 5 reports standardized path coefficients, 95% confidence intervals, and permutation-based multi-group comparisons for Muslim ($n = 134$) and Non-Muslim ($n = 216$) samples, enabling direct assessment of cross-cultural differences.

4.6.2 Multi-group analysis

To further explore cultural differences, a multi-group analysis was conducted comparing Muslim ($n = 134$) and Non-Muslim ($n = 216$) respondents. Table V reports standardized path coefficients, 95% confidence intervals, and permutation-based multi-group comparisons, enabling direct assessment of cross-cultural differences.

- Halal Legitimacy: The effect of Halal Legitimacy on Purchase Intention is significant and substantially stronger among Muslim respondents ($\beta = 0.31$, 95% CI [0.13, 0.49], $p < 0.001$), while it is not statistically significant among Non-Muslim respondents ($\beta = 0.05$, 95% CI [-0.08, 0.18], p n.s.). This result indi-

Table 5. Multi-Group structural model results.

Path	Muslim β	95% CI	p-value	Non-Muslim β	95% CI	p-value	$\Delta\beta$	p(MGA)
Halal Legitimacy → Purchase Intention	0.31	[0.13, 0.49]	<0.001	0.05*	[-0.08, 0.18]	n.s.	-0.26	<0.05
Health Motivation → Purchase Intention	0.18	[0.04, 0.32]	<0.05	0.55	[0.31, 0.79]	<0.001	+0.37	<0.01
Sensory Acceptance → Purchase Intention	-0.09*	[-0.21, 0.03]	n.s.	0.12*	[-0.05, 0.29]	n.s.	+0.21	n.s.
Personal Values → Purchase Intention	0.22	[0.08, 0.36]	<0.01	0.16	[0.04, 0.28]	<0.05	-0.06	n.s.

Note: Confidence intervals are based on 5,000 bootstrap resamples.

Multi-group differences ($\Delta\beta$) were assessed using permutation-based MGA. Non-significant paths included for comparability across groups.

cates that Halal certification functions as a context-dependent institutional signal, acting as a purchase driver in Muslim-majority markets but not in Non-Muslim contexts.

Appendix A, Figure 1 illustrates the path diagram for Muslim respondents, highlighting the role of Halal Legitimacy in shaping Purchase Intention.

- **Health Motivation:** The effect of Health Motivation on Purchase Intention is stronger in the Non-Muslim group ($\beta = 0.55$, 95% CI [0.31, 0.79], $p < 0.001$) compared to the Muslim group ($\beta = 0.18$, 95% CI [0.04, 0.32], $p < 0.05$). This pattern underscores the prominence of health-related motivations in Non-Muslim markets, where consumption decisions are more strongly aligned with wellness-oriented value systems.

Appendix A, Figure 2 shows the path diagram for Non-Muslim respondents, emphasizing the dominant role of Health Motivation.

4.6.3 Conceptual framework

The structural model empirically tests the hypotheses derived from the integrated theoretical framework in Section 2.2. Figure 3 presents the a priori conceptual framework derived from MEC theory and its integration with cultural, institutional, and behavioral perspectives, specifying the hypothesized pathways through which product attributes are cognitively translated into values and subsequently into purchase intention across cultural contexts.

The framework highlights the following key constructs and their relationships:

- **Halal Legitimacy:** The importance of Halal certification in Muslim-majority markets.
- **Health Motivation:** The role of health benefits in driving non-alcoholic wine adoption in Non-Muslim markets.
- **Sensory Acceptance:** The influence of sensory attributes (taste and aroma) on consumer acceptance.
- **Brand Trust:** The impact of brand reputation and trust on purchase decisions.
- **Social & Symbolic Fit:** The alignment of non-alcoholic wine with social and symbolic contexts.
- **Personal & Cultural Values:** The alignment of non-alcoholic wine with personal and cultural values.

Figure 4 in the Appendix provides a detailed path diagram for the overall sample, complementing the conceptual framework in Figure 3 by illustrating empirical relationships.

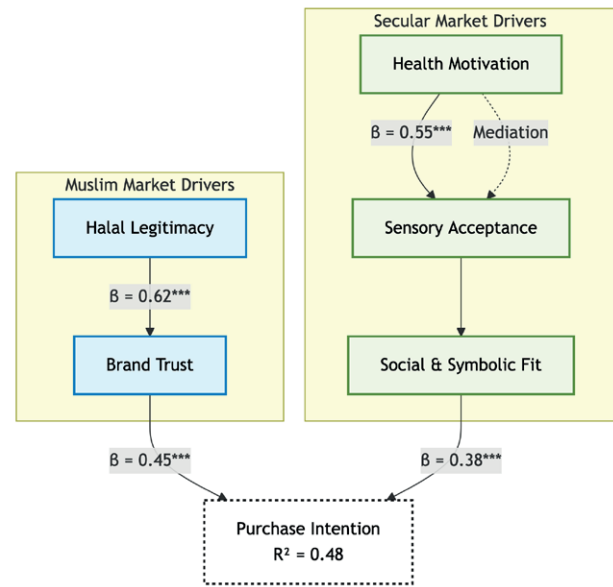


Figure 3. Conceptual Framework illustrating the relationships between key constructs and their influence on Purchase Intention.

The structural model and multi-group analysis provide a comprehensive understanding of the factors influencing consumer motivations for non-alcoholic wine across different cultural contexts. The results highlight the critical role of Halal certification in Muslim-majority markets and the importance of health benefits in Non-Muslim markets. The mediation effect of health motivation underscores the complex interplay between sensory acceptance and personal values. These findings offer actionable insights for producers and policymakers seeking to expand the non-alcoholic wine market sustainably and inclusively.

4.6.4 Map of study countries

To provide a visual representation of the cultural and religious profiles of the study countries, a map was created to highlight the distinct characteristics of each region. This map aids in understanding the geographical context and the cultural nuances that influence consumer motivations for non-alcoholic wine.

The map includes the following countries with annotations indicating their cultural and religious profiles:

- Germany, Denmark and Sweden: Non-Muslim-majority country with a focus on health and sensory satisfaction.
- Iran, Indonesia, Malaysia and UAE : Muslim-majority country with a focus on Halal certification and religious compliance.

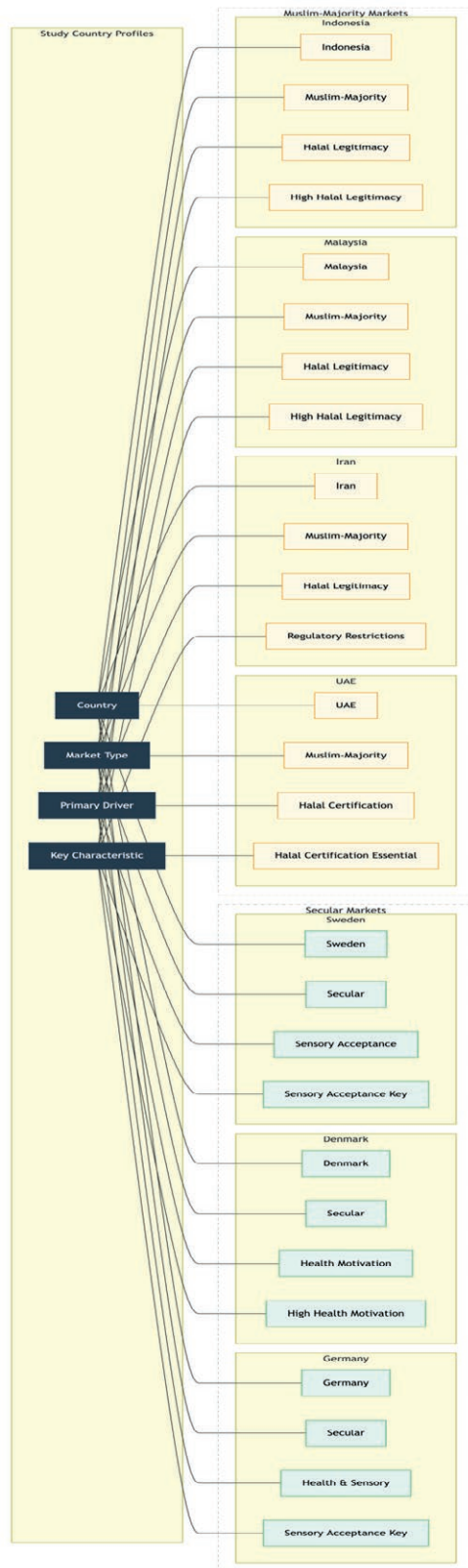


Figure 5. Map of Study Countries highlighting the cultural and religious profiles (Secular vs. Muslim-majority).

The map of study countries provides a clear visual representation of the cultural and religious profiles of the regions included in the study. This geographical context is essential for understanding the distinct consumer motivations and market dynamics in Non-Muslim and Muslim-majority markets. By highlighting these profiles, the map underscores the importance of tailoring marketing strategies to align with the specific cultural and religious contexts of each region.

4.7 Hierarchical value maps

Hierarchical Value Maps (HVMs) illustrate the attribute-consequence-value (A-C-V) ladders for non-alcoholic wine consumption in Muslim and Non-Muslim markets (Figure 9).

Figure 6 presents the Hierarchical Value Map for the overall sample, providing an integrated view of attribute-consequence-value ladders.

Muslim Markets: In Muslim-majority countries, the HVM links “Halal-certified” attributes to “Religious compliance” consequences, culminating in “Faith” values. For instance, in Malaysia, 80% of respondents connected Halal certification to their core values, underscoring its role as a gatekeeper for product acceptance.

Figure 7, shown in the Appendix, illustrates the Hierarchical Value Map for Muslim respondents, highlighting the Halal-certified → Religious compliance → Faith ladder.

Non-Muslim Markets: In Non-Muslim-majority countries, the HVM links “Alcohol-free” attributes to “Health benefits” consequences, aligning with “Wellness” values. In Germany, 75% of respondents tied health benefits to purchase intentions, highlighting the priority of health motivation.

Figure 8 in the Appendix shows the Hierarchical Value Map for Non-Muslim respondents, emphasizing the Alcohol-free → Health benefits → Wellness ladder.

Figure 9 illustrates A-C-V ladders for Muslim (Halal-certified → Religious compliance → Faith) and Non-Muslim (Alcohol-free → Health benefits → Wellness) markets.

Figures 1, 2, 4, 7, 8, and 10 have been moved to Appendix A to streamline the main text and reduce redundancy with Table 5.

4.8 Cross- country contrasts

The study reveals distinct consumer motivations across cultural contexts. In Western Non-Muslim markets (Germany, Denmark, Sweden), health motivation

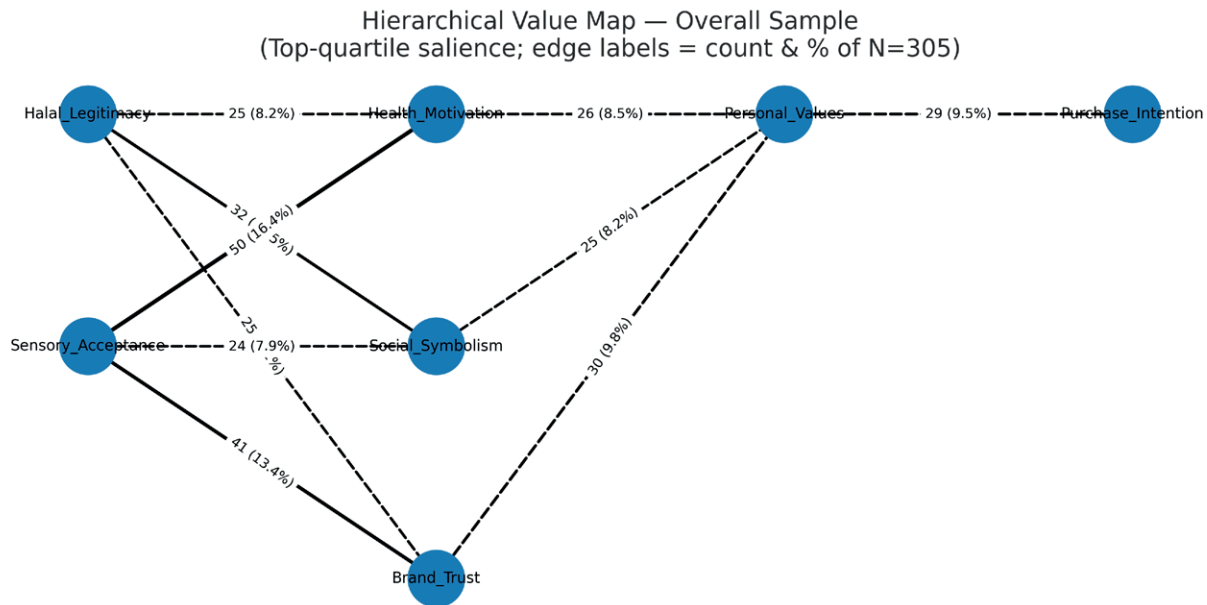


Figure 6. Hierarchical value map. Overall sample.

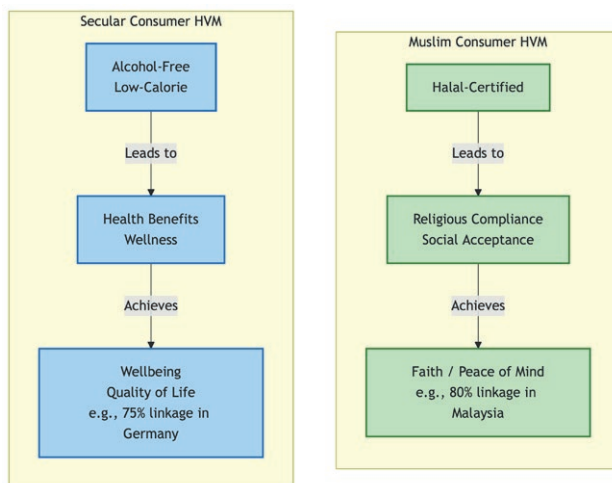


Figure 9. Hierarchical Value Maps (HVM).

drives non-alcoholic wine consumption, with sensory acceptance contributing indirectly through health benefits, reflecting individualistic values and the “sober-curious” movement. In Muslim-majority markets (Malaysia, Indonesia, UAE, Iran), Halal legitimacy is paramount, ensuring compliance with Islamic dietary laws. For example, despite Iran’s ban on wine terminology, travel-based responses indicate that Halal certification remains a key factor for Iranian consumers purchasing non-alcoholic wine abroad. These contrasts highlight the need

for tailored marketing strategies to address diverse consumer preferences.

Figure 10 in the Appendix integrates MEC ladders with predictive paths, illustrating how qualitative and quantitative findings converge to explain consumer motivations across cultural contexts.

5. DISCUSSION AND IMPLICATIONS

5.1 Academic contributions

This work extends MEC [10] to cross-cultural settings, blending with Hofstede’s Cultural Dimensions (2001), Institutional Theory [12], and Theory of Planned Behavior [13] for a holistic view. The integrated framework advances theory by demonstrating how cultural dimensions moderate institutional legitimacy signals (e.g., Halal) in shaping planned behaviors, offering a novel lens beyond prior fragmented applications.

This mediation structure empirically supports the MEC proposition that product attributes acquire motivational force only when cognitively translated into personally meaningful consequences [10].

5.1.1 Extension of MEC theory

The application of MEC theory in this study extends its use beyond traditional marketing contexts to explore

cross-cultural and religious differences in consumer motivations. By linking product attributes to consumer values through the lens of MEC, this study offers a nuanced understanding of how non-alcoholic wine attributes drive consumer values in both Non-Muslim and Muslim-majority markets. This extension of MEC theory provides a robust methodological approach for analyzing consumer behavior in diverse cultural contexts.

5.1.2 Integration of theoretical frameworks

The integration of Hofstede's Cultural Dimensions, Institutional Theory, and TPB enriches the understanding of consumer motivations by considering cultural, institutional, and behavioral factors. Hofstede's dimensions, particularly uncertainty avoidance and individualism, provide insights into how cultural contexts shape consumer preferences and decision-making processes. Institutional Theory highlights the role of Halal certification in ensuring product legitimacy in Muslim markets, while TPB underscores the influence of health beliefs and social norms on purchase intentions. This multi-theoretical approach offers a holistic view of consumer motivations, contributing to the broader literature on cross-cultural marketing.

5.1.3 Empirical findings and theoretical implications

The empirical findings of this study confirm the importance of cultural context in shaping consumer motivations. In Muslim-majority markets, the critical role of Halal certification aligns with high uncertainty avoidance and the need for religious compliance. In contrast, Non-Muslim markets prioritize health benefits and sensory satisfaction, reflecting individualistic values and a focus on personal well-being. These findings support the theoretical frameworks used and provide empirical evidence for the influence of cultural and religious contexts on consumer behavior.

The absence of Halal effects in Non-Muslim markets reinforces the context-dependence of institutional legitimacy cues, highlighting that certification only enters MEC ladders where it aligns with culturally embedded value systems.

This study's academic contributions lie in its extension of MEC theory to cross-cultural and religious contexts and the integration of multiple theoretical frameworks to explain consumer motivations. By providing a comprehensive analysis of consumer motivations for non-alcoholic wine, this research enhances the understanding of how cultural and religious contexts influence mar-

ket dynamics. These findings offer valuable insights for future research and contribute to the broader literature on cross-cultural marketing and consumer behavior.

5.2 Managerial implications

The findings of this study offer several actionable insights for managers and marketers aiming to expand the non-alcoholic wine market sustainably and inclusively. These implications are tailored to address the distinct motivations and preferences of consumers in both Non-Muslim and Muslim-majority markets.

5.2.1 Dual- branding strategies

To effectively target diverse consumer segments, dual-branding strategies are recommended:

In Non-Muslim markets, campaigns that emphasize health benefits and sensory satisfaction are likely to resonate strongly with consumers, for example by highlighting low-calorie or heart-healthy attributes. By contrast, in Muslim-majority countries, branding strategies must place Halal legitimacy at the center: certification logos should be prominently displayed, and in contexts such as Iran, alternative labels like "grape beverage" are necessary to comply with regulations while still conveying the product's nature.

5.2.2 Digital marketing initiatives

Leveraging digital platforms can enhance brand visibility and consumer trust:

Instagram influencers can be particularly effective in Muslim-majority markets, especially among younger consumers, provided that their endorsements are anchored in verifiable Halal certification. Prior research on Halal marketing and digital trust-building [3,12] supports the idea that trusted third-party signals enhance legitimacy. Thus, when influencers explicitly highlight certification or institutional endorsements, their impact on credibility and adoption is likely to be stronger.

5.2.3 Packaging innovations

Packaging plays a crucial role in communicating product attributes and aligning with consumer values:

In Non-Muslim markets, sensory-enhanced packaging that highlights taste and aroma can attract consumers by positioning non-alcoholic wine as a satisfying alternative to traditional products. For Muslim consum-

ers, by contrast, packaging should prominently display Halal certification logos, since clear visual confirmation of compliance with dietary laws reassures buyers and fosters acceptance.

The managerial implications derived from this study provide actionable strategies for expanding the non-alcoholic wine market. By adopting dual-branding strategies, leveraging digital marketing through social media influencers, and innovating packaging design, producers can effectively target diverse consumer segments. These strategies address the distinct motivations and preferences of consumers in Non-Muslim and Muslim-majority markets, contributing to the sustainable and inclusive growth of the non-alcoholic wine industry.

5.3 Policy implications

The findings of this study highlight several critical policy implications, particularly in the context of unlocking the significant potential of the 1.9 billion Muslim consumer market. These implications focus on the need for harmonized Halal standards and clear, consistent terminology for non-alcoholic products.

5.3.1 Harmonized halal standards

One of the most significant barriers to the expansion of the non-alcoholic wine market in Muslim-majority countries is the lack of harmonized Halal certification standards. Currently, different countries have their own certification bodies and standards, such as JAKIM in Malaysia and ESMA in the UAE. This fragmentation creates confusion for producers and consumers alike, leading to increased costs and complexities in the certification process.

Policymakers and regulatory bodies should work towards harmonizing Halal certification standards across countries by creating unified guidelines and criteria. Such streamlining would lower certification-related expenses and operational hurdles for producers, while building greater consumer confidence through uniform, reliable Halal benchmarks.

5.3.2 Clear and consistent terminology

Inconsistent terminology across jurisdictions is a practical barrier to consumer understanding and market access – for example, Iran’s statutory ban on the term “wine” requires alternative descriptors such as “grape beverage,” which can confuse cross-border consumers and traders [9]. Regulators should therefore promote clear, context-sensitive labeling frameworks that reconcile national legal constraints with consumer transparency: validated alternative descriptors (where “wine” is prohibited), harmonized ingredient/process disclosures, and agreed test thresholds for residual alcohol would minimize confusion and prevent misleading claims across markets [15].

Complementing labeling reform, targeted consumer-education initiatives co-designed with trusted local stakeholders (including religious and community leaders) can explain what “non-alcoholic” entails, clarify the role and limits of Halal certification, and responsibly communicate any health-related claims. Such culturally sensitive education campaigns are likely to boost understanding and reliability – particularly in markets less familiar with these product categories – and thus facilitate acceptance and market entry [3].

The policy implications of this study underscore the importance of harmonized Halal standards and clear, consistent terminology in unlocking the potential of the non-alcoholic wine market in Muslim-majority coun-

Table 6. Summary of managerial and policy implications.

Stakeholder	Target Market	Key Implication	Basis in Findings
Producers	Secular markets	Emphasize health benefits (low-calorie, heart-healthy) in branding, with sensory appeal supporting indirectly through health motivation.	Strong effect of Health Motivation ($\beta = 0.55$) on Purchase Intention; Sensory Acceptance was not a significant direct driver.
Producers	Muslim-majority markets	Obtain and prominently display recognized Halal certification; use compliant terminology (e.g., “grape beverage” in Iran).	Halal Legitimacy is a key driver ($\beta = 0.31$) and a prerequisite for trust in these markets.
Policymakers	Global/Muslim markets	Harmonize Halal certification standards and clarify labeling regulations for non-alcoholic products.	Fragmented standards increase costs; clear labels reduce consumer confusion [9,15].
Marketers	Muslim markets	Partner with trusted institutions (e.g., JAKIM) and use social-media influencers to highlight certification.	Qualitative findings show trust is built through credible institutions and transparent communication [3].

tries. By streamlining certification processes and advocating for standardized labeling practices, policymakers can reduce barriers to market entry and enhance consumer trust. These measures are crucial for the sustainable and inclusive expansion of the non-alcoholic wine industry, ensuring that it can effectively serve the needs of diverse consumer segments.

6. CONCLUSION

This study provides a comprehensive analysis of consumer motivations for non-alcoholic wine across diverse cultural contexts, confirming the distinct drivers in Non-Muslim and Muslim-majority markets. In Non-Muslim markets such as Germany, Denmark, and Sweden, health and sensory attributes are primary motivators, reflecting a preference for low-calorie, heart-healthy, and sensory-pleasing alternatives to traditional alcoholic beverages. Conversely, in Muslim-majority markets such as Malaysia, Indonesia, the UAE, and Iran, Halal legitimacy is paramount, underscoring the importance of religious compliance and certification in product acceptance.

6.1 Academic contributions

This research makes several significant academic contributions. By extending Means-End Chain (MEC) theory to cross-cultural contexts, the study offers a nuanced understanding of how product attributes translate into consumer values across different cultural and religious backgrounds. The integration of Hofstede's Cultural Dimensions, Institutional Theory, and the Theory of Planned Behavior (TPB) provides a robust theoretical framework for analyzing consumer motivations. This multi-theoretical approach enriches the literature on cross-cultural marketing and consumer behavior, offering a comprehensive lens through which to understand the complex interplay between cultural contexts and consumer preferences.

6.2 Practical implications

The findings provide actionable strategies for expanding the non-alcoholic wine market sustainably and inclusively. As detailed in Section 5.2, dual-branding strategies, digital marketing initiatives, and packaging innovations can effectively target diverse consumer segments. Additionally, harmonized Halal standards and clear, consistent terminology are critical for reducing certification and labeling barriers, enhancing consumer

trust, and unlocking the potential of the 1.9 billion Muslim consumer market.

7. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

While this study offers robust insights, it is limited to seven countries, potentially restricting generalizability; future work could expand to additional regions. The reliance on online panels may introduce selection bias, such as in Iran where the sample skews toward less religious respondents, as discussed in the methodology, and the cross-sectional design precludes causal inferences over time. Longitudinal studies could track changes in consumer adoption over time, providing insights into evolving preferences and market trends. Comparative analyses of urban versus rural consumers, leveraging variables such as occupation and education, could reveal differences in motivations and market opportunities. The impact of social media on consumer trust, particularly in the context of Halal certification, could be explored to understand how digital platforms influence consumer behavior. Finally, cross-cultural comparisons beyond the seven countries studied here could provide a broader perspective on global market dynamics and consumer preferences.

This study confirms the distinct drivers of non-alcoholic wine consumption in Non-Muslim and Muslim-majority markets, offering valuable insights for sustainable market growth. By extending MEC theory to cross-cultural contexts and providing actionable dual-branding and policy solutions, this research contributes to both academic and practical understandings of consumer motivations. Future research can build on these findings to explore longitudinal trends, urban-rural differences, the impact of social media, and cross-cultural comparisons, further enriching our knowledge of this evolving market.

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APPENDIX A

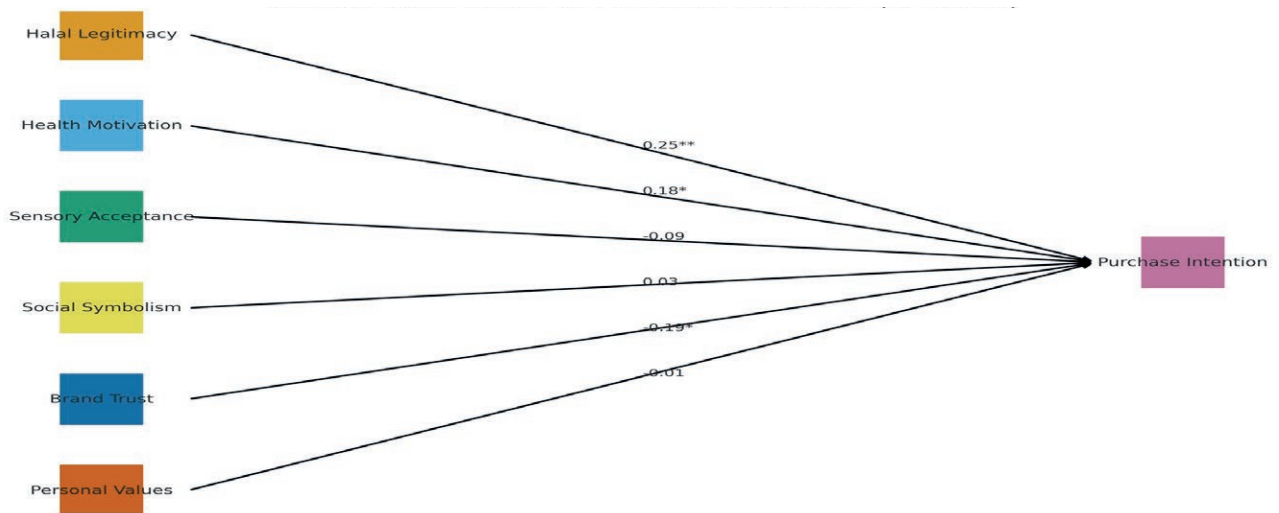


Figure 1. Path Diagram. Muslim respondents.

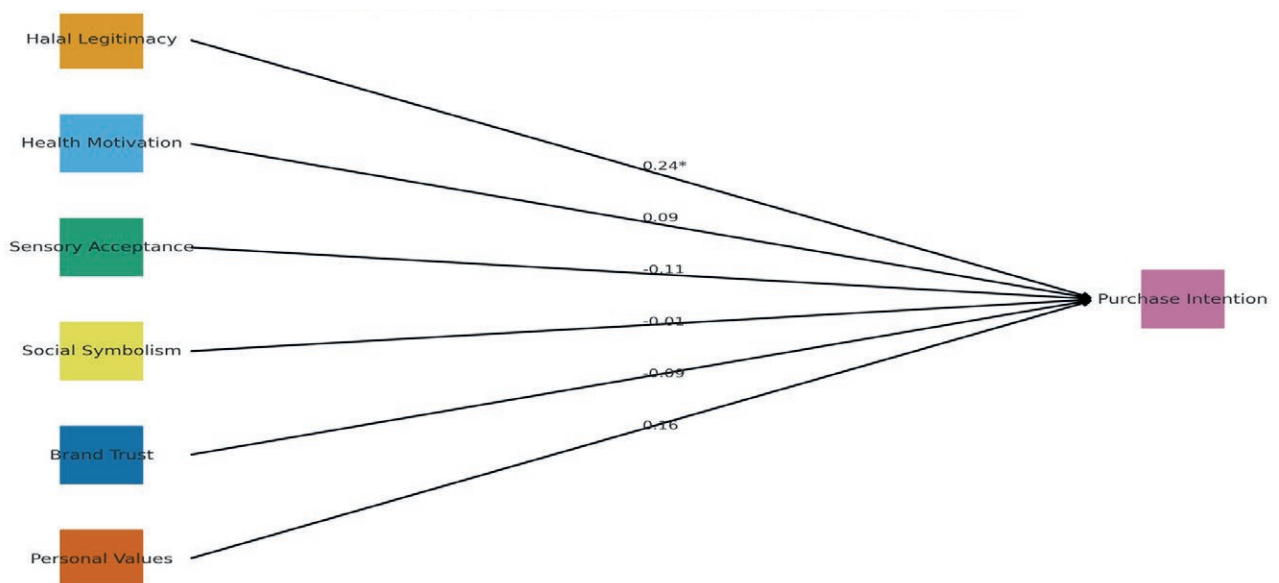


Figure 2. Path Diagram. Non-Muslim respondents.

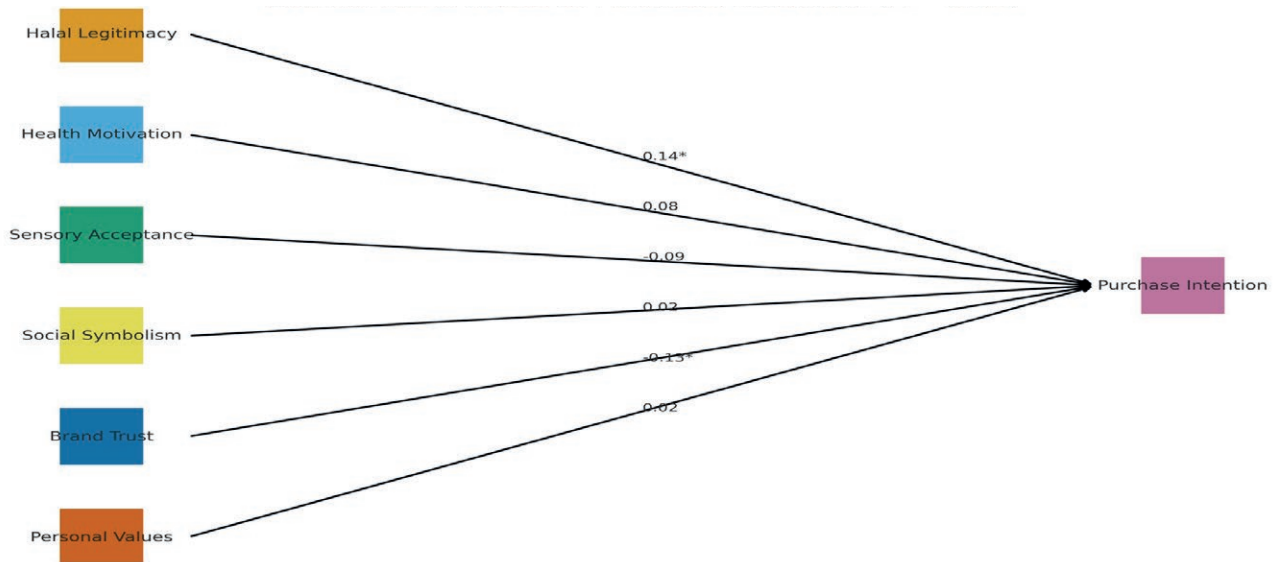


Figure 4. Path Diagram. Overall sample.

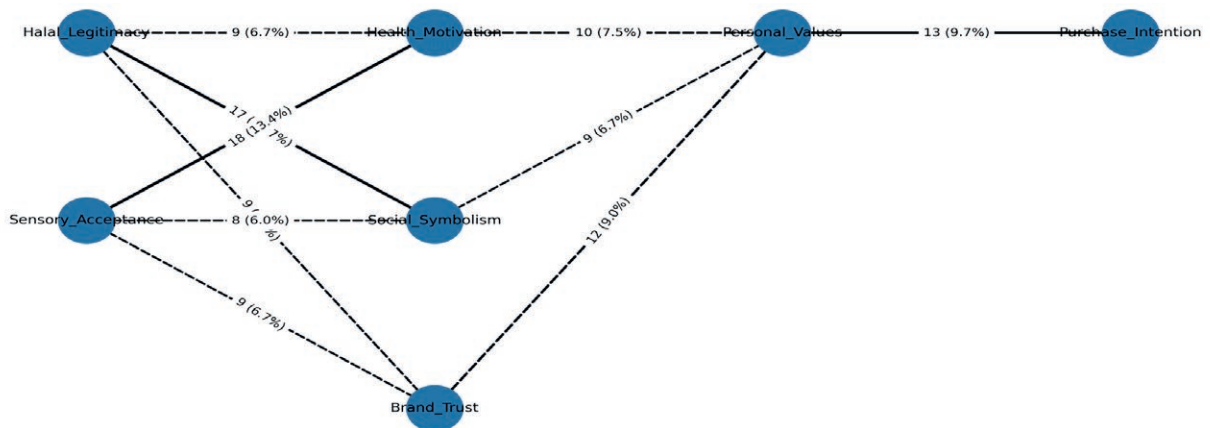


Figure 7. Hierarchical Value Map. Muslim respondents (N = 134).

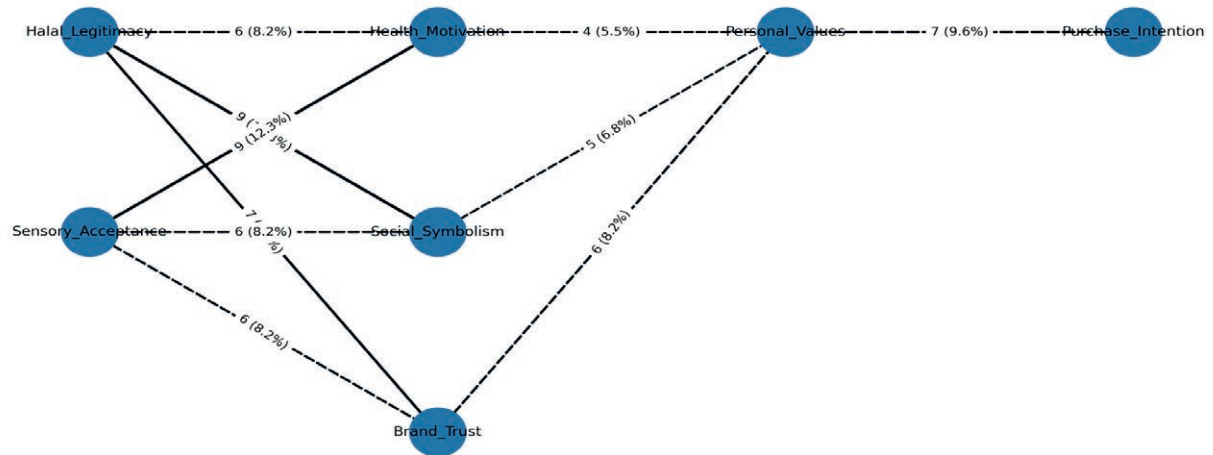


Figure 8. Hierarchical Value Map. Non-Muslim respondents (N = 216).

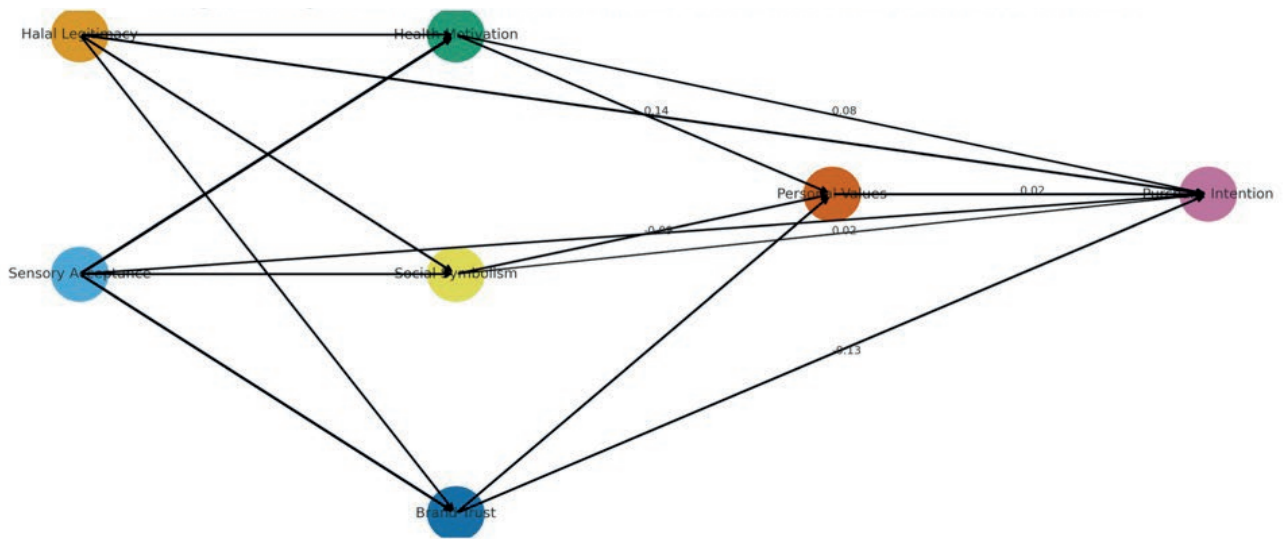


Figure 10. Integration Figure. MEC ladders and predictive paths.



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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Data Irregularities in Wine Sector Statistics: A Benford's Law Approach to the Portuguese Case

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Abstract. The wine industry plays an important role in many national economies, it combines agricultural production with cultural heritage and global trade. In Portugal, it contributes significantly to economic value, regional identity, and rural sustainability. As international wine markets become increasingly complex, the information from financial and production data is essential for regulation, policymaking, and economic analysis. Despite the growing emphasis on viticulture and market dynamics, the wine sector data anomalies have attracted only limited attention so far. This study introduces Benford's Law – a statistical method used to detect irregularities in naturally occurring datasets. Applying first- and second-digit Benford's Law tests to Portuguese wine industry data from 2014 to 2023, which includes company-level financial statements and wine production figures, the analysis reveals data irregularities. Nonconformity between empirical data and theoretical expectations refers to wine must production data and profit before tax. The irregularities must be explained in a further and more detailed survey. The study offers a novel application of Benford's Law in the wine sector.

Keywords: Benford's Law, wine production, reporting.

1. INTRODUCTION

The wine industry plays a central role in many national economies, combining agricultural production with cultural heritage, regional identity, and participation in global trade. In Portugal, where viticulture is deeply embedded in rural structures and economic activity, the availability of reliable financial and production data is essential for informed policymaking, regulatory oversight, and sectoral analysis. As wine markets become increasingly globalised and complex, the accuracy of reported figures – both at the firm level and in official production statistics – assumes strategic importance for tax administration, subsidy allocation, and market monitoring.

Although a substantial body of research has examined viticulture, oenology, climate impacts, and market behaviour, relatively little attention has been devoted to the quality and reliability of the numerical data underpin-

ning these analyses. It contrasts with other empirical fields, where data integrity assessment has become a standard component of validation. Benford's Law, which describes the expected logarithmic distribution of digits in many naturally occurring datasets, has been widely applied in areas such as forensic accounting, macroeconomic reporting, environmental monitoring, and financial market analysis to detect irregularities or patterns warranting further investigation [1, 2]. Its usefulness lies in its domain-independence and sensitivity to reporting errors, structural anomalies, and potential manipulation in large numerical datasets.

Given the wine sector's reliance on both firm-level accounting data and officially reported production statistics, it represents a particularly relevant yet largely unexplored context for applying Benford's Law. Existing empirical studies have focused mainly on macro-level agricultural aggregates or individual commodity markets, leaving open the question of whether digit distributions remain consistent across different types of wine-sector data and whether deviations may signal issues in reporting practices.

This study addresses this gap by examining the conformity of Portuguese wine-sector data with Benford's expected digit distributions. Using first- and second-digit tests evaluated through Mean Absolute Deviation (MAD) and the Kolmogorov–Smirnov (K–S) test and Chi-square test, the analysis covers company-level financial statements and official wine must production statistics for the period from 2014 to 2023. Rather than treating conformity as proof of data accuracy or deviations as evidence of manipulation, the study adopts a conservative perspective, using Benford-based diagnostics as indicators of potential irregularities that may merit closer scrutiny.

By integrating two distinct data sources within a single analytical framework, this research contributes to the literature on wine economics and agribusiness by introducing a systematic approach to assessing data quality. It provides empirical evidence on the consistency of reported figures in an economically significant and heavily regulated sector, highlighting the potential of Benford's Law as a complementary tool for enhancing transparency and confidence in sectoral data used for economic, regulatory, and scientific analyses.

The paper is structured as follows. Section 2 reviews the relevant literature and outlines the theoretical background and research gap. Section 3 describes the methodology and research sample. Section 4 presents and discusses the results, and Section 5 concludes the study.

2. LITERATURE REVIEW

2.1 Theoretical background

Research on the quantity of wine grapes and wine production provides fundamental insights into the functioning, efficiency, and resilience of the wine industry. Studies in this area address diverse issues such as yield optimisation, the economic implications of viticulture, tax policy, climate change, and market behaviour. The majority of research focuses on viticultural and oenological determinants of production volumes [3, 4], while relatively few studies investigate the economic and regulatory consequences of these patterns [5–7].

Among the studies addressing these interrelated factors, Anderson et al. [8] provide a comprehensive analysis of global wine production dynamics. They showed that climatic variability, technological progress, and economic cycles jointly determine production outcomes. Their findings highlight a general stabilisation of output in traditional European regions and faster growth in emerging markets such as South America and Asia. These observations support the notion that stable production promotes predictable market behaviour and aids in policy design.

Earlier work by Jones et al. [4] identified several critical factors affecting production, including vineyard management practices, technological innovation, and, in particular, climate change. Their study demonstrated how rising temperatures have led to shifts in vineyard locations and the adoption of adaptive techniques to maintain both yield and quality. More recently, Del Rey and Loose [9] explored the economic implications of global wine production trends, noting that fluctuations in production volumes have a pronounced effect on price volatility and trade flows.

While environmental and technological factors remain crucial determinants of production, a growing body of research highlights the influence of economic and institutional conditions on the performance and stability of the wine sector. Taxation policies also play an essential role in shaping production decisions and market competitiveness. Anderson and Pinilla [8] and Katunar et al. [10] examined how fiscal regulations influence production incentives, emphasising that well-structured and transparent data are indispensable for designing equitable tax systems. Behmiri et al. [5] further linked macroeconomic conditions – GDP growth, exchange rates, and agricultural policy – to production trends across the European Union. In parallel, Rickard et al. [6] investigated the effects of trade liberalisation on the EU and US wine markets, illustrating how the interaction

between international trade agreements and domestic regulations affects production stability.

Together, fiscal, macroeconomic, and trade factors define the context in which wine producers operate, although environmental conditions continue to play a decisive role in shaping production outcomes. Finally, Ashenfelter and Storchmann [3] discussed the economic implications of climate change, demonstrating how variations in temperature and precipitation influence grape yields, wine quality, and production costs.

Overall, these studies highlight the complex interplay of environmental, technological, and economic factors that determine wine production patterns. Understanding these interactions relies heavily on the availability of accurate and transparent production data. Yet, despite its importance, the usefulness of such data has rarely been evaluated systematically. To address this gap, statistical tools capable of identifying irregularities in numerical data can be applied, among which Benford's Law has proven particularly useful.

2.2 Quality data measures – Benford's law in real-world applications

Benford's Law describes the expected frequency of digits in naturally occurring numerical datasets. Rather than following a uniform distribution, the first digit in many datasets is disproportionately likely to be small – most commonly „1“ – with probabilities decreasing logarithmically for higher digits [11]. This statistical regularity arises in datasets that span several orders of magnitude and result from multiplicative or exponential processes.

Initially discovered in the natural sciences, this method has found widespread application in economics, finance, and environmental monitoring. For example, various geophysical datasets such as measurements of the Earth's geomagnetic field, earthquake depths, and seismic velocities have been shown to conform closely to Benford's distribution [1]. In economics, the method has become a cornerstone of forensic accounting, where it helps detect potential manipulation or fraud in financial statements [2,12]. Auditors routinely use Benford-based analyses of assets, liabilities, and revenues to identify anomalies that warrant further investigation [13,14].

Benford's Law has also been applied in emerging areas such as cryptocurrency analysis, where it helps identify suspicious transaction patterns [14]. In macroeconomics, it has been used to evaluate the plausibility of reported figures – such as GDP, inflation, and fiscal data – submitted by national governments to Eurostat, revealing significant irregularities in Greece's statistics [12]. Likewise, it has served as a diagnostic tool for validating

self-reported water-use data in the United States [15] and detecting anomalies in ecotoxicity datasets [1].

The versatility of Benford's Law lies in its simplicity and universality. Because it does not require prior assumptions about the data structure, it can be applied across disciplines to reveal inconsistencies that might otherwise remain unnoticed. Given its proven effectiveness in auditing and environmental monitoring, the method is well-suited to the validation of agricultural and production datasets, where manual reporting and aggregation often introduce potential errors. Despite its wide application, empirical research using Benford's Law in agriculture and the wine industry remains scarce: according to Web of Science database data, more than two hundred studies address its role in fraud detection and only a limited number focus on agricultural data (twelve studies such as Hanci [16], Suzuki et al. [17], Novovic et al. [18]) whereas only two refer to the wine sector [7,19].

2.3 Quality data measures – Benford's law in agricultural data

Benford's Law has increasingly been recognised as a valuable instrument for assessing the quality of numerical data in agriculture. As a statistical regularity describing the distribution of digits, it provides a straightforward yet powerful means of detecting irregularities and improving the quality of agricultural datasets.

Several empirical studies have explored its application in agricultural and related contexts. In the Philippines, Parreño [20] applied Benford's Law to crop production data – covering six major commodities, including bananas – using both Chi-squared and Mean Absolute Deviation (MAD) tests. The results confirmed that Benford's Law is applicable for evaluating data integrity and identifying inconsistencies in national agricultural statistics.

A detailed investigation by Hanci [16] extended this approach to official production data in Sri Lanka, encompassing multiple crop categories across several years. Employing first- and second-digit conformity tests, Hanci found that most datasets closely followed Benford's expected pattern, suggesting a generally reliable reporting system. However, moderate deviations in some manually reported crops indicated localised inconsistencies. Importantly, Hanci emphasised the preventive role of Benford's Law, arguing that its use could strengthen national data collection and monitoring practices.

Complementing these findings, a large-scale study conducted in China applied Benford's Law to agricultural and precipitation datasets spanning the period from 1951 to 2015. The analysis revealed a high degree of con-

formity between actual and expected digit distributions, confirming both internal consistency and robustness in long-term agricultural data [21]. Minor deviations were attributed mainly to transcription errors and incomplete time series, again demonstrating the method's diagnostic potential.

Beyond crop statistics, Benford's Law has also been successfully applied to fisheries and commodity markets. Noleto-Filho et al. [15] evaluated small-scale fisheries data in Brazil, discovering localised deviations caused by manual reporting, while Domínguez-Bustos et al. [22] used the method to detect structural shifts in tuna catch data following the introduction of total allowable catch (TAC) regulations. Similarly, Martínez-Sánchez [23] analysed Spanish almond prices, noting weaker conformity in first-digit tests but stronger alignment in second- and third-digit analyses. This outcome was attributed to the moderate variability of price data. This observation may also hold for the wine sector, where regional and quality constraints bound prices and production volumes.

Collectively, these studies demonstrate the adaptability and robustness of Benford's Law as a tool for assessing data irregularities in agriculture. However, most research has concentrated on single data sources or aggregate statistics, leaving open questions regarding the consistency between official datasets and firm-level financial data. This gap is particularly relevant for specialised branches of agriculture such as the wine industry, where both production statistics and firm-level accounting data are systematically collected and reported.

2.4 Research gap and contribution

While Benford's Law has been widely employed to assess the usefulness of data in various economic and agricultural contexts, its potential application within the wine industry has received little attention. This study, therefore, addresses that gap by examining whether the Law's expected digit patterns hold for both official production data and firm-level financial statements. Existing studies have focused on macro-level agricultural statistics, such as crop yields, production volumes, and fisheries data, confirming that Benford's distribution can serve as a valuable indicator of data integrity. However, no prior research has examined whether the same principles apply to a wine production sector that simultaneously produces official agricultural statistics and firm-level financial data.

The wine sector provides a particularly suitable context for such analysis. It combines highly regulated production environments with heterogeneous firm structures, varying from small family-owned vineyards to

large-scale cooperatives. Moreover, the coexistence of official production records and independently reported accounting data raises questions about the consistency of information across reporting levels. Understanding whether these datasets conform to Benford's distribution provides valuable insight into data irregularities, which is crucial for both data quality and the effectiveness of institutional reporting frameworks in agribusiness.

This study aims to address this research gap by developing a dual-source Benford framework for Portuguese viticulture. The contribution is threefold:

1. It establishes theoretical and practical criteria for selecting between first- and second-digit tests based on the numerical dispersion and aggregation levels typical of viticultural data.
2. It applies Benford analysis simultaneously to official production statistics and company-level accounting data, assessing both internal validity and cross-source consistency.
3. It interprets deviations in light of the institutional and regulatory context of the Portuguese wine industry, where market concentration, climate variability, and reporting obligations may influence numerical regularities.

The following section outlines the methodological framework used to test the conformity of Portuguese wine sector data with Benford's Law. It specifies the datasets examined, the structure of the Benford tests applied (first- and second-digit), and the criteria for evaluating conformity through statistical indicators such as the Chi-squared (Chi-2) test, the Kolmogorov-Smirnov (K-S) test, and the Mean Absolute Deviation (MAD) test.

3. METHODOLOGY, RESEARCH SAMPLE

The study draws on two primary data sources: the BvD Orbis database, which provides financial information for companies in the wine sector, and the Statistics Portugal (ine.pt) database, which provides data on wine production.

The criteria for selecting financial data from the BvD Orbis database were as follows:

1. Status – active companies
2. Country – Portugal
3. Sector activity NACE Rev. 2 - 1102 - Manufacture of wine from grapes

In total, BvD Orbis gives 1366 companies that match our search criteria. In the next step, the dataset was manually refined, and cases with missing or incomplete data were excluded from the analysis. The study period covers 10 years, from 2014 to 2023. The choice of

the final year (2023) reflects the availability of the most recently published financial statements.

The selected variables from companies' financial statements relate to wine production activities. The first variable is sales revenues (turnover), i.e., the value of economic benefits companies realise when selling wine. The pre-tax financial result is the second variable used to measure the business's effectiveness. The choice of this pre-tax variable is related to the elimination of tax optimisation used by companies and the possibility of tax management. In terms of income, profit before tax and loss before tax are separately calculated. The separate analysis is consistent with the assumption that there might be different irregularities for losses and profits.

The variables related to the companies' resources are total assets and inventories. Total assets represent the company's total resources, whereas stock refers to inventories (e.g., materials, work-in-progress, finished products). Wine producers' inventories disclose the value of current assets at all stages of wine production, from the must to bottled wine, which is ready for sale (from the extraction of the must to the final finished product). The variables from financial statements for Benford's Law tests used in the survey follow the literature review considerations. Ausloos et al. [24] analysed pre-taxation data (pre-tax income, separately for profit and loss) and total assets. Nigrini [2] justifies the separate analysis of positive and negative numbers, as there may be different causes for profit and loss manipulation. Revenues are also frequently used for Benford's law irregularity analysis [25–27].

Data from the Statistics Portugal database (INE) were subject to the following selection:

1. Source - Statistics Portugal, Vegetable production statistics
2. Name of the table - Wine production declared in grape must (hl) by producers by Vinification location (NUTS - 2013) and quality and colour of wine (New regulation) - annual
3. Measure unit (symbol) - Hectolitre (hl)

The data included the locations of wine producers where they produce must through the vinification process. The database lists 308 official geographical areas of Portugal (municipales) where information on the grape must produced was collected. The data collected is the same as the available financial data of companies in the wine production sector (2014–2023).

The irregularities in financial and non-financial data that occurred will be assessed using Benford's Law. This Law is not limited to specific phenomena and units of measurement. It is a universal concept that refers to analysing the distributions of digits occurring in measures

of various natural, financial, and non-financial phenomena. The frequency of occurrence of specific digits in a given place in a number can be described by the logarithmic formula proposed by Benford. We calculate the Benford distribution as follows [2]:

$$BL(d) = \log\left(1 + \frac{1}{d}\right)$$

Where:

d – number of digits

Based on the calculation formula for the Benford distribution, you can obtain information about the frequency of digits in the number in the first place from the left for the first-digit test. Figure 1 shows the Benford distribution for the first digit.

Based on Figure 1, it can be observed that the digit 1 appears most frequently (30%) as the leading digit in the data representing the analysed phenomenon, while the digit 9 appears the least often (4%). Discrepancies between the actual digit distribution, such as assets or revenues, and the expected Benford distribution may suggest the presence of anomalies that warrant further investigation. These irregularities might stem from data manipulation, for instance, due to rounding practices employed by companies when reporting financial information or errors in data collection. Additionally, anomalies could result from the construction of the research sample, such as restricting companies based on the size of a specific variable. In such cases, analysing the second-digit distribution may provide further insight.

The first-digit test examines the frequency distribution of digits ranging from 1 to 9, whereas the second-digit test analyses digits from 0 to 9. The second-digit test is particularly useful for identifying underlying irregularities or inconsistencies within the data. [16].

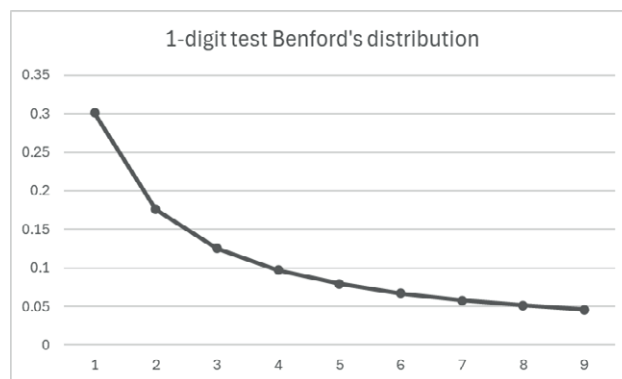


Figure 1. Benford's distribution – 1-digit test. Source: Authors' calculation.

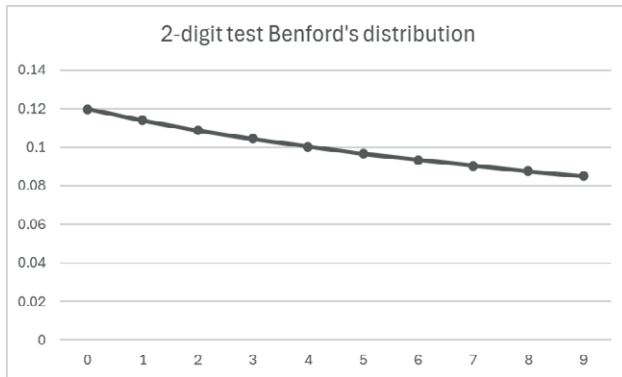


Figure 2. Benford's distribution – 2-digit test. Source: Authors' calculation.

The study of deviations between the empirical (for each variable) and theoretical (Benford) distributions can be measured using the Kolmogorov-Smirnov, Chi-squared, and Mean Absolute Deviation (MAD) test [1,2,20,28]. The conformity with Benford's Law is tested by Isaković-Kaplan, Demirović, and Proho [25] or Adahali and Hall [29], who used all three approaches. MAD is also used by Půček, Plaček, Ochrana [30] or Van Caneghem [31]. The previous application of the Chi-squared test for this purpose can be found in the research of González [32], Cella and Zanolla [33], or Geyer and Drechsler [34]. Aggarwal, Dharni [35] and Badal-Valero, Alvarez-Jareño, Pavía [36] have already used the Kolmogorov-Smirnov test for this kind of comparison. The K-S test applies to the study of the fit of distributions for smaller research samples [37]. Carno [38] analysed the conformity of empirical data (pandemic-related data) with Benford's distribution through a literature review and found that the most frequently used conformity tests were the Chi-square test (21 out of 26 studies), the Mean Absolute Deviation (MAD) test (11 out of 26), and the Kolmogorov-Smirnov test (9 out of 26). Moreover, seven studies used both Chi-square and K-S tests, eight used Chi-square and MAD, and four employed all three methods simultaneously.

Figueiredo and Silva [39] utilised multiple conformity tests, including the Chi-squared, K-S, and MAD tests. They observed that as the sample size increases, statistical tests tend to become more sensitive, raising the likelihood of detecting smaller deviations. It has been noted that the Chi-squared test is particularly sensitive to sample size [40]. However, the excessive statistical power typically becomes noticeable only for datasets exceeding 5,000 records [2]. In our research, the variables: profit before tax, loss before tax and wine production, all consist of fewer than 5,000 observations, thereby mitigating

this concern (Tables 2, 3 and 4). The other variables, revenues, assets, and stock, exceeded 5,000 observations. In the study, the conformity of distributions (both empirical and theoretical) is measured using the Chi-2 test, K-S test and MAD [41].

MAD provides a more robust measure of conformity with Benford's Law than other statistical measures. It can handle outliers, detect minor deviations, and is based on a strong statistical foundation [2, 42, 43]. In this study, MAD:

$$MAD = \frac{1}{n} \sum_{i=1}^n |x_i - m(X)|$$

where:

$m(X)$ – average data value;

n – number of data values;

x_i – data values in the set.

Depending on the level of MAD, it can be considered a close conformity, an acceptable conformity, a marginally acceptable conformity, or a nonconformity. The ranges for MAD are presented in Table 1. MAD does not test the hypothesis of whether two samples originate from the same or different distributions. MAD provides the level of conformity.

Measuring the fit of MAD distributions is commonly used to determine the conformity of an empirical distribution with the Benford distribution [44,45]. The rejection threshold for distribution conformity is 0.015 for the first-digit test. For the second-digit test, the nonconformity threshold is 0.012.

The Kolmogorov-Smirnov test, in contrast, is a non-parametric statistic based on the empirical distribution function [2,25]. It is used to determine whether a random sample originates from a specified continuous distribution.

Kolmogorov-Smirnov test (K-S)

Table 1. Ranges for mean absolute deviation.

Digit	Range	Conclusion
First-digit	0,000–0,006	close conformity
	0,006–0,012	acceptable conformity
	0,012–0,015	marginally acceptable conformity
	above 0,015	Nonconformity
Second-digit	0,000–0,008	close conformity
	0,008–0,010	acceptable conformity
	0,010–0,012	marginally acceptable conformity
	above 0,012	Nonconformity

Source: based on Nigrini [2].

$$D_{n_1, n_2} = \sup_{-\infty < x < \infty} |F_{1, n_1}(x) - F_{2, n_2}(x)|$$

where:

$F_{1, n_1}(x)$ – empirical distribution function of the first sample

$F_{2, n_2}(x)$ – empirical distribution function of the second sample

Two distribution functions are compared using the following test criterion:

$$\sqrt{\frac{n_1 n_2}{n_1 + n_2}} D_{n_1, n_2} > K_\alpha$$

where:

n_1 – number of observations of the first sample;

n_2 – number of observations of the second sample;

K_α – test criterion at level α .

The tested hypotheses are:

H0: Two univariate random variables come from the same probability distribution.

H1: Two univariate random variables do not come from the same probability distribution.

The Chi-square test (Chi-2) is a nonparametric statistical method used to determine whether an observed frequency distribution differs significantly from an expected theoretical distribution [2]. It is commonly applied to categorical data to assess how well the observed data fit a specified model.

Chi-square test (x^2)

$$x^2 = \sum_{i=1}^n \frac{(e - t)^2}{t}$$

where:

n – total number of phenotypic classes;

e – experimental frequency of the i -th class;

t – theoretical frequency of the i -th class.

The tested hypotheses are:

H0: The observed frequency distribution is consistent with the theoretical distribution.

H1: The observed frequency distribution is not consistent with the theoretical distribution.

Carno [38] reported that at least one of the conformity tests indicated nonconformity even when other tests did not. Consequently, the assumption applied in our research is that if at least one of the applied tests (Chi-2,

K-S or MAD) indicates nonconformity between empirical and theoretical distributions, this may serve as evidence of potential anomalies.

The analysis and statistical evaluation were processed using MS Excel for extracting digits and the MAD test, and Statistica 13.3 for the Chi-2 test and the KS test.

4. RESEARCH RESULTS AND DISCUSSION

Upon examining the financial data of companies from the wine production sector, a subset of companies met the criteria described in the methodological section. The mere indication of a company belonging to the NACE 1102 sector in Portugal does not mean that the BvD Orbis database will include figures on financial results and company resources. The first-digit test requires the first digit of the values of the relevant variables in the study to be analysed between 1 and 9. Table 2 presents the final research sample, excluding companies with missing financial data from the database and those with variables of 0.

The second-digit test requires seeing which variables have values greater than 10. It is a condition for the second digit in the number. Therefore, only those companies that reported data for individual variables were selected from the database: stock, total assets, operating revenue, or profit before tax with a value of at least 10. Table 3 shows the number of observations for each variable.

Figure 3 illustrates the first- and second-digit tests for data from the financial statements of companies in the Portuguese wine industry. It can be observed that the digits in the first and second positions of operating revenue, total assets, profit before tax, loss before tax, and inventories conform to the theoretical values implied by Benford's Law.

Table 2 presents the results of three goodness-of-fit tests for financial variables: revenues, assets, profit before tax, loss before tax, and stock. It can be noted that for the profit before tax variable, two tests indicated acceptance of the alternative hypothesis: chi-square (the observed frequencies differ from the expected frequencies) and K-S (the sample does not follow the specified distribution). The lack of consistency between the distributions demonstrated by the chi-square and K-S tests may suggest anomalies in determining profit before tax. A closer examination of profit formation in Portuguese wine sector companies would enable an assessment of the potential scale of earnings management practices in these companies.

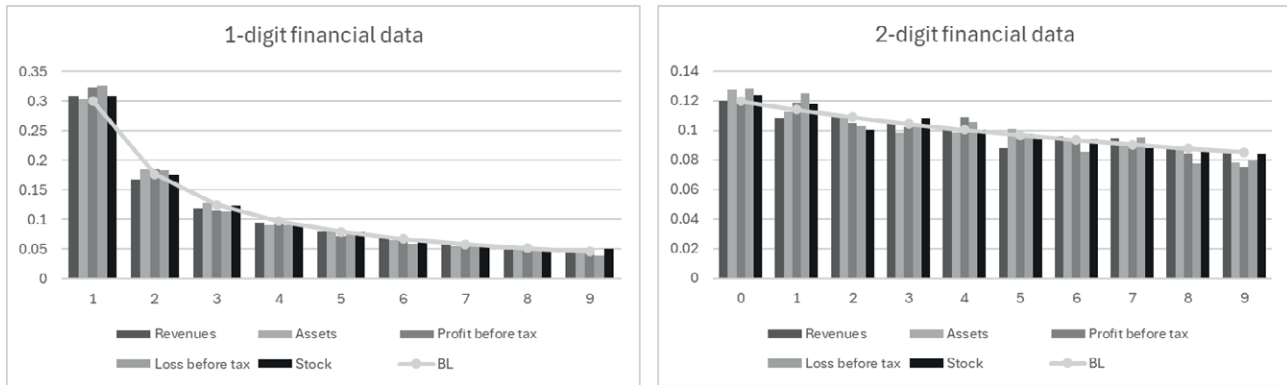


Figure 3. Financial data: assets, revenues, profit before tax, loss before tax, inventories (2014 - 2023). Source: Authors' calculation.

Table 2. 1-digit test Chi-2, K-S and MAD results.

Variable	No. Obs.	Chi-2	Decision	K-S test	Decision	MAD	Decision
Revenues	6766	12.061	conformity	0.500	conformity	0.004	close
p-value		p = 0.149		p > 0.05			conformity
Assets	7503	9.924	conformity	0.797	conformity	0.003	close
p-value		p = 0.270		p > 0.05			conformity
Profit before tax	4345	18.967	nonconformity	1.469	nonconformity	0.007	acceptable
p-value		p = 0.015		p < 0.05			conformity
Loss before tax	2506	14.945	conformity	1.135	conformity	0.008	acceptable
p-value		p = 0.060		p > 0.05			conformity
Stock	6098	7.128	conformity	0.485	conformity	0.003	close
p-value		p = 0.523		p > 0.05			conformity

Df = 8, at 5%, critical value Chi-2 (8) = 15.507; critical value K-S test = 1.36.

Source: Authors' calculation.

For the remaining variables: revenues, assets, loss before tax, and stock, the results of the first-digit test using the chi-square and K-S goodness-of-fit measures indicate no basis for rejecting the null hypothesis that the observed counts for digits 1 to 9 do not differ from the expected counts based on the Benford distribution. The MAD measure additionally introduces a range of fit, and for all these variables, the range of fit is either close conformity or acceptable conformity.

Table 3 presents the results for the second-digit test. All goodness-of-fit tests indicate goodness-of-fit distributions or no basis for rejecting the hypothesis that there is no difference in observed and expected numbers. For the second-digit test, the analysis ranged from digits 0 to 9.

The next step in the study is to verify the statistical data on wine must production in Portugal. The study examined anomalies in the distribution of the amount of wine must produced in 308 regions of Portugal between 2014 and 2023 using the first- and second-digit tests. The data collectively refer to the production of must

from white and red grapes and various appellations: Generous wine by protected designation of origin, wine by protected designation of origin, wine by protected geographical indication, wine with grape variety indication, and wine without certification.

Table 4 presents the results of the first and second digit tests for the grape must production variable. The chi-square goodness-of-fit test supported the alternative hypothesis that the empirical and theoretical observation counts were significantly different for both the first and second digit tests. Although the remaining K-S and MAD goodness-of-fit tests did not reveal any discrepancies in the distributions, the chi-square test indicates irregularities that require further investigation.

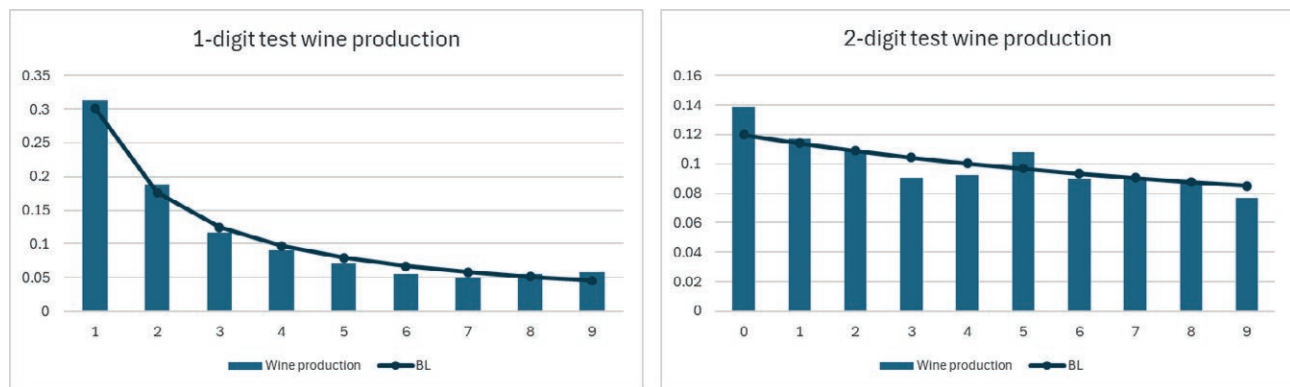
Based on the results of the first-digit and second-digit tests (Table 4) for grape must production, it can be seen that the chi-square test indicates a lack of basis for accepting the null hypothesis of equality between the empirical and theoretical digit distributions. The lack of conformity between the distributions, as indi-

Table 3. 2-digit test Chi-2, K-S and MAD results.

Variable	No. Obs	Chi-2	Decision	K-S test	Decision	MAD	Decision
Revenues	6321	9.746	conformity	0.532	conformity	0.003	close
p-value		p = 0.371		p > 0.05			conformity
Assets	7190	12.310	conformity	0.471	conformity	0.003	close
		p = 0.196		p > 0.05			conformity
Profit before tax	3114	7.799	conformity	0.512	conformity	0.004	acceptable
		p = 0.554		p > 0.05			conformity
Loss before tax	1768	8.418	conformity	0.589	conformity	0.007	acceptable
		p = 0.493		p > 0.05			conformity
Stock	5561	6.433	conformity	0.447	conformity	0.003	close
		p = 0.696		p > 0.05			conformity

Df = 9, at 5%, critical value Chi-2 (9) = 16.919, critical value K-S test = 1.36.

Source: Authors' calculation.

**Figure 4.** Wine production stat data (2014–2023). Source: Authors' calculation, based on INE database.**Table 4.** 1-digit and 2-digit test Chi-2, K-S and MAD wine production results.

Variable	No.	Chi-2	Decision	K-S test	Decision	MAD	Decision
1-digit test wine production	2349	22.859	nonconformity	0.835	conformity	0.009	acceptable
		p = 0.004		p > 0.05			conformity
2-digit test wine production	2281	17.815	nonconformity	0.758	conformity	0.007	close
		p = 0.037		p > 0.05			conformity

Df = 8, at 5%, critical value Chi-2 (8) = 15.507; critical value K-S test = 1.36.

Df = 9, at 5%, critical value Chi-2 (9) = 16.919, critical value K-S test = 1.36.

Source: Authors' calculation.

cated by the chi-square test, may result from difficulties in obtaining this data by statistical offices [16]. Possible causes of nonconformity of distributions may include data entry errors or misinterpretation during data collection, as well as inconsistencies in data processing methods [20].

5. CONCLUSIONS

This study examined the application of Benford's Law to identify irregularities in financial and production data within the Portuguese wine industry. By examining company-level financial variables – such as operating revenues, total assets, profit before tax, loss before tax, and inventories – alongside official statistics on wine

must production across 308 regions, the research provides a robust evaluation of data integrity over ten years (2014–2023). The first- and second-digit test results demonstrate strong conformity with Benford's expected digit distributions, with Mean Absolute Deviation (MAD) values falling within the ranges of close or acceptable conformity. To confirm the consistency of the distributions, the study employed the Chi-squared and the K-S tests in addition to the MAD. The Chi-2 and K-S test results indicate a lack of consistency in one case of the financial variable (profit before tax) and in the wine production variable (wine must production).

These findings hold important implications. First, they validate the use of financial and statistical data in subsequent economic modelling, sectoral studies, and policy assessments in viticulture. Second, they demonstrate the applicability of Benford's Law in the wine production sector, providing a replicable methodology for auditing financial and non-financial data. Parreño [20] revealed significant deviations from the expected Benford distribution, indicating potential issues with data accuracy, collection methods, or reporting irregularities. These deviations highlight the importance of data validation in wine production statistics. The problem of obtaining precise data in the agriculture sector was highlighted by Hanci [16]. Our findings revealed that some irregularities were detected in the Portuguese wine sector, as indicated in data collected by the statistical office.

The causes of irregularities may differ between companies that report profits and those that report losses. A discrepancy in the distribution of pre-tax profits may suggest actions related to corporate earnings management. The literature offers explanations for the detected irregularities in financial figures, including rounding errors [34,46,47], fraud detection [2,11], and adjustments to comply with legal regulations [48,49]. Revealed in the survey, nonconformity in reported profit before tax indicates the threat of earnings management and financial figure manipulation [2,50]. The findings revealed the need to assess earnings management in the wine production sector and identify the reasons for nonconformity. These actions prompt further research to conduct a first two-digit test to select companies whose first-digit pre-tax profits had the most significant deviations.

Moreover, the results of this study may inform the work of public institutions and regulatory bodies, particularly in areas such as tax compliance, subsidy allocation, and agricultural monitoring. By ensuring that datasets are reliable, authorities can base their decisions on solid evidence. In the private sector, wineries and investors may employ similar analytical approaches to audit

internal data, enhance transparency, and mitigate the risk of reporting errors or fraud.

However, the study has certain limitations. Benford's Law can identify anomalies, but does not reveal the specific causes of irregularities. Additionally, the data may be affected by limitations in availability or representativeness, particularly for smaller producers. Future research could expand its scope to other wine-producing countries or examine trends in data quality over time.

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Exploring Barriers Arising From Coopetition: A Case Study in the Brazilian Wine Tourism Industry

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Abstract. In this study, we aim to understand how coopetition can create barriers to real-estate projects through a focus on the collective interests that seek to preserve the identity of a geographical indication (GI). A qualitative longitudinal study that analyzes a Brazilian wine industry, specifically the Vale dos Vinhedos (a GI region), because it provides examples of coopetition leveraged to develop the region. The study was conducted over ten years (2012–2022), collecting primary data from representatives of the Brazilian wine industry in 36 semi-structured interviews. The study found that wineries and formal institution agents established a coopetition strategy to stop uncontrolled expansion in the form of real-estate development, blocking the entry of new ventures such as hotels and timeshares that could distort the region's character. Our study highlights the relevance of exploring the relationship between environmental, social, and governance performance in coopetition studies to understand how coopetition can support sustainable development. However, we found evidence that contrasts the perspective of coopetition as a strategy for developing a wine destination.

Keywords: coopetition, geographical indication, Brazilian wine industry.

1. INTRODUCTION

In today's intricate business environment, firms often employ coopetition – a strategy of concurrently pursuing cooperation and competition – to navigate uncertainties stemming from emerging markets, rapid technological changes, and intensified global competition[1]. As a well-developed theory, coopetition attracts attention from researchers and practitioners exploring its role in value creation and capture and in competitive strategies influenced by institutions [2,3].

Coopetitive relationships can offer insights into development of tourism destinations amidst complexity [4]. Local products, crucial in tourism, gain greater significance with Geographical Indications (GIs), such as Champagne in France or Port in Portugal, emphasizing the geographical essence of coopetition manifesting in varying degrees of competition and collaboration [5]. The same is true of the case of the Vale dos Vinhedos (literally, the Valley of the Vineyards) in Brazil.

By 2023, Brazil had 109 Geographical Indications (GIs), a 60% increase since 2019, with more regions likely to receive accreditation [6]. The Vale dos Vinhedos, Brazil's first GI, marked a significant shift in wine tourism, driving job creation, attracting tourists, boosting local product consumption, and fostering socio-territorial revitalization [7]. In this region, the wine industry thrives on a mix of competition and cooperation among producers and managers [8]. Wine tourism contributes directly to job creation, increased tourist visits, local product consumption, new investments, and business opportunities, all of which support broader social and territorial development [9]. For winemakers, wine tourism extends the wine business, offering diversification and greater value-added production [10].

Coopetitive strategies in this emerging market, heavily influenced by government actions [11], have evolved beyond financial gains and strategic positioning to address new tourism industry entrants [4, 12]. However, coopetition also has a “dark side,” with potential negative impacts on firms and tourism development from a barrier to the advance of hotel and real estate megaprojects. It can create barriers by emphasizing collective interests aimed at preserving the identity of a Geographical Indication (GI) [13]. This led us to define the research question: How does coopetition create barriers to tourism through a focus on preserving a GI's identity? The study aims to explore the dynamics of coopetition and its effects on tourism when centered on GI preservation.

To fill this critical gap, we conducted a ten-year qualitative longitudinal study (2012-2022) focused on the Brazilian wine industry in Vale dos Vinhedos, a Geographical Indication (GI) region, as it demonstrates the role of coopetition in regional development. Our study builds on Miná and Dagnino [14] and Chim-Miki and Batista-Canino [15], who emphasized the importance of examining the interplay of environmental, social, and governance factors in coopetition to support sustainable development.

1.1 Coopetition in wine tourism: institutional dynamics and the case of Vale dos Vinhedos

Coopetition, combining cooperation and competition, is context-dependent and acts as a strategic tool for increasing value in tourism destinations [1, 16]. It enables stakeholders to collaborate while maintaining competitive dynamics, addressing economic, political, and social challenges, and fostering value creation [17]. This has been examined in settings such as Italian opera houses and theme parks in Finland and Italy [18,19]. Researchers generally adopt two institutional perspectives: informal, which considers the influence of culture and ethics on coopetition, as explored by Klimas [20] and Knein et al. [21]; and formal, which focuses on regulations, intellectual property, and competitive advantage [22,23]. Most studies are set in developed nations, where institutional frameworks facilitate business strategies [26,25].

However, coopetition also has a “dark side,” where value can be destroyed rather than created [13,26]. This typically occurs when tensions between firms lead to suspicion and conflict, increasing risks and costs [27]. In tourism, geographical overlap exacerbates these challenges, as businesses compete for the same customer base, making cooperation more complex [28,29]. Moreover, the opportunistic behavior of players who seek to capture value without having participated in the value creation stage can damage the relationship between the players who participate in wine tourism enterprises [30].

For instance, tensions and social conflicts arising from coopetition in wine regions can significantly impact their long-term business sustainability. These conflicts often stem from competing economic interests, environmental concerns, and sociocultural dynamics, which can undermine cooperative efforts essential for sustainable practices [31]. In the Prosecco region, social conflicts are intertwined with environmental concerns, as local communities demand greater attention to social values and equitable resource distribution [32]. Furthermore, the case of the AOC Saint-Émilion illustrates how crises can alter coopetition dynamics, leading to conflicts that hinder value creation and sustainability efforts [33]. Similarly, research in Spain has highlighted tensions arising from the competing interests of wine tourism, heritage preservation, and local communities' housing or infrastructure needs. In this context, while Priorat has used detailed terroir zoning to strengthen community cohesion and revitalize rural residency, regions such as Penedés show how weaker regulation leaves room for urban pressure and potential social friction [34]. Thus, while coopetition can foster collaboration among wine producers, the inherent tensions and conflicts can jeopardize the long-term business sustainabil-

ity of these regions, necessitating careful management and regulation to balance competing interests.

In wine tourism, coopetition is evident as wineries and related entities work together to enhance visitor experiences while maintaining competition [13,35]. This strategy drives innovation by encouraging shared research, sustainable practices, and improved viticulture techniques, benefiting both individual wineries and the broader industry [36,37]. It also includes collaboration with hotels and tour operators to create comprehensive packages that enrich the visitor experience. However, achieving a balance is crucial, as too much competition or cooperation can result in fragmented experiences and shorter visitor stays [23,24].

The Vale dos Vinhedos in southern Brazil illustrates the role of coopetition in wine tourism. Known for its grape and wine production, the region comprises 37 municipalities, managed by the Serra Tourism Association (Atuaserra), which oversees regional tourism efforts [8]. In 2015, the region attracted about 400,000 visitors, gradually becoming Brazil's leading wine tourism destination [Formal Institution Agent 8, 2024]. The cooperative environment has enabled family wineries to expand beyond local markets, reaching national and international audiences [8].

The region, historically linked to Italian immigration since 1875, encompasses Bento Gonçalves, Garibaldi, and Monte Belo do Sul. It currently hosts 22 wineries, 40 employees, and has a designation of origin seal for its products [Formal Institution Agent 8, 2024]. The establishment of Formal Institution Agent 8 led to infrastructure improvements, job growth, and increased acceptance of local wines, as noted by Zanini and Rocha [40,41] and Valduga and Minasse [43]. Klinger et al. [42] further emphasize that coopetition benefits both established and emerging wineries along the 35-kilometer wine tourism route.

Despite these successes, the region also faces coopetition challenges. Tensions among firms can lead to negative outcomes, underscoring the need for strategic balance [18–20]. Wineries must maintain their brand identity while contributing to the destination's appeal [18,19]. Achieving this delicate balance is crucial to ensuring a cohesive and attractive tourist experience [38].

2. METHODOLOGY

The Vale dos Vinhedos epitomizes the historical, cultural, and gastronomic legacy of Italian immigrants who began to arrive in Brazil in 1875 and has become a focal point for coopetitive strategies in the Brazilian

wine industry [46]. The region's industry association, Formal Institution Agent 8, was founded in 1995 and plays a pivotal role in orchestrating coopetitive endeavors targeting sustainable development through wine tourism. The region attracted approximately 300,000 visitors in 2022, consolidating its status as Brazil's premier wine tourism destination [47].

We used a data analysis process employing an inductive method to offer a strategy for constructing theories [48]. Processual research requires examination of phenomena over time with scrutiny of individual case studies to understand the flow of activities, demanding comprehensive longitudinal data [49]. We registered in detail and analyzed the evolution of a geographical location over time, exploring its response to new opportunities and conflicts, mainly focused on the dilemma of steering between promotion and development of tourism in the region and protecting and preserving the identity of the Vale dos Vinhedos GI.

For data collection, in this study we employed a combination of semi-structured interviews, observation, and document analysis. This multifaceted approach enables the essential triangulation of data, as recommended for qualitative research objectives [50].

A ten-year longitudinal study (2012–2022) collected primary data from the Brazilian wine industry through 36 semi-structured interviews with executives, managers, and consultants from wineries and formal institution agents involved in the development of the Vale dos Vinhedos' Geographical Indication (GI) status. The initial phase (2012–2013) included 18 interviews with winery representatives and formal agents, along with three follow-up interviews with the same participants. The second phase in 2017 featured six interviews, including four repeat participants and two new ones. The third phase in 2022 added nine interviews with formal institution agents representatives new to the study (Table 1). The process was mapped to identify key events and establish a timeline that captured the evolving discourse on tourism and GI in the region.

Data were triangulated to strengthen both validity and reliability. Primary data was collected at different points in time, from multiple sources, and using varied instruments, in order to build a more comprehensive set of findings. We compared similarities and differences across the data to ensure diverse perspectives were captured, incorporating verbatim quotations from participants to reinforce the results [51]. Secondary data were obtained from companies and formal institution agents, serving both to complement and to contrast with the interview material. In addition, bibliographic sources such as websites, reports, magazines, and books were

Table 1. General information about the interviewees.

No.	Organization	Position	Interview Dates
-	<i>First Phase</i>		2012-2013
1	Formal Institution Agent 1	Technical Director	01/2012
2	Formal Institution Agent 2	Export Manager	01/2012
3	Winery 1	Export Supervisor	01/2012
4	Winery 2	Export Coordinator	01/2012
5	Winery 3	International Relationship Manager	02/2012
6	Winery 4	Export Manager	02/2012
7	Formal Institution Agent 3	Researcher	01/2013
8	Winery 3	International Relationship Manager	01/2013
9	Winery 5	Sales Manager	01/2013
10	Winery 6	Sales Manager	01/2013
11	Formal Institution Agent 4	Business Promotion Director	01/2013
12	Formal Institution Agent 5	Brazilian Companies Relationship Manager	01/2013
13	Formal Institution Agent 7	Executive Manager	01/2013
14	Formal Institution Agent 2	Export Manager	03/2013
15	Formal Institution Agent 6	International Relationship Manager	03/2013
16	Winery 2	Export Coordinator	04/2013
17	Winery 7	Winemaker	06/2013
18	Specialist	Researcher and winemaker	06/2013
19	Winery 8	Winemaker	06/2013
20	Winery 9	Foreign Trade Manager	06/2013
21	Formal Institution Agent 8	President	07/2013
-	<i>Second Phase</i>		2017
22	Formal Institution Agent 2	Promotion Department Manager	05/2017
23	Winery 1	Import and Export Assistant	05/2017
24	Winery 3	Export Manager	06/2017
25	Formal Institution Agent 3	Researcher	06/2017
26	Specialist	Researcher	06/2017
27	Winery 10	Export Manager	06/2017
-	<i>Third Phase</i>		2022
28	Educational Institution 1	Researcher and Professor	04/2022
29	Formal Institution Agent 8	Executive Director	04/2022
30	Winery 11	Winemaker	05/2022
31	Formal Institution Agent 8	Technical Advisor	05/2022
32	Educational Institution 2	Researcher and Professor	05/2022
33	Educational Institution 2	Researcher and Professor	08/2022
34	Vale dos Vinhedos Planning District Council	Architect and Member of the Municipal Planning Council	08/2022
35	Winery 12 and Formal Institution Agent 8	Owner and Vice-president of the Superior Council and Fiscal Council	08/2022
36	Subprefecture of Vale dos Vinhedos	President of the Vale dos Vinhedos District Planning Council / President of the residents and community of Vale dos Vinhedos	08/2022

included. We took care to fulfill specific criteria of reliability, as detailed in Table 2 [51].

Data analysis was carried out in three sequential phases: (i) data reduction; (ii) data display; and (iii) drawing and verifying conclusions [52]. A template analysis approach was applied to develop a hierarchical coding system, striking a balance between a predefined structure for analyzing texts and an iterative process to

capture emerging codes [54]. We used the main quotes to present the case analysis. The analysis involved a systematic comparison of interview topics, a visual map, and individual cases, facilitating definition and validation of constructs. Throughout this process, “in vivo” codes were employed, aligning with the language and terms used by key informants, as recommended by Langley and Abdallah [50].

Table 2. Reliability criteria.

Reliability criterion	What we did
Validity	To ensure the validity of both the process described and the data analyzed, we triangulated the evidence across multiple respondents and secondary sources.
Reliability	We sought to guarantee reliability by carefully examining the soundness of researchers' decisions, involving an independent researcher to evaluate comparable findings and reduce potential biases linked to researchers' philosophical stances, experiences, or perspectives.
Generalizability	To allow other researchers and practitioners to transfer the findings to their own contexts, we described in detail the organizational field that shaped each decision-making process. This expanded the understanding of the trajectory under analysis. We also detailed contextual phenomena to support application of the findings in other settings.
Consistency	We provided a transparent account of the research process, from the initial outline through methodological development and presentation of findings. Emerging issues were openly debated with team members experienced in qualitative research, enabling assumptions to be challenged and consensus reached.
Dependability	We safeguarded the confidentiality of firms and institutional representatives by assigning them codes with numbers. Interviews were conducted by two researchers, who also contributed to the design of composite visual maps integrating various data sources. This allowed for auditing of the data and ensured that the narrative reflected respondents' shared meaning, not just researchers' interpretations. We also used NVivo 14 to assign open, axial, and selective codes, and included interview excerpts in the paper.
Confirmability	All interviews were recorded and transcribed verbatim. Two researchers conducted interviews with representatives from different organizations, while one simultaneously took notes. The full inventory of secondary data was accessible online.

The first phase involved selecting, discarding, and organizing data according to the research design and predefined categories. Interview excerpts were examined to identify elements contributing to the debate on how coopetition can hinder tourism by prioritizing collective interests that preserve the identity of a geographical indication. Primary data from interviews and secondary sources from print and digital materials were processed, producing summaries that highlighted key aspects.

The second phase focused on linking codes with data sources. Two researchers independently coded the material, organizing the summaries according to categories that emerged during analysis (a posteriori categories). Relationships were established by mapping each interview excerpt (coding references) to analytical categories defined in the first phase, generating coded items. Data summaries were then cross-referenced using NVivo 14.0.

In the final phase, the coded output provided the foundation for interpretation. Codes were classified in line with existing literature, covering different dimensions of the phenomenon and consolidated into a research map [54]. Two researchers worked independently to refine codes, merging or separating them as appropriate, before comparing results to reach consensus (Table 3). Ultimately, the observed phenomena were explained and grouped under three central categories, which are presented in the following section.

3. RESULTS

3.1 Establishment of the Vale dos Vinhedos: coopetition and institutional dynamics

The Vale dos Vinhedos was established in the 1990s when Brazil's shift towards a more open economy facilitated global market integration. Six wineries initiated discussions to implement a Geographical Indication (GI) for the region, supported by the Brazilian Agricultural Research Corporation's grape and wine department (Formal Institution Agent 3). Due to a crisis in the cooperative model, they chose to create the Vale dos Vinhedos Fine Wine Producers Association [Formal Institution Agent 8], formally established in 1995 as described below:

Aprovale is an organization that was set up with the main aim of bringing together the companies here in the Vale dos Vinhedos region, which later became a GI. With the aim of organizing, especially these small companies that were springing up here at the time. And winemaking was in its infancy here at the time, in the 1990s. What we had was viticulture, in other words, we didn't make wine, we produced grapes, but what we did was supply this raw material to other larger companies in the sector. The creation of Aprovale was then to strengthen these companies that were springing up, to promote joint work between them, to be able to organize the purchase of inputs with better conditions, the marketing of the product also at fairs and external events, in São Paulo, Rio de Janeiro, they participated together at the beginning, and also, to do, and this is still one of the main objectives, to evolve

Table 3. Analytical categories used for the interview script.

Categories	Guiding concepts	Theoretical background
Introduction	History; role and influence of the firm or formal institutions agents; relevance of the firms or formal institution agents in the industry; influence of formal institutions to develop the industry and region; characteristics of the industry.	Characterization of the firm or formal institution agent in the industry
Business strategies	Firms share or compete for the same resources; firms work alone or together with my competitors; firms cooperate in some areas/markets and compete in other areas; strategy of coopetition; interests of the firms and the formal institution agents for the coopetition to be successful.	Cooperation, competition, and coopetition
Role and influence of formal institution agents	Main formal institution agents in this industry and their roles; the role of the formal institution agents in the industry; influence (intervention) of government in this industry; the role of trade associations, industrial agencies, tax bureaus, state banks, commercial administration bureaus, and universities, the influence of GI in the industry.	Decision-making of firms and institutions from the political and economic perspective of the Neo-institutional theory
The Role of Coopetition in Value Dynamics within Tourism Destinations	Coopetition, Value Creation, Value Capture, Value Destruction, Formal Institutions, Informal Institutions, Institutional Interplay, Collective Branding, Asymmetric Gains, Sustainable Tourism Development.	When laws and policies conflict, the value dynamics in tourism are affected, which can result in the destruction of value for the destination.

the product. Imagine a small winery that started twenty years ago, the technology was very simple and well, you had to compete in an increasingly competitive market, with quality. So that was the most important step we took, seeking support mainly from Embrapa, Sebrae and universities. (Formal Institution Agent 8, 2013)

In 1995, facing a crisis in the cooperative model, the group established the Vale dos Vinhedos Association of Fine Wine Producers [Formal Institution Agent 8] instead of a cooperative. A pivotal moment for regional cooperation was a visit to Napa Valley, where local entrepreneurs considered creating a wine tourism route in Vale dos Vinhedos. This sparked discussions that led to the simultaneous launch of the wine tourism project and the Geographical Indication (GI) process. As a winemaker from Winery 11 noted: “The members were meeting to create a wine tourism route, inspired by Napa Valley... But it seems that this initial conversation provoked a further step – why not have a GI?” [Winery 11, Winemaker, 2022]. The initiative was driven by shared cultural identity and trust, reinforcing the GI’s foundation.

Formal Institution Agent 8 aims to promote sustainable development in the Vale dos Vinhedos through wine tourism, member integration, and community engagement. It oversees the Geographical Indication (GI) and the products protected by it. Since the 2000s, efforts to expand both domestic and international markets have increased, boosting wine tourism, earning awards for regional wines, and attracting more tourists [Formal Institution Agent 8, 2024].

So, if the association worked to promote the local products and wine tourism, and the regional crafts as well, as a consequence it also managed to promote Brazilian wine in general. Nowadays, Brazilian wine benefits from Vale dos Vinhedos’ recognition even in the European Union, since 2007. We have a level of recognition that we would have struggled to achieve if we didn’t have this region and the work that was done specifically focused on its identity, its products, and their recognition. (Executive Director, Formal Institution Agent 8, 2022)

In 2002, wines adhering to the standards set by Formal Institution Agent 8 and Formal Institution Agent 3 received the Indication of Origin (IO) seal, covering grape varieties, cultivation, and winemaking [Formal Institution Agent 8, 2024]. In 2012, this recognition advanced to Geographical Indication (GI) status, reserved for wines meeting specific technical criteria. This upgrade enhanced the product’s value, consumer confidence, and media visibility for Vale dos Vinhedos. As Brazil’s first product to earn this designation, the IO seal was also recognized by the European Union, benefiting grape growers, wineries, and consumers through higher product quality and spontaneous marketing. An interviewee from Formal Institution Agent 3 noted that this recognition improves the region’s business landscape, particularly in tourism, creating a favorable environment for wine enterprises:

So, if the association did a job promoting the local product, or products, because wine tourism too, the region’s handicrafts too, it consequently managed to promote

the national wine too. Today, national wine has the recognition of the Vale dos Vinhedos even in the European Union, which was done back in two thousand and seven. You have a situation of recognition that we would hardly have had if we didn't have a region with a strong focus on its identity, its product and recognition. (Formal Institution Agent 3, 2017)

Strategies of cooperation among competitors are evident in the learning gains and expanded networks through interactions among wineries, formal institution agents, and traditional events. This reflects the coopetition model, where wineries of all sizes collaborate and compete in areas like marketing, foreign commerce, and sales. The goal was to create value collectively, establishing an identity for Brazilian wine centered on the Geographical Indication (GI). This approach involved sharing resources and knowledge, leading to greater outcomes than what individual efforts could achieve, particularly in expanding both domestic and international market shares.

3.2 Expansion of tourism and real estate development

At the beginning of the 21st century, South Brazil's winemaking region achieved Geographical Indication (GI) accreditation, prompting significant developments, particularly accelerated urbanization. The Vale dos Vinhedos Denomination of Origin (DO) spans 72 km², distributed across Bento Gonçalves (61%), Garibaldi (34%), and Monte Belo do Sul (5%). The region's wine label, "Vale dos Vinhedos," comes from a grape-intensive area within Bento Gonçalves, home to most winemakers [57].

Following GI recognition, a Regulatory Board was established in 2001 to manage, maintain, and preserve the GI. This self-regulating body, approved by association members, ensures the origin and quality of Vale dos Vinhedos wines. It introduced the Vale dos Vinhedos Seal of Quality, awarded to still and sparkling wines made with local grapes and bottled at origin. These wines undergo rigorous testing by experts from Formal Institution Agent 3 and Formal Institution Agent 8. Each seal is uniquely numbered for control, setting these wines apart from competitors [Formal Institution Agent 8, 2024]. This perspective is reinforced by representative from Formal Institution Agent 1:

Our first geographical indication was the indication of origin, in 2002. And in this year (2012) we were recognized as an appellation of origin. Which is another stage. You can't compare the two. The first was the introduction of the Vale dos Vinhedos, and the denomination is, in a way, the recognition that what is made here really is

linked to our conditions, to our terroir. The denomination, as well as being a geographical indication like the indication of origin, which links the product to its origin, needs to approve that the product does have a link to what is made here. So, as long as we have approved a product that we have made here, it is linked to our geographical and physical conditions, our people, our varieties, in short, to our terroir. (Formal Institution Agent 1, 2012)

The recognition of Vale dos Vinhedos as a Geographical Indication (GI) was a milestone with significant impacts on the region's sustainable economic development. The GI not only adds value to the wine products but also benefits winemakers, the working environment, and rural properties. It enhances winemakers' involvement in national and international sales, promotes investment in new vineyards and technology, encourages family succession, preserves the region's cultural heritage, supports quality control, and boosts consumer trust. Additionally, it fosters the expansion of wine tourism [Formal Institution Agent 8, 2024].

Wine tourism expansion in Vale dos Vinhedos began in 1999, marked by increased hotel construction [Architect, Complan, 2022]. At the same time, wineries have begun to explore wine tourism in order to add value to their products and services. The winemaker at winery 8 explains:

Our focus has been on markets with higher returns, adding value with wine tourism activities, such as customer visits to the winery, the winery's theme park, tasting events, an enoteca, a restaurant and a wine museum. It has also focused its efforts on individual customers who are wine connoisseurs and connoisseurs, through active telemarketing, using limited batch production. (Winery 8, 2013).

However, real estate speculation, with property values rising up to 500% in recent years due to the GI's creation, threatens the region's wine landscape. This underscored the need for regulated land use, formalized by the Cities Statute (Law 10.257) in 2001, which mandates Town Plans for municipalities with over 20,000 residents, identifying tourism-focused and environmentally significant areas.

The Bento Gonçalves Town Plan created conflicts, as it often dominated planning decisions in the Vale dos Vinhedos, despite the region spanning three municipalities [Architect, Complan, 2022]. As the area's popularity and infrastructure investments grew, with new restaurants, bed and breakfasts, and retail outlets, Vale dos Vinhedos became Brazil's leading wine tourism destination. This attracted real estate developers and the construction industry seeking to invest within the demarcated region.

By 2010, rising property values led landowners and winemakers to sell land for residential development, threatening vineyards and the Geographical Indication (GI) status [Architect, Complan, 2022]. Real estate pressures escalated after Denomination of Origin (DO) status was granted in 2012, with developments often prioritizing profit over community interests. Formal Institution Agent 8 remarked, *“The Vale is easy to sell, because it is the best wine tourism route in Brazil”* [Formal Institution Agent 8, Executive Director, 2022]. In response, a collaborative effort by Formal Institution Agent 8 and local stakeholders secured recognition of Vale dos Vinhedos as Historic and Cultural Heritage of Rio Grande do Sul, with interventions from the Public Prosecutor to curb unregulated growth [Winery 11, 2022].

Despite these efforts, internal conflicts emerged within Formal Institution Agent 8 from 2014 onward. Differences in firm size, unclear common goals, inconsistent GI promotion, and rising land prices contributed to tensions. Consequently, some members disengaged from the association, shifting focus to other business ventures unrelated to wine production [Vice-president of the Senior Board and Financial Board, Formal Institution Agent 8, 2022].

3.3 Coopetition as a barrier to the advance real estate projects

Recently, new conflicts have emerged over construction and real estate developments in the Vale dos Vinhedos. In 2021 and 2022, large projects like resorts began occupying winemaking lands with Denomination of Origin (DO) status. Political interests, linked to election campaigns and economic gains, fueled these developments. The longstanding issue of conflicting Town Plans among Bento Gonçalves, Garibaldi, and Monte Belo do Sul persisted, enabling ongoing approval of unsuitable constructions in Garibaldi and Monte Belo do Sul [President of the Vale dos Vinhedos District Planning Council/Residents and Community, 2022].

In response, Formal Institution Agent 8 issued an open letter to the community, warning that the region's sustainable development was at risk. The letter emphasized that expanding hospitality capacity alone does not justify new developments, as it threatens the vineyard landscape and impacts wine tourism. Formal Institution Agent 8 stressed that the region's appeal lies in its natural beauty, tranquility, and preservation of wine culture, free from overcrowding [Formal Institution Agent 8, 2022].

Intellectual property and the Denomination of Origin (DO) are major concerns, as highlighted in Formal Institution Agent 8's Open Letter. According to arti-

cle 178 of Law 9.279, GIs are recognized based on the unique qualities of wines derived from their geographical context, including natural and human factors [57]. If these factors are compromised, the DO status is at risk. To prevent this, a reevaluation and planning process is needed, involving entrepreneurs, producers, public administrators, and the community, to understand the negative impacts of real estate developments. Such developments could not only lead to the loss of DO status but also threaten the sustainable development and international reputation of Vale dos Vinhedos as a wine tourism destination [Formal Institution Agent 8, 2022].

The District Planning Council representative expressed concerns about large-scale developments, citing issues with mobility, public transportation, sanitation, water, daycare, and healthcare. He stated, *“All of this growth does not fit in the Valley”* [President of the District Planning Council/Residents and Community, 2022]. For example, two urban projects proposed in 2021 and 2022 would require 2,500 workers commuting daily over six years, doubling the current population of 2,300 and overwhelming infrastructure like water, electricity, roads, sewage, and waste management. The region's insufficient labor force suggests that workers would likely relocate with families, further straining healthcare, education, and housing resources that the area cannot support [President of the Vale dos Vinhedos District Planning Council/Residents and Community, 2022].

In response to local concerns, a public meeting led to the removal of a project that proposed altering the Bento Gonçalves Town Plan to allow mega developments within the DO area. City Hall also introduced a Vale dos Vinhedos Landscape Management and Development Plan, which involves Bento Gonçalves, Garibaldi, and Monte Belo do Sul [Formal Institution Agent 8, 2024]. Winery 12's owner emphasized, *“We're not against progress or development, but it must be in context... The Vale's identity was built on vineyards, wine, fine dining, and tourism, and this character must be preserved.”* (Winery 12, 2022).

Formal Institution Agent 8 resumed efforts to unite wineries, suppliers, educational institutions, and the community. Joint purchasing of supplies has helped winemakers sustain their operations, while group negotiations for machinery and equipment have delivered shared benefits. As noted by the President of Formal Institution Agent 8, *“The Association's contribution to the Valley is to help producers retain their ownership”* [President of Formal Institution Agent 8, 2022].

Over time, the Geographical Indication (GI) has become central to the region's economic, social, and environmental development (Figure 1). This is evident

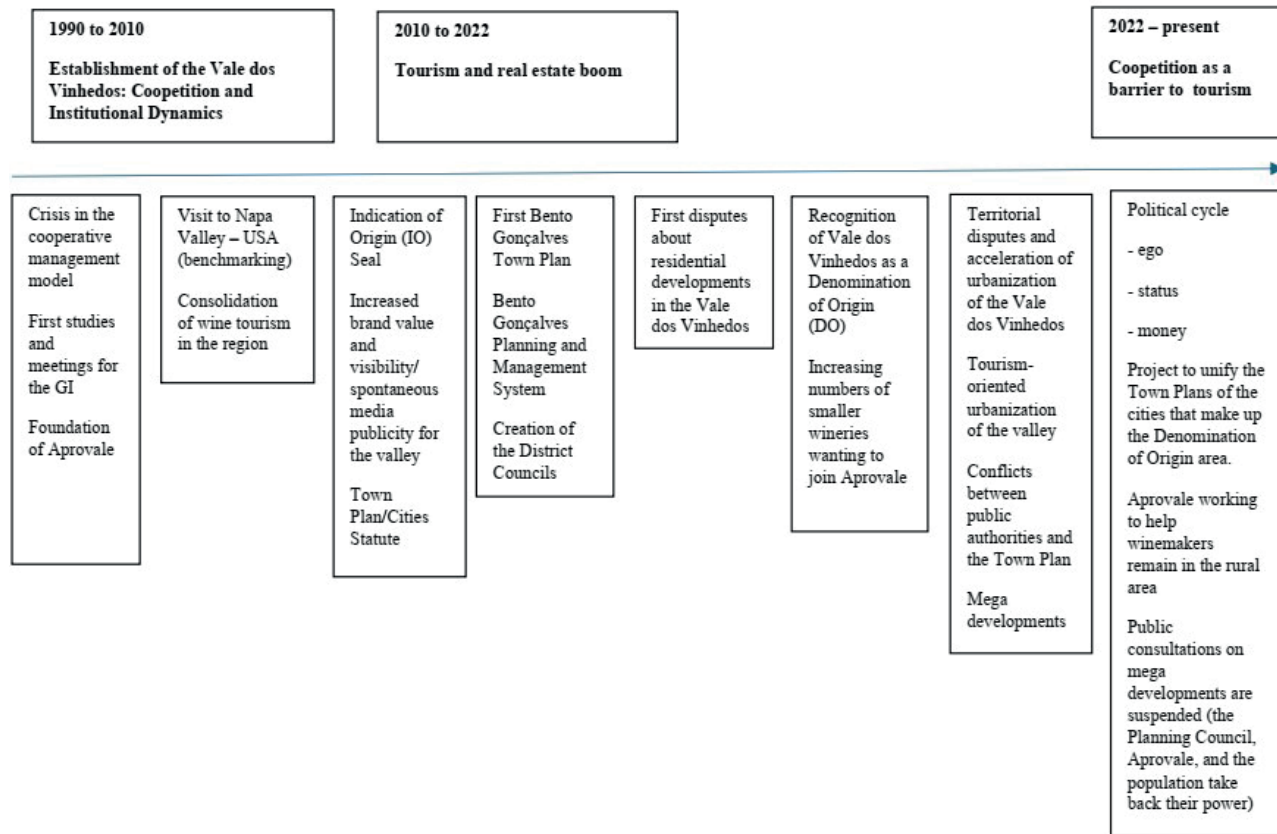


Figure 1. Timeline of Brazilian wine industry.

in increased wine production linked to tourism, fine dining, hospitality, input production, and cultural heritage. Public and private representatives stress the need for infrastructure investment and fostering a sense of belonging to the GI territory, pointing to the enhanced value of both tangible and intangible assets.

The representative from Formal Institution Agent 8 described the region's shift toward collaboration: "[...] here, an entity tried to join forces. Initially, there was fierce competitiveness – wineries would even criticize each other's wines. But now, they've realized the power of working as a group. However, competition still exists, as wineries compete for space on restaurant wine lists and in shops" [President of Formal Institution Agent 8, 2013]. This evolution over the past decade illustrates how Vale dos Vinhedos has grown not only as a center for wine production and tourism but also as a community that embraced coopetition to expand its strategic opportunities.

In these terms, several formal institution agents acted to prevent the de-characterization of the Vale dos Vinhedos. "Embrapa, for example, played an important role in identifying the most suitable regions for growing

certain grape varieties, taking into account environmental factors (topography, soil, climate, rainfall). Aprovale coordinated actions between different participants in the wine chain. Ibravin acted on behalf of the wineries." (Specialist, 2017). This coordination between different formal institutional agents was relevant in dealing with another challenge, the drop in tourist numbers due to the COVID-19 pandemic. For example, in 2019, the Vale dos Vinhedos received around 450,000 tourists, while in 2020 this number fell to 229,000 tourists[58,59]. The drop in tourist arrivals has led to multi-scalar cooperation: Aprovale as the local coordinator, the City Council as the executor of public policies, the State and Federal Governments as providers of credit and campaigns, and Sebrae/Embratur as promoters of innovation and marketing. This institutional network made it possible to reduce the impact of the crisis and speed up the recovery from 2021 onwards.

Therefore, on the one hand, coopetition has played an important role in the development of the wine tourism destination. On the other hand, it has contributed to constraining opportunistic behavior by establishing bar-

riers to real estate speculation and large-scale hotel projects. These dynamics illustrate the paradoxical nature of coopetition, not only with regard to the interplay between competition and cooperation, but also in terms of its outcomes, which simultaneously foster tourism development while discouraging initiatives that could undermine the cultural and territorial identity of the region. In this way, the collective efforts of decades have been preserved.

4. DISCUSSION

Coopetition has proven to be a relevant response to institutional threats and challenges, particularly those arising from divergent interpretations of the benefits associated with the Vale dos Vinhedos Geographical Indication. Wineries in the region engage in cooperative and competitive behaviors simultaneously, although in distinct domains, in order to achieve outcomes that would be unattainable individually, both in terms of market positioning and the development of wine tourism. This collective strategy also produces positive externalities that extend to other actors along the winemaking value chain. Evidence from Vale dos Vinhedos thus supports the perspective advanced by [15], which frames coopetition not simply as a deliberate managerial choice, but as a structural condition intrinsic to tourism destinations. As emphasized in the tourism coopetition literature (e.g. [31,34], the shared use of resources, destination reputation, and infrastructure renders cooperation unavoidable, even as competitive dynamics in the marketplace persist. Nevertheless, wineries continue to display strongly individualistic behavior, characterized by intense competition in the domestic market [11]. Such dynamics result in asymmetries between individual contributions and the benefits captured by each winery, a pattern that may be partly explained by industry-specific cultural traits that favor individual action [10]. Even so, there remains a broadly shared understanding among stakeholders that collective initiatives generate greater long-term advantages than isolated efforts, particularly in safeguarding the GI from pressures linked to real estate development.

This study traced the collaborative efforts over the years to establish the GI, involving wineries, sectoral organizations, universities, research centers, public administration, and groups rooted in Italian ethnicity. The culmination of these efforts was the creation of the Vale dos Vinhedos Indication of Origin, ensuring quality assurance [42]. However, the region now faces a decision: maintaining its winemaking and tourism achieve-

ments or allowing further development focused on real estate. This situation aligns with findings by Duarte Alonso et al. [59], who highlighted the sustainable development potential of wine tourism.

The proposed framework (Figure 2) serves to analyse the paradoxical and dynamic form that cooperative competition) scene presents in a tourism destination managed by GI. The basic formation of collective branding by the actors, to assure the singularity and identity of a quality product (dimension of value creation) that integrates a degree of specificity that characterizes GI. But the other side of this cooperation would be value capture such as asymmetric gains and appropriation conflict among some actors rather than most. And the strategy may involve some value destruction that could be avoided: opposing real estate developments that would diversify what is left of the local economy. There are three dynamic values that are not linear but intersect each other: and often against, giving the paradoxical effectiveness of the strategy.

This process is structured and intermediated by institutional bases that so-called ‘rules of the game’ (both formal and informal). These rules govern the nature of competition and how costs and benefits of coopetition are shared. The result is dialectical two contradictory forces are set into play at once. On the one hand, the strategy becomes a facilitator in accurately maintaining the authenticity of GI and in achieving destination sustainability and enhancement initiatives for GI. On the other hand, it can be seen as a “breakwater” that controls tourism diversification and then limits opportunities for value added creation; this causes an intersystem contradiction between conservation and development.

The Vale dos Vinhedos has become a model for other regions, inspiring new winemaking projects and tourism investments across Brazil. The GI underscores the physical distinctions among wine regions, based on climate, soil, terrain, grape varieties, cultivation practices, and cultural factors, similar to traditional winemaking countries. This enhances the international reputation of Brazilian wines, strengthening their image, confidence, and recognition [55]. The region’s perception of quality is also closely linked to wine tourism practices that emphasize co-creation of experiences [8,47].

5. CONCLUSIONS

The objective of this study was to understand how coopetition can create barriers to tourism through coopetition focused on collective interests that seek to

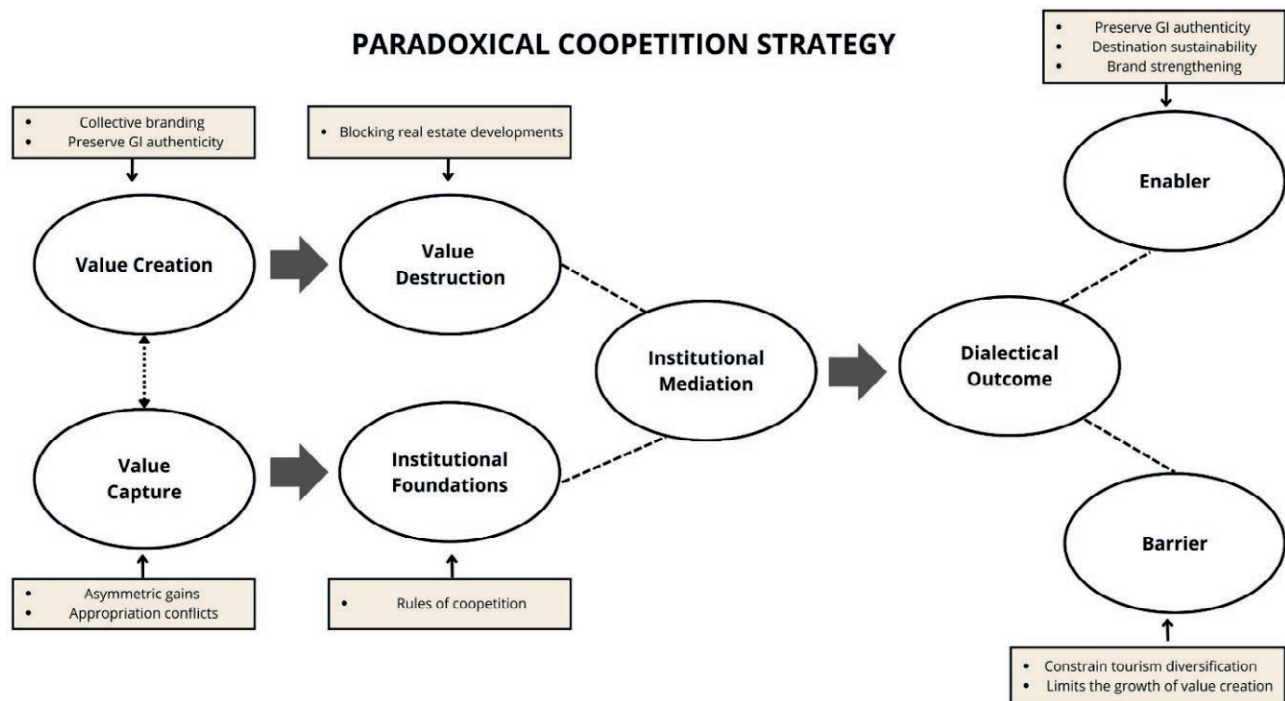


Figure 2. Paradoxical coopetition strategy.

preserve the identity of a geographical indication. We found that GI constitutes a central driver of development in the Vale dos Vinhedos, whether economic, social, or environmental, by increasing winemaking activity in conjunction with fine wine dining, with hospitality, with winemaking equipment and supplies, and with the Vale's cultural heritage. However, this movement is also creating a need for increased public and private infrastructure, increasing the feeling of community belonging, and appreciation of the value of the material and immaterial heritage of the territories of the geographical indications.

As such, coopetition has played a relevant role while, at the same time, impeding development of tourism through real estate projects. To stop this uncontrolled expansion, wineries and formal institution agents established a coopetition strategy to block the entry of new ventures such as hotels and timeshare resorts that could distort the region's character. For instance, Formal Institution Agent 8 warns that the sustainable development of the region is threatened, both in the sense that increasing the accommodation supply in the Vale dos Vinhedos is an insufficient argument to justify planning approval for new real estate developments, and also in relation to degradation of the vineyard landscape and the impact on wine tourism. Therefore, coopetition has also made it possible to face up to institutional threats and difficulties, mainly those arising from different perspectives

based on understanding the gains for association members from the Vale dos Vinhedos GI, but that can slow tourism development in the region.

The study showed that coopetition in Vale dos Vinhedos is a paradoxical strategy. On the one hand, it is fundamental to the establishment and maintenance of the Geographical Indication (GI), crucial for promoting economic, social, and environmental development through wine tourism; on the other hand, it also plays a role in reinforcing social identity at the regional level. Thus, this logic also creates obstacles to tourism development, preventing the diversification of demand for new real estate offerings (hotels, resorts), perceived as a threat to the authenticity of the wine landscape. The study shows how "coopetition" protects the GI from institutional threats and unrestricted real estate proliferation (which are likely to lead to overexploitation), while it can further restrict the possibilities for creating added value for the benefit of the tourist destination, leading to a conflict between conservation and development.

Despite its contributions, this study does have limitations. First, the investigation took place in a single destination, but as this is the most important wine-producing region in Brazil, the research could be easily expanded in the future to encompass other such regions. Second, it is necessary to collect more perspectives from representatives of real estate developers, hotels, and other tourism

businesses to evaluate different perceptions about the challenge of steering between promoting the region's development and preserving the region's characteristics.

For future research, we suggest analyzing the dynamics of coopetition in other Brazilian wine regions that have obtained or are seeking a GI, from which management models and balances between conservation and creation values can be inferred. Furthermore, it would be interesting to contribute with research that considers the percentage of agents from the real estate and/or hotel sectors, analyzing how different actors perceive the challenges and growth potential in the region and how coopetition strategies among them could become more inclusive to seek to preserve the GI identity while simultaneously achieving efficient economic diversification.

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A Delphi Analysis of Italian Stakeholders' Perspectives on Partial Dealcoholization of PDO and PGI Wines: Navigating Innovation and Territorial Identity

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Abstract. The growing relevance of No- and Low-alcohol (NoLo) wines, largely produced through post-fermentation dealcoholization techniques, is reshaping the wine sector, driven by evolving consumer preferences and climate-related increases in grape sugar content. Although European Union (EU) legislation permits partial dealcoholization for Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) wines, national approaches differ, with Italy maintaining a cautious stance. This study explores wine experts' perspectives on introducing partial dealcoholization into Italian PDO and PGI specifications through a two-round Delphi survey. It examines levels of acceptance, key conditions, and perceived barriers to its inclusion in official production regulations. Results show broad acceptance for PGI wines, while PDO wines, especially higher-tier categories, face strong resistance due to concerns about authenticity, sensory identity, and cultural heritage. Experts favor naturally low-alcohol wines achieved through viticultural and oenological practices, but recognize the limits imposed by climate change and grape composition. A flexible, integrated approach is therefore suggested, using partial dealcoholization as a complementary tool when necessary. Findings underline the importance of governance, protection Consortia, and transparent labeling, framing partial dealcoholization as a "bounded innovation" whose legitimacy depends on preserving territorial identity, regulatory coherence, and consumer trust. This exploratory study maps stakeholder positions and offers insights for future research and policy development on integrating NoLo wines into geographical indication systems.

Keywords: dealcoholized wines, quality wines, Delphi method, wine experts.

1. INTRODUCTION

In recent years, the wine sector has faced growing pressure to innovate in response to changing consumer expectations and global market dynamics [1]. Among the most discussed innovations are No- and Low-alcohol (NoLo) wines, which are progressively gaining relevance. Unlike traditional wines, NoLo wines are characterized by reduced or absent alcohol content, achieved through specific technological processes such as nanofiltration, reverse osmosis, and pervaporation [2]. Although alcohol removal techniques have existed since the early 20th century [3], these products remained marginal until recently.

NoLo wines are increasingly perceived as viable alternatives to conventional wines, addressing current challenges facing the global wine sector: rising alcohol levels due to climate change [4], consumer shifts toward moderation and wellness [5,6], and structural decline in alcohol consumption in major markets [7]. According to the 2024 International Organisation of Vine and Wine (OIV) report, global wine consumption fell by 3.3% in 2024 compared to 2023, continuing a downward trend observed since 2018 across both traditional and emerging markets [7]. From a supply perspective, NoLo wines enable product diversification [3] and allow wineries to reach new consumer segments, including health-conscious and culturally or religiously restricted individuals [6,8–11], while supporting stock management and long-term resilience in a highly volatile sector [2]. On the demand side, interest in NoLo wines is driven by health, cultural, and lifestyle factors [12,13]. In particular, the growing global trend toward “mindful drinking” [6,13–15] is increasing interest in lower-alcohol options, associated with reduced health risk, lower calories intake, and broader market and social inclusion [8,16,17]. Increased awareness of alcohol’s negative health effects has expanded the appeal of reduced-alcohol alternatives [18]. Additionally, drivers include religious norms, physical conditions such as pregnancy, and lifestyle choices further support demand [11,19]. Recent evidence confirms the growing relevance of health motivations, sensory expectations, and contextual factors in shaping consumer attitudes toward these products [20].

Market indicators confirm the growing relevance of the sector: the global NoLo wine market reached approximately USD 2.84 billion in 2025 and is expected to grow at annual rates exceeding 10% over the next decade [21]. Among European Union (EU) countries, Germany already represents a significant market for NoLo wines [3]. In 2020, non-alcoholic sparkling wines accounted for about five percent of Germany’s sparkling wine market, while still wines remained below one percent. Together,

these dynamics highlight the potential of NoLo wines as both an expanding opportunity and an emerging necessity within the contemporary wine market.

Recent EU legislation [22] has authorized the partial dealcoholization of Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) wines. This allows these wines to be marketed with alcohol by volume (ABV) levels below the standard EU minimum limits (8.5% in Northern EU Member States and 9% in others). Nevertheless, national implementation varies across Member States: while France has already authorized these practices [23], Italy has not yet done so.

The partial dealcoholization of PDO and PGI wines presents opportunities but also raises concerns regarding their legitimacy. Dealcoholization entails a technological modification that partially deconstructs and reconstructs the wine’s original characteristics [24,25]. Therefore, the EU’s openness to this practice may appear conceptually at odds with the legal foundations of geographical indications (GIs), which are defined as names used to describe a product whose quality and characteristics are linked to its territory of origin [26]. This tension is particularly relevant for PDO wines, whose quality and characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors. By contrast, PGI wines require a weaker link, as their specific quality, reputation, or other characteristics can only be “attributable” to the area of origin. Even though, the sensory impact of partial dealcoholization might be relatively minor, naturally low-alcohol wines achieved through viticultural and oenological practices could appear more coherent with PDO and PGI principles than wines modified through post-fermentation interventions. However, this technical option is not currently constrained by legal definitions: grape fermentation must reach minimum ABV thresholds for a product to be classified as “wine”. This raises broader questions about whether current minimum alcohol requirements remain appropriate. Since PDO and PGI wines are a strategic component of the EU wine supply, reconciling the legal nature and perceived identity of GI wines with the increasing demand for lower-alcohol products emerges as a key research challenge. This study explores this issue through an investigation of stakeholders in Italy, a topic that has so far received limited scholarly attention, leaving several open questions regarding the opportunities and challenges associated with the risk of eroding PDO and PGI reputation.

This tension between innovation and institutional preservation is not unique to the wine sector. GIs are collective institutional constructions in which reputation functions as a shared asset, co-produced by producers,

territory, and governance structures over time [27]. Any technological modification of the product therefore risks affecting this collective reputational good, regardless of its technical merits. At the same time, GI systems are not static: they evolve through incremental adjustments that add new elements alongside existing rules without dismantling the institutional core [28]. Partial dealcoholization can thus be understood as a candidate for institutional layering, a potential addition to the GI regulatory framework that, if properly bounded, need not undermine the identity principles on which these systems rest. Whether and how such an addition would be perceived as legitimate by the actors embedded in this institutional context is precisely the question this study addresses.

Consequently, the study investigates expert opinions on the potential integration of partial dealcoholization into the specification for Italian PDO and PGI wine production. The analysis is guided by the following five research questions: i) Do wine experts in Italy accept the introduction of partial dealcoholization in PDO and PGI wines? (RQ1); ii) What minimum alcohol content should be set for such wines? (RQ2); iii) Who are the key actors in the debate? (RQ3); iv) What opportunities and challenges exist for the Italian wine value chain? (RQ4); v) Are naturally low-alcohol wines currently preferred over partially dealcoholized ones? (RQ5). By analyzing the perspectives of wine industry experts, this research aims to identify the main opportunities, concerns, and future outlook associated with the incorporation of dealcoholization practices within prestigious wine categories. To this end, a Delphi analysis was conducted with a panel of key stakeholders in the Italian wine sector, providing a multi-actor and informed assessment of the issue.

The structure of the article is organized as follows. Section 2 outlines the background considering also the EU regulatory framework for NoLo wines. Section 3 describes materials and methods while section 4 presents the findings. Section 5 discusses the results and draws conclusions, highlighting implications, acknowledging limitations, and suggesting future research directions.

2. BACKGROUND

The rapid growth of the NoLo wine sector is driving regulatory innovation at both EU and international levels, progressively redefining production and marketing conditions. First, the OIV updated the International Code of Oenological Practices in 2012. Specifically, Chapter 6, titled “Products derived from grapes, grape must or wine”, now includes two new categories: “beverages obtained through total dealcoholization of wine”

and “beverages obtained through partial dealcoholization of wine” [24,25]. These updates restrict the use of the term “wine” to products explicitly labeled as “dealcoholized” or “partially dealcoholized” [29].

Subsequently, Regulation (EU) 2021/2117 [22] amended Regulation (EU) 1308/2013 [26] by including partially or totally dealcoholized versions of all seven wine categories within the EU grapevine product classifications. These products are defined as having an ABV below standard legal thresholds. For PDO and PGI wines, only partial dealcoholization is permitted [22,26]. This extension of dealcoholization, even if only partial, from generic wines to prestigious designation categories represents, as mentioned, a major policy shift.

Implementation, however, remains uneven across Member States. France has already integrated partial dealcoholization into its regulatory system, authorizing PGI wines with alcohol content down to 6% ABV subject to sensory evaluation since April 2024 [23]. Several PGIs are adapting their specifications accordingly. In the Gard area (Languedoc-Roussillon), IGP Cévennes is preparing to allow dealcoholized wines at 6% ABV [30]. Similarly, IGP Atlantique, covering Bordeaux and surrounding regions, has reduced its minimum alcohol level to 9% ABV and is considering a further reduction to 6% ABV [30]. These cases illustrate how the implementation of EU regulations differs not only across Member States, but also within national contexts, as individual PGIs adjust their standards in response to evolving market and policy dynamics. By contrast, Italy has adopted a more conservative stance: national rules still prohibit partial dealcoholization for PDO and PGI wines [31,32], reflecting strong cultural attachment to tradition and institutional concerns over product identity and market positioning. This divergence highlights tensions between regulatory innovation and tradition, as countries like Italy confront issues of wine authenticity and identity.

Beyond dealcoholized wines, naturally low-alcohol wines are emerging as an alternative strategy for reducing alcohol content within PDO and PGI schemes. These wines are already allowed within PDO and PGI frameworks, within the limits set by their specifications, when obtained through agronomic measures, targeted winemaking practices, or the use of naturally low-sugar grape varieties. Spain offers a relevant example: in 2024, a naturally 9% ABV PDO dry wine from Parellada grapes was presented at Barcelona Wine Week and granted PDO status under traditional rules [30]. A similar trend is emerging in Italy, where the Delle Venezie PDO has amended its production specification to introduce a new lower-alcohol wine category ranging from 9% to 11% ABV [33]. This revision formally inte-

grates reduced-alcohol wines into the PDO system without dealcoholization, reinforcing their strategic relevance in response to market and climate pressures. Notably, these examples still comply with current minimum alcohol thresholds, while naturally low-alcohol wines below the legal threshold represent an emerging frontier. The techniques under experimentation in the cases above could, if further advanced, enable such wines to achieve improved sensory quality beyond the standard minimum alcohol level required for wine classification.

Within the EU regulatory framework, Italian PDO wines are marketed as DOC (*Denominazione di Origine Controllata*) and DOCG (*Denominazione di Origine Controllata e Garantita*), while Italian PGI wines are classified as IGT (*Indicazione Geografica Tipica*). Although both PDO categories comply with strict production regulations linked to specific geographical areas, DOCG wines represent the highest quality tier, with more stringent rules, lower yields, and mandatory official chemical-physical analyses prior to market release. Most PDO and PGI designations are governed by Consortia, namely associations of producers, processors, and bottlers, responsible, among other tasks, for updating product specifications. These documents define key parameters such as minimum alcohol content and the required viticultural, oenological, and geographical conditions. Therefore, introducing dealcoholization practices in these schemes would require formal amendments and broad institutional and sectoral consensus.

Italy's wine sector is heavily oriented toward PDO and PGI wines: Federdoc (2025) reports 77 DOCG, 330 DOC, and 118 IGT wines [34], with about two-thirds of grapes destined for GI wines [35,36]. Economically, this sector generated about €11 billion in 2023, with bottled production of 25.9 million hectoliters, confirming its central role despite a slight contraction in volumes and exports [36].

3. MATERIAL AND METHODS

The possible introduction of partial dealcoholization into the production regulations of Italian PGI and PDO wines is an emerging topic for which no consolidated empirical evidence or prior regulatory experience exists. For this reason, and in line with Delphi applications in the agri-food domain, a qualitative approach was adopted to gather, compare, and synthesize the perspectives of a heterogeneous group of experts operating within the Italian wine sector.

3.1 The Delphi approach

The Delphi approach is a structured expert consultation technique characterized by anonymity, iteration, and controlled feedback [37]. Originally developed to support decision-making under conditions of uncertainty, it is well suited to complex issues that combine regulatory, technical, and value-based dimensions and where empirical data are sparse [38]. Its qualitative nature allows researchers to explore future scenarios, identify opportunities and challenges, and highlight areas of convergence without forcing consensus among participants [39].

Within this study, the Delphi method was used to investigate the potential integration of partial dealcoholization into the PGI and PDO frameworks, drawing on the viewpoints of actors positioned at different levels of the Italian wine value chain.

3.2 Expert panel

Experts were selected through purposive sampling. The main criterion was extensive knowledge of the denomination system, oenological practices, and the potential technical, economic, and institutional implications of dealcoholization. Invitations were sent to representatives of wine protection Consortia, professional and trade organizations, certification bodies, institutional and technical authorities, universities and research centers. In total, 162 experts were contacted, 35 of whom participated in the first round; 26 of them also took part in the second round. This heterogeneous participation ensured a broad range of viewpoints, consistent with the exploratory aims of the research. Table 1 summarizes the professional backgrounds of the experts who participated in the Delphi exercise.

The reduction from 35 to 26 participants between rounds represents an attrition rate of approximately 26%, consistent with ranges commonly reported in the Delphi literature [40–42]. Non-participation in round 2

Table 1. Professional categories of the respondents of the two rounds.

Professional category	First round (n = 35)	Second round (n = 26)
Wine protection Consortia	13	8
Trade organizations	7	6
Certification bodies	4	3
Universities or Research Institutions	10	8
Policy makers	1	0

was attributed to scheduling constraints and professional commitments. Dropout was distributed across all professional categories represented in round 1 (Table 1), with no single group disproportionately absent, which limits concerns about systematic non-response bias. Nevertheless, as with any voluntary expert panel, some degree of self-selection cannot be excluded: participants may be more engaged with the topic of dealcoholization than the broader professional community. The limited participation of policymakers (n=1 in round 1, n=0 in round 2) is acknowledged as a limitation, particularly given the regulatory focus of the study, and is discussed further in Section 5.

3.3 Execution of the Delphi process

The Delphi exercise was conducted in two rounds between June and September 2025. In round 1, participants were invited to provide reasoned assessments on several dimensions of the potential inclusion of partial dealcoholization within PGI and PDO specifications. These included: feasibility considerations, expected impacts across the value chain, identification of key actors shaping the debate, and the broader implications for the Italian wine sector. Responses were open-ended and subsequently synthesised by the research team. In round 2, a structured summary of the first round was shared anonymously with all participants, who were asked to reconsider their earlier positions in light of the collective feedback. Prior to distribution, the round 1 questionnaire was piloted with four experts representing the main professional categories included in the panel (academics, Consortia representatives, and policymakers), leading to minor adjustments in question wording and structure. The questionnaire was developed directly from the five research questions guiding the study. The round 2 questionnaire was constructed on the basis of a structured synthesis of round 1 responses, designed to deepen the most salient and divergent themes identified in the first round, in line with standard Delphi practice. The second questionnaire further explored the most salient or divergent issues, to clarify emerging tendencies and identify possible areas of alignment. As for the key actors, in this round respondent evaluated each stakeholder's level of interest and influence on a four-point Likert-type scale (1 = not at all; 4 = highly), enabling their classification into distinct groups. The combination of a qualitative approach (applied in round 1) and a quantitative one (in round 2) for analyzing key stakeholders proved highly effective in refining the assessment. Indeed, it built on the initial set of actors identified by survey respondents, in line with the expectations

of a stakeholder analysis, thereby ensuring consistency in the selection process across the two rounds. Throughout the process, communication was mediated exclusively by the researchers, thereby preserving anonymity and preventing peer-influence effects.

3.4 Data analysis

All qualitative material collected across the two rounds was analyzed through thematic analysis, consistent with methodological standards for Delphi studies [43]. The analytical approach was primarily deductive, with themes derived from the five research questions, while remaining open to inductively emerging sub-themes. All four co-authors independently coded the responses; divergences were resolved through iterative discussion among the research team until consensus was reached [44]. Five main thematic areas were identified, corresponding to the subsections presented in Section 4. The analysis aimed not to reach consensus but to map the argumentative landscape around the potential adoption of partial dealcoholization, identifying perceived opportunities, risks, and key conditions for future regulatory developments

4. RESULTS

This section summarizes the main findings that emerged from the two-round Delphi exercise. The results are organized thematically and reflect areas of convergence and divergence among experts regarding the possible introduction of partial dealcoholization into the PGI and PDO wine regulations in Italy.

4.1 Feasibility of introducing partial dealcoholization into PGI and PDO wines

Experts expressed diverse views on the feasibility of introducing partial dealcoholization into Italian quality wine schemes. A broad consensus identified PGI wines as the most suitable context, seen as a way to meet growing demand for lower-alcohol products, diversify portfolios, and enhance international competitiveness. Some participants also cautioned that, if the regulatory framework remains unchanged, Italy risks falling behind countries such as France, where partial dealcoholization is already permitted for PGI wines.

Despite this general openness, a minority suggested initially limiting the practice to wines without G until clearer evidence on consumer acceptance and market

performance emerges. Others recommended prioritizing viticultural and oenological practices that naturally reduce alcohol content, in some cases combined with adjustments to existing PGI regulations, rather than relying on dealcoholization.

Attitudes toward introducing partial dealcoholization into PDO wines were markedly more cautious. A narrow majority opposed their inclusion, citing concerns over authenticity, typicity, sensory identity, and cultural value, with particularly strong resistance for high-tier categories such as DOCG and related special typologies. Some experts viewed dealcoholization as potentially conflicting with the traditional principles of PDO wines and likely to weaken their established reputation, while others proposed gradual solutions, such as allowing Consortia to decide autonomously or creating dedicated PDO categories for partially dealcoholized wines. This resistance appears to be more pronounced among stakeholders more closely linked to institutional and territorial governance (e.g., Consortia, policy makers, and certification bodies), who more frequently express cautious or negative positions. For these actors, PDO wines represent not only an economic asset but also a form of collective heritage to be preserved. These patterns suggest that attitudes toward partial dealcoholization are not solely shaped by technical or market considerations, but are deeply embedded in the institutional positions of the actors involved: those responsible for safeguarding collective reputation are structurally more resistant to changes that may alter the perceived authenticity of the product.

4.2 Minimum alcohol content for partially dealcoholized PDO/PGI wines

Experts expressed highly varied opinions regarding minimum residual alcohol levels, and no clear consensus emerged. While some favored aligning with the French threshold of 6% ABV, which was viewed as a reasonable compromise between market expectations and product integrity, others advocated maintaining higher limits (typically 7-8% ABV) to better safeguard wine structure and sensory profile. A smaller group supported lower thresholds (around 4-5% ABV), particularly for PGI wines. Additional proposals included differentiated thresholds for PGI versus PDO wines, as well as greater case-by-case flexibility, with several participants arguing against the adoption of rigid national limits. Many experts also highlighted the need for further technical and scientific evaluation to better assess the sensory and qualitative implications of different thresholds. These divergent positions reflect, at least partially, differences across stakeholder groups. Actors more directly involved

in governance and quality control (e.g., Consortia, certification bodies, and policy makers) tend to favor more cautious approaches and, in some cases, higher or more structured thresholds, in order to safeguard product identity and consistency. By contrast, actors with a more technical or representative role (e.g., research institutions and trade organizations) more frequently express openness toward flexible or differentiated thresholds, while also highlighting the need for case-by-case evaluation.

As regards regulatory governance, most experts favored a decentralized approach, assigning a key role to protection Consortia in defining appropriate limits and conditions for dealcoholization within their respective PDO and PGI product specifications. The preference for more decentralized or hybrid governance arrangements (particularly among stakeholders such as Consortia, trade associations, and, to some extent, research institutions) highlights the importance of local institutional control within GI systems, where legitimacy is closely tied to collective decision-making at the territorial level. Others supported a hybrid model, combining a national baseline threshold (often identified at 6% ABV) with the possibility of more restrictive local rules, while a smaller group preferred a uniform national standard to ensure clarity and prevent regulatory fragmentation.

4.3 Key actors shaping the national debate

In the first round, respondents identified the key stakeholders shaping the debate, resulting in a broad mapping of institutional, economic, scientific, and market actors involved, including wine protection Consortia, wine trade associations and professional agricultural organizations, the Italian Ministry of Agriculture, Food Sovereignty and Forests (MASAF), the National Committee for PDO and PGI Wines, OIV, large wineries and cooperatives, individual wine producers, universities and research institutions, retailers, certification bodies, consumers and their associations, as well as opinion leaders, oenologists, journalists, wine critics, and wine marketing experts. In the second round, stakeholders were classified into the following four groups, as outlined in the influence-interest matrix [45] in Figure 1: “Key actors” (moderate-high interest and influence), “Secondary actors” (low interest and influence), “Market drivers” (moderate-high interest but low influence), and “Public institutions and sector associations” (moderate-high influence but low interest).

Within the group of “Key actors”, large production groups and cooperatives play a central role due to their capacity to invest in innovation and influence market dynamics and strategic debates. Wine trade

associations are also pivotal in representing producers' interests and exerting political and technical influence at the national level. Universities and research institutes contribute through their scientific and technological expertise, supporting evidence-based decision-making. Retailers complete this group thanks to their strategic position in shaping product offerings, influencing consumer demand, and facilitating the market uptake of innovative wines. "Secondary actors" include stakeholders with more limited involvement in the regulatory debate, such as the National Committee for PDO and PGI Wines, which mainly fulfils technical and advisory functions, and small-scale producers constrained by limited resources and technological capacity to influence national-level discussions. Certification bodies also belong to this group, as they focus primarily on regulatory compliance and the monitoring of standards rather than on shaping policy or innovation pathways. Opinion leaders, journalists, and wine marketing experts are perceived as having a modest impact on formal decision-making, although they contribute to framing public discourse and influencing perceptions of innovation within the wine sector, as in the case of NoLo wines. The OIV is likewise included, exerting indirect influence through international standards and scientific legitimacy that do not necessarily translate into immediate or binding effects on national regulatory processes. The "Market drivers" group includes consumers and their associations, who play a key role in shaping demand and acceptance for innovative products such as partially dealcoholized wines. However, their impact on politi-

cal and regulatory processes remains limited, and the translation of demand into regulatory change depends on broad market uptake and producers' strategies, particularly in Italy, where innovation must balance market trends with cultural and heritage considerations. Finally, "Public institutions and sector associations" include wine protection Consortia, MASAF, and professional agricultural organizations, which are characterized by high influence but moderate interest. Their limited focus on partial dealcoholization for PDO and PGI wines may reflect competing priorities within the wine sector, including trade issues (i.e., new tariffs), price volatility, declining production volumes, climate-related risks, and wider market uncertainties.

4.4 Opportunities and risks associated with partial dealcoholization

Experts identified a wide range of potential opportunities linked to the introduction of partial dealcoholization. These include the possibility of innovating product portfolios, accessing new markets as well as consumer segments (particularly younger, health-conscious, or alcohol-sensitive groups), and enhancing international competitiveness by better responding to evolving global demand. Dealcoholization may also serve as a strategic response to declining wine consumption and oversupply in several markets. Retailers could benefit from expanded assortments and product differentiation, while consumers may find in these wines a viable alternative that reduces alcohol-related concerns. Overall, transpar-

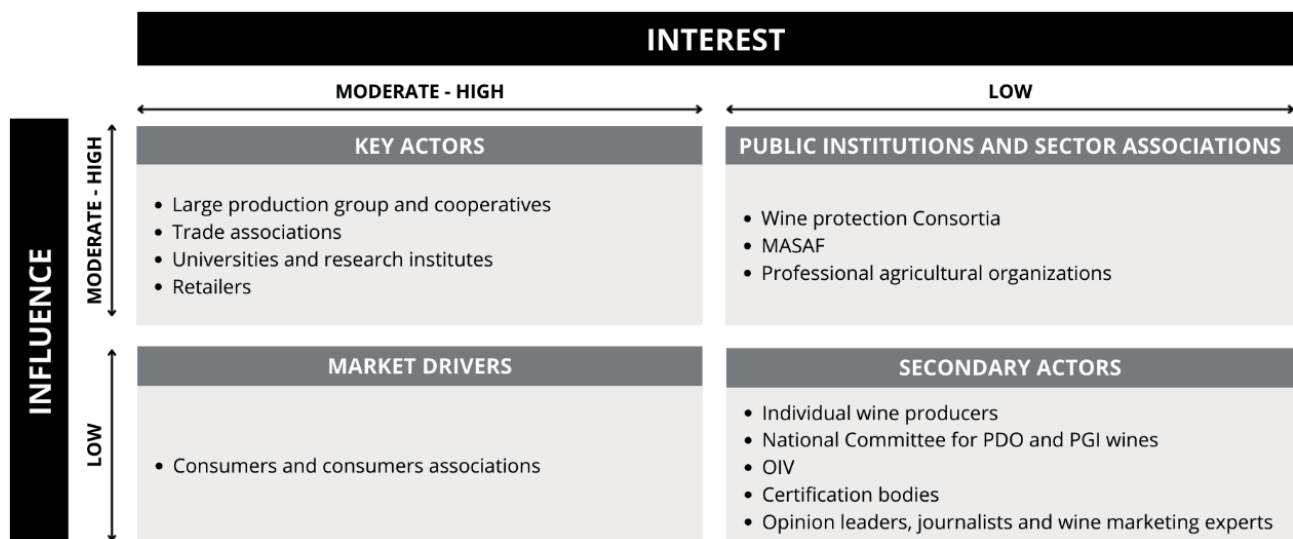


Figure 1. Stakeholders' influence-interest matrix. Note: Scale 1-4; actors scoring 1-2 were classified as low, while those scoring 3-4 were classified as moderate to high.

ent labelling requirements were viewed as essential for maintaining consumer trust.

At the same time, important risks and challenges were highlighted. The main concern relates to the potential erosion of quality, typicity, and territorial identity, especially for PDO wines, along with possible cannibalization of traditional products and reputational impacts on quality denominations. Technological limitations were also noted, as current dealcoholization methods may reduce aromatic intensity, structure, and overall sensory balance, potentially affecting consumer satisfaction and willingness to pay. These concerns, particularly those related to quality, typicity, and territorial identity, emerge across different stakeholder groups, but appear especially relevant among actors involved in safeguarding collective reputation and product standards. This pattern suggests that risk perception in the context of GI innovation is not homogeneous but partially shaped by actors' positions within the governance system: those entrusted with protecting collective reputation and product standards tend to weigh potential threats to identity more heavily than potential market gains.

Experts further emphasized economic and organizational barriers, particularly for small and medium-sized producers, who may face difficulties accessing costly and complex technologies, leading to competitive asymmetries. Additional challenges may arise along the distribution chain due to increased operational complexity (e.g., related to assortment management, logistics, and the need for targeted staff training).

These issues could be exacerbated by regulatory fragmentation and uneven implementation across Member States and the lack of harmonized standards on labelling, controls, and traceability, potentially generating consumer confusion and weakening trust.

Figure 2 summarizes the main drivers and barriers identified across the panel.

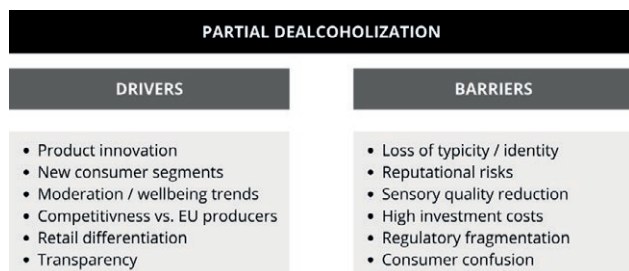


Figure 2. Key drivers and barriers identified by experts.

4.5 Preference for naturally low-alcohol wines

A recurring theme across both rounds was experts' strong preference to produce naturally low-alcohol PGI wines, obtained through viticultural and enological practices that limit sugar accumulation or modulate fermentation, rather than through physical dealcoholization. This approach was generally perceived as offering several advantages, including stronger protection of sensory quality, territorial identity, and the distinctive characteristics of PGI wines. It was also regarded as more consistent with traditional production methods, better aligned with consumer expectations of authenticity and naturalness, and easier to communicate, thereby facilitating market acceptance. This preference can also be interpreted as reflecting a compromise between innovation and tradition: it appears to be more strongly supported by actors more closely linked to production and territorial governance (e.g., Consortia and trade associations), while other stakeholder groups express more heterogeneous positions, suggesting different sensitivities to issues of product authenticity and market adaptation.

Moreover, many experts considered naturally low-alcohol wines to be more sustainable from both an environmental and socio-cultural perspective. However, limitations in terms of feasibility also emerged, linked to increasing climatic variability and to the challenges of consistently ensuring sensory balance and stability. In this context, experts pointed to the need for an integrated and flexible approach, combining agronomic and enological practices with partial dealcoholization when necessary.

5. DISCUSSION AND CONCLUSIONS

This study examines stakeholders' perceptions in the Italian wine sector regarding the EU's regulatory opening to the partial dealcoholization of PGI and PDO wines, within the framework of the EU policy on GIs. Here, coherence remains an underlying theme. Given the novelty of NoLo wines [21] and their potential application within PGI and PDO regulatory frameworks, existing literature provides limited guidance for interpreting these findings. While technological feasibility, production methods, and the growing market relevance of dealcoholized wines have been increasingly examined in recent contributions [6], the governance implications of their inclusion within GIs schemes remain underexplored. Consequently, this section positions the results within the current regulatory, institutional, and market context, highlighting their conceptual and policy implications.

From the current regulatory and market context, the findings reflect a broader tension in the contemporary European wine sector: the coexistence of increasing pressure for innovation and a strong commitment to the protection of wine identity and territorial authenticity. This pattern reflects the recent evolution of EU wine policy, marked by the introduction of innovations such as the recognition of dealcoholized and partially dealcoholized wines, including the possibility of partial dealcoholization for PDO and PGI wines. It also enables the use of fungus-resistant grapevine varieties, which have long been marginalized due to the traditional emphasis on the genetic purity of *Vitis vinifera*.

Dealcoholization represents a clear departure from traditional European wine regulation, in which alcohol content has historically been regarded as an essential component of wine identity [46]. At the same time, market analyses highlight how the NoLo wine segment remains structurally sensitive to issues of identity, positioning, and competitive dynamics [3].

This tension is particularly evident in Italy, where the regulatory framework has so far maintained a conservative stance toward dealcoholization within quality wine schemes [31,32], despite the opening introduced at the EU level. The differentiated attitudes observed among experts in our sample toward PGI and PDO wines reflect this underlying institutional asymmetry. The broader acceptance of partial dealcoholization for PGI wines appears consistent with their historically more flexible positioning, whereas the strong resistance observed for PDO wines, especially for higher-tier categories such as DOCG and related special typologies, highlights the strong symbolic and reputational value associated with these designations. In this context, dealcoholization appears to conflict with the very definition of PDO wines, which are intrinsically linked to their territory, as it involves a process of modification and later adjustment of the product that may alter its sensory profile and, in turn, its authenticity and heritage [6]. The comparison implicitly drawn by experts with other national experiences (e.g., France) further reinforces this interpretation. Rather than serving as a model to be replicated, the French case is viewed as a benchmark showing how regulatory openness can coexist with safeguards such as minimum alcohol thresholds and sensory evaluation. Overall, the debate, as reconstructed through this Delphi analysis, focuses less on technical feasibility, which is generally acknowledged, and more on the governance and legitimacy of introducing dealcoholization practices within a deeply institutionalized system of GIs.

From a conceptual standpoint, partial dealcoholization can be considered a form of “bounded innovation”.

Stakeholders do not frame dealcoholization as a radical or disruptive change, but rather as a conditional innovation whose acceptability depends on clearly defined limits and safeguards. These boundaries are product-related (greater acceptance for PGI wines), technical (minimum alcohol thresholds), institutional (a central role for Consortia), and temporal (preference for gradual implementation). This framing helps explain why consensus remains elusive: partial dealcoholization is neither rejected outright nor embraced unconditionally but negotiated as an innovation whose legitimacy depends on alignment with territorial identity, regulatory coherence, and market credibility. From a theoretical standpoint, this pattern of conditional acceptance is consistent with what Mahoney and Thelen (2010) [28] describe as institutional layering: rather than displacing existing rules, partial dealcoholization is conceived by stakeholders as an addition to the GI framework – one that must remain subordinate to the core principles of territorial identity and collective reputation [27]. The boundaries that define “bounded innovation” (product-related, technical, institutional, and temporal) can therefore be read as the conditions under which layering is deemed legitimate by institutional actors. Resistance is strongest where the institutional core is most consolidated, as in the case of PDO wines, and weakest where institutional rules are more flexible, as with PGI wines. This confirms that the acceptability of innovation in GI systems is not primarily a technical question, but a governance one.

The Delphi results also underline the central role of governance and actor configuration in shaping potential regulatory change. The prominence of wine protection Consortia, large production groups, trade associations, and public institutions reflects a multi-level governance system in which innovation is mediated by institutional authority, economic capacity, and scientific legitimacy. Consortia emerge as pivotal actors, acting both as guardians of territorial identity and intermediaries between producers, institutions, and markets, a role consistent with the literature identifying collective action among producers as a key determinant of GI system performance [27,47]. Public institutions, particularly the competent Ministry, retain decisive power in enabling or constraining regulatory evolution. Large wineries and retailers appear as potential drivers of innovation, while small producers and certification bodies are perceived as less influential, raising concerns about asymmetries in adoption. Consumers, despite strong interest, remain indirect actors, suggesting that market demand alone is insufficient to legitimize innovation in quality wine schemes without institutional endorsement. A further key insight concerns the strong preference expressed by

experts for naturally low-alcohol wines. This preference reflects broader concerns related to authenticity, naturalness, and consistency with traditional production methods, particularly within PGI wines. Accordingly, recent reviews emphasize that both pre-fermentation strategies and post-fermentation technologies contribute to alcohol reduction, but each involves trade-offs affecting sensory properties and sustainability performance [6]. From this perspective, the debate should not be framed as a strict opposition between natural and technological solutions, but rather as a search for governance mechanisms capable of balancing flexibility, identity, and consumer trust.

These findings highlight the need for carefully designed regulatory pathways that acknowledge both the opportunities and sensitivities associated with partial dealcoholization, particularly in light of the recent European Regulation on GIs for wine, spirit drinks and agricultural products [48]. This Regulation reinforces the collective nature of GIs, strengthens the role of producer groups, and emphasizes the protection of reputation, value creation, sustainability, and effective governance. Within this framework, innovation in PGI and PDO schemes is encouraged only when compatible with product identity, consumer trust, and producers' collective interests. Nevertheless, producing PGI and PDO wines with an alcohol content below the standard threshold inevitably requires regulatory adjustments, though with varying degrees of complexity and trade-offs. For partially dealcoholized products, a relatively simple yet potentially impactful change would be to allow blending between dealcoholized and non-dealcoholized wines. This would increase flexibility along the supply chain (e.g. wineries without dealcoholization equipment could still produce such blends) and could improve the sensory profile of the final product, as the standard wine component may help preserve the product quality. However, this option may raise concerns about product authenticity and transparency, particularly within GI systems. Notably, this issue is currently under discussion at the OIV, and the EU may move ahead independently if progress is delayed. For naturally low-alcohol wines, two main regulatory pathways can be identified. The first is to introduce a new wine category with an alcohol range below the current minimum threshold (i.e., currently set to 8.5 - 9% ABV). While this would provide clarity and formal recognition, it entails significant institutional and political constraints, including misalignment with OIV standards, the need to revise EU legislation, and potential consumer confusion. The second option is to lower the minimum alcohol threshold for wines, either generally or specifically for GI wines. This approach appears more feasible within the current framework and more

consistent with OIV provisions (as some EU examples already exist, such as PDO Moscato d'Asti). However, extending this possibility more broadly, especially below thresholds such as 7%, would remain challenging under current OIV rules and would require a strong justification to ensure consistency with the traditional definition of wine and to preserve the credibility of GI systems. Overall, these options highlight a fundamental trade-off between regulatory flexibility and the protection of product identity, suggesting that gradual and context-specific adjustments may be the most viable path forward.

From a sustainability perspective, dealcoholization partly aligns with the Regulation's social objectives by supporting more inclusive consumption contexts where alcohol intake is discouraged [1]. However, the process remains energy-intensive, potentially conflicting with environmental goals. In this regard, naturally low-alcohol wines may represent, at least within PGI schemes, a more coherent pathway, as they better align with both social and environmental sustainability while preserving territorial identity. Experimental and differentiated approaches, supported by robust sensory evaluation and transparent communication, may therefore help reconcile innovation with the core principles of GIs. However, further regulatory adjustments are needed to enable the production of naturally low-alcohol wines. From a research perspective, the limited empirical evidence on dealcoholized designation wines highlights the need for additional studies on consumer perception, willingness to pay, and long-term reputational effects. In this sense, the present study represents an initial exploratory step, providing a structured map of stakeholder positions that can inform future empirical, experimental, and policy-oriented research on geographical indication NoLo wines. However, future research should integrate demand-side analyses to complement the stakeholder-based approach adopted here, allowing for a more comprehensive understanding of the market acceptance and legitimacy of these innovations.

While the literature has increasingly acknowledged the potential impacts of dealcoholized wines across health, social, environmental, and market dimensions, dedicated and systematic analyses of their sustainability, especially within PDO and PGI schemes, remain largely lacking and therefore constitute a promising avenue for future research. This study is not without limitations. First, although the research design aimed to involve all relevant actors across the sector, the findings reflect the perspectives of those who agreed to contribute and may not fully capture the diversity of positions within the Italian wine system. Second, the absence of a direct demand-side perspective represents a limitation of the

study, as consumer attitudes may differ from expert expectations and could play a crucial role in shaping the future acceptance of dealcoholized PDO and PGI wines. Addressing this gap represents a key direction for future research. A further limitation concerns the limited participation of policymakers in the panel, which may have constrained the representation of institutional and regulatory perspectives, particularly relevant given the policy focus of the study. However, the reasons underlying the limited participation of this group of respondents remain unclear. Future research should seek to more systematically engage policy actors, whose positions are likely to play a decisive role in shaping the regulatory evolution of partial dealcoholization within Italian GI frameworks.

AUTHOR CONTRIBUTION

Conceptualization idea: E.G., E.P., C.F.F.

Methodology: G.S., C.F.F., E.G.

Formal analysis: G.S., C.F.F., E.G.

Investigation: G.S., C.F.F., E.G.

Data curation: C.F.F., E.G.

Writing – original draft: G.S., C.F.F., E.G., E.P.

Writing – review, editing: G.S., C.F.F., E.G., E.P.

Supervision: E.G., E.P.

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Regional Variations in the Returns to Credible Signals of Product Quality: Empirical Evidence from the German Wine Industry

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Abstract. This study examines regional variation in the returns to quality signals in the German wine industry. Utilizing signaling theory, we investigate whether the price premiums associated with producer reputation and sustainable production methods vary across regional quality contexts. Using 51,069 wine observations from the Gault Millau guide from 2010 to 2017, covering 1,396 wineries, we classify Germany's major wine regions into high-, medium-, and low-quality clusters based on yield per hectare and the density of elite association memberships. Hedonic price regressions reveal that individual reputation commands significant premiums across all contexts. However, sustainability signals, such as organic and biodynamic production, yield meaningful price premiums only in low-quality regions. In high-quality regions where collective reputation is strong, sustainability certifications provide limited incremental value. These findings suggest that optimal signaling strategies are context-dependent: in established high-quality environments, producers benefit most from individual reputation building and elite association membership, whereas in regions with weaker collective reputation, sustainability certification offers an effective differentiation mechanism. Our results extend signaling theory by demonstrating that signal effectiveness depends on both production costs and the information environment in which signals are deployed. We acknowledge that our sample comprises guide-selected wines, representing a quality-filtered subset, and our findings should be interpreted accordingly.

Keywords: quality signals, reputation, organic wine, biodynamic, wine prices, German wine industry.

1. INTRODUCTION

The importance of producer reputation on the one hand and of sustainable production methods on the other hand in determining consumers' willingness to pay for a particular product has been widely acknowledged in the theoretical as well as the empirical literature [see e.g. 1,2,3,4]. Theoretical models have established the mechanisms through which reputation operates as a market signal [5,6,7]. Empirical research has documented significant price effects across various industries [8]. The evidence available for the wine industry in countries like France, Germany Italy and the US shows that individual as well as collective reputation are equally important as they both have a statistically significant and economically relevant impact on bottle prices [see e.g. 9–18]¹.

The effect of different production methods on bottle prices has not yet received the same attention and the available results are so far inconclusive. Germany's wine industry offers a suitable context for the examination of these questions, given that its eight primary wine-producing regions exhibit significant variations in their collective reputations. The regions are then classified into three clusters: Cluster 1 (high quality) consists of the Mosel, Nahe, and Rheingau regions; Cluster 2 (medium quality) consists of Baden, Franken, and Württemberg; and Cluster 3 (low quality) consists of Pfalz and Rheinhessen. The classification is based on yield per hectare and density of VDP (Verband Deutscher Prädikatsweingüter) membership. This classification enables the investigation of whether quality signals function differently across regional reputation contexts.

In the wine industry, three types of production methods can be distinguished. First, the conventional or traditional one, that relies on the use of fungicides, herbicides and pesticides to protect the grapes from vermin particularly during blossom². Second, the organic one that largely refrains from chemicals inputs. Third, biodynamic production incorporates additional practices based on lunar and cosmic cycles, including specific soil preparations; scientific assessments of these

methods remain contested [19]³. While organic production is usually considered “serious” as growers use established procedures, biodynamic production is often considered “dubious” and “esoteric” as its proponents take into account cosmic and lunar rhythms when burying cow horns filled with manure and later spray the swirled ingredients in their vineyards⁴. Moreover, it is necessary to further distinguish between self-declared ecological behavior (which most economists would immediately dismiss as “cheap talk”) and certified ecological behavior (which – due to the costs involved – is typically regarded a “credible commitment”). While some papers identify a price premium that the producers of organic and biodynamic wines can charge [e.g. 14], others find a price penalty especially for high-quality wines [e.g. 29]⁵.

We extend the available literature by asking whether the effect of individual and collective reputation on the one hand and the impact of different production methods on the other hand on the prices charged by wine-makers are similar in different regions or whether they vary with certain characteristics of the environment. More specifically, we seek to answer two different, yet closely related questions: First, which firms abandon conventional production methods and decide to produce either according to organic or biodynamic rules in three homogenous regional clusters and, second, what are the returns to reputation and organic/biodynamic production methods in these clusters?

We operationalize returns as the price premiums estimated via hedonic regression, conditional on wine characteristics, over our 2010–2017 observation period.

Our theoretical framework generates the following hypotheses:

³ A number of recent studies show that consumers in surveys say they are willing to pay between 15 and 30 percent more for an organic wine than for a traditional one [see e.g. 20,21,22,23,24]. As we will show below, the price premium charged by organic wine-makers is much smaller, suggesting that consumers overstate their willingness to pay.

⁴ Kirchmann [25], Barquin and Smith [26] as well as Caon [27] argue that the rejection of scientific objectivity in favour of the subjective mystical approach means that biodynamic recommendations cannot be tested and validated by established scientific methods. In practical terms this means that any effect attributed to biodynamic preparations is a matter of belief, not of empirical evidence. Using different samples of wines from Alsace, Negro et al. [28] show that biodynamically produced wines are evaluated better than traditionally produced wines only in non-blind tastings (i.e. when the name of the producer is displayed on the bottle) while in blind tastings both types of wines receive similar evaluations and explain their finding with the stronger “category signaling effect” of biodynamic wines.

⁵ Using two large samples with thousands of wines from California and from France, Delmas et al. [30] as well as Delmas and Gergaud [31] find that organic wines receive significantly better expert ratings than conventionally produced wines.

¹ While the former is based on the past quality of a single firm's output, the latter may be defined as the average quality produced by a group of firms to which an individual firm belongs. It is typically less costly for consumers to acquire information on collective quality that can then be used as an indicator of the quality produced by individual firms in that group. For example, a consumer's expectation of the quality of a wine made by an individual winemaker from the Mosel valley may depend on the average quality of all Mosel wines.

² Traditional or conventional production does not rule out the use of full automatic harvesters or steel tanks.

H₁: Individual reputation positively affects wine prices across all regional contexts.

H₂: VDP membership (collective reputation signal) positively affects wine prices across all regional contexts.

H₃: The price premium for sustainable production methods varies across regional quality contexts.

H₄: Sustainable production methods generate larger price premiums in low-quality regions than in high-quality regions.

Our findings support these hypotheses. Individual reputation commands similar significant premiums across all regions. Sustainable production signals, however, yield meaningful returns only in regions with weaker collective reputation, where they serve as differentiation mechanisms. These results suggest that optimal signaling strategies are environment-dependent.

The remainder of the paper proceeds as follows: In the next section, we develop a model of investing in reputation and the choice of sustainable production methods. We then continue with the presentation of the data and our econometric results. We conclude with an interpretation of our findings, the limitations of our study and some suggestions for future research.

2. THE ECONOMICS OF SIGNALING

The economic theory of signaling provides a framework for understanding market outcomes under asymmetric information, where one party – typically the producer – possesses private information about product quality that is not directly observable to consumers⁶. The seminal works of Akerlof [32], Spence [33], and Shapiro [7] established the foundations for analyzing such markets, demonstrating that information asymmetries generate inefficiencies in exchange and that credible signaling mechanisms can partially restore allocative efficiency.

2.1 Information asymmetry and market breakdown

In markets for experience goods – where product quality is known only after consumption – buyers face uncertainty about the true quality of the good *ex ante*. Absent credible information, consumers rationally form expectations based on the average quality in the market. In equilibrium, low-quality producers (lemons) have an

incentive to mimic high-quality producers, leading to adverse selection and potential market unraveling [32]. High-quality firms therefore face incentives to separate themselves through costly signaling.

2.2 Signaling and separating equilibrium

According to Spence [33], a credible signal must satisfy two conditions: (i) it must be observable by the uninformed party, and (ii) it must be less costly for high-quality types to produce than for low-quality types. When these cost differentials are sufficiently large, the equilibrium is separating, i.e. each type of firm reveals its quality through its chosen signal. Observable, costly actions such as investments in reputation, third-party certification, and self-commitment mechanisms constitute such signals. For high-quality firms, these expenditures serve as an investment in credibility; for low-quality firms, the cost of imitation is prohibitively high, ensuring the persistence of separation. In equilibrium, the price premium for high-quality goods represents a quasi-rent accruing to the firm's stock of reputational capital. This premium both compensates the initial signaling investment and sustains incentives for quality maintenance. Conversely, in the absence of credible signaling channels or price differentials, opportunistic strategies – characterized by short-term cost reductions and quality deterioration – become privately optimal, even though they are socially inefficient.

2.3 Reputation dynamics

When product quality is not directly observable prior to purchase, consumers rely on historical information to infer expected quality. Repeated interaction and consistent quality provision allow firms to accumulate reputation capital over time. During the initial reputation-building phase, producers must operate below cost, as market prices do not yet reflect the firm's true quality. Once the reputation is established, equilibrium prices exceed marginal cost, yielding a return on reputation investment. The present value of these future rents must exceed the upfront costs for the investment to be privately optimal. In a steady-state equilibrium, reputation functions as an endogenous mechanism of market discipline. However, due to moral hazard and adverse selection, complete enforcement of quality is infeasible, particularly in industries with a large number of small producers and limited traceability. Consequently, collective mechanisms often emerge to mitigate free-riding and coordinate quality expectations.

⁶ While the quality of search goods (e.g. computers) can be identified prior to purchase, experience goods (e.g. food and wine) can only be evaluated after consumption [34]. Moreover, the quality of credence goods (e.g. drugs or therapeutic treatments) is difficult to ascertain even after purchase and consumption [35].

2.4 Collective reputation and common property problems

Tirole [36] extends the analysis to consider collective reputation, where a firm's expected quality is a function of the average quality of all producers within a group or region. In such settings, the collective reputation operates as a common property resource: individual firms internalize only a fraction of the reputational benefits of their quality investment but fully bear the cost. This generates a dynamic externality and a tendency toward underinvestment in quality [37]. As the number of producers increases, incentives for individual monitoring and quality maintenance diminish, producing a free-rider problem. Heterogeneity in product quality exacerbates this issue. High-quality producers capture only limited marginal benefits from collective reputation, while low-quality producers gain disproportionately. Hence, top producers face incentives to exit the pooling equilibrium and establish a separating mechanism through the creation of selective associations.

2.5 Institutional solutions: the case of the VDP

A salient institutional response is the formation of professional associations, such as the **Verband Deutscher Prädikatsweingüter** (VDP). Such associations function as endogenous signaling institutions that facilitate a separating equilibrium among heterogeneous producers. Membership is restricted and conditional on reputation-compatible behavior, enforced through peer monitoring and social sanctions. Incumbent members screen entrants *ex ante* and engage in continuous *ex post* evaluation to preserve the association's collective reputation. Social proximity and repeated interaction among members generate informal enforcement mechanisms that reduce the incentive to free-ride on shared reputation. Membership thus acts as a credible signal of high quality, while individual reputation serves as a necessary precondition for access to the collective reputation mechanism.

2.6 Two-stage model of reputation formation

Reputation building can be conceptualized as a two-phase process. In the initial phase, producers incur losses by offering high-quality goods at prices below cost. In the subsequent equilibrium phase, the established reputation allows firms to charge a price premium exceeding production costs. The equilibrium premium represents the return on initial reputation investment, sustaining long-run incentives for quality maintenance. Absent

such premiums, a firm may find an opportunistic strategy, that is temporarily lowering quality to reduce costs, more profitable. However, the reputational damage from such behavior manifests only in the long run. Thus, in a dynamic optimization framework, a firm will maintain quality if and only if the discounted value of future reputation rents exceeds the short-term gain from shirking. Nevertheless, moral hazard implies that full quality commitment is unattainable, as monitoring remains imperfect and guarantees incomplete.

2.7 Sustainable production as a signaling mechanism

The signaling framework extends to sustainable production technologies. From the perspective of information economics, self-declaration without third-party verification constitutes a weaker signal because it involves no cost to the producer. Conversely, third-party certification serves as a costly signal, representing a credible commitment to environmental quality, as it involves monitoring and compliance costs.

Although Demeter certification provides standard third-party verification for biodynamic practices, some producers adhere to biodynamic principles without pursuing certification. The underlying rationales encompass factors such as financial implications of certification, the administrative burden it entails, philosophical objections to formal certification regimes, and partial adoption scenarios that do not meet the criteria for full certification. In accordance with the theoretical framework employed, self-declared biodynamic production signifies a rather weak signal in comparison with Demeter certification, due to the complete absence of third-party verification. The Gault Millau guide identifies self-declared producers based on reported practices that editors verify through winery visits.

The transition from conventional to sustainable production occurs in stages: self-selection (initial declaration) and screening (certification authority evaluation). Conversion in this context is associated with higher expenses and a reduction in yield for producers. Certification serves as a differentiating factor, distinguishing authentic high-quality producers from those who seek to exploit market opportunities through imitation. The adoption decision constitutes an intertemporal optimization problem, determined by expected premiums, cost differentials, and discount rates.

In formal terms, let t_0 denote the pre-transition period, t_1 the initiation of the transition, and t_2 the certification date. During $t_1 - t_2$, producers experience negative profit differentials. Only if the expected discounted value of post-certification premiums (in t_3) exceeds the net

present value of transition costs will the investment be rational for a profit-maximizing producer.

2.8 Context- dependent signal effectiveness

Our primary theoretical contribution pertains to the effectiveness of signals across diverse market environments. Standard signaling theory posits that credible signals must be costly. However, the value of a signal is contingent not solely on its cost but also on the information gap it addresses. In regions with a strong reputation, where mechanisms such as VDP membership, individual expert ratings, and a robust collective reputation already serve as reliable indicators of quality, the adoption of sustainable production certification, while costly, offers only limited additional information. The signal is costly but potentially redundant.

In regions where collective reputation is weaker and fewer producers have achieved individual distinction, sustainable production provides a mechanism for differentiation that is both costly and informative. This theoretical extension suggests that optimal signaling strategies are environment-dependent, thereby generating our core hypotheses about heterogeneous returns to sustainability signals across regional contexts.

2.9 Heterogeneous objectives: utility vs. profit maximization

Empirical studies suggest that not all producers conform to the neoclassical assumption of profit maximization. Morton and Podolny [38] document substantial non-pecuniary motivations among California winemakers: a majority express disutility from selling their wineries even at higher financial returns elsewhere, and a significant fraction willingly incur monetary losses to enhance product quality. Similarly, Delmas and Gergaud [39] find that producers with dynastic or stewardship motives exhibit higher propensities to adopt sustainable practices and seek certification. These findings imply that the representative producer's objective function includes both pecuniary and non-pecuniary components. For such producers, the marginal utility of non-pecuniary attributes can offset the disutility of lower profits. In equilibrium, the market may consist of both profit- and utility-maximizing firms, generating heterogeneous behavioral responses and potentially stabilizing high-quality equilibria.

Summarizing, the economics of signaling provides a powerful analytical lens for understanding how markets with asymmetric information can sustain efficiency

through endogenous signaling and reputation mechanisms. In industries such as wine production, reputation operates both at the individual and collective levels, with associations and certification bodies acting as institutionalized signals. When reputation and certification generate sufficient price premiums, they ensure that high-quality equilibria are sustainable. However, heterogeneity in objectives and information structures implies that equilibrium outcomes are shaped not only by profit incentives but also by broader notions of utility, identity, and social embeddedness.

2.10 The objectives of differentiation

In both, the strategic management and the economics literature, *differentiation* refers to the process of distinguishing a product or service by making it more appealing to a specific group of customers. Products that are horizontally differentiated vary in their characteristics. For wineries, this could involve differences in production methods. Vertically differentiated products, on the other hand, differ in quality, which in the wine industry may be reflected by star ratings or scores in various guidebooks. This distinction implies that a profit-maximizing firm can pursue two conceptually different strategies: it can either “*do things better*” by offering superior quality or “*do things differently*” by targeting market niches unoccupied by competitors. The fundamental objective of differentiation is to establish a position that existing customers value and potential customers perceive as unique. Both, horizontal as well as vertical differentiation enable a firm to command a price premium because customers who value the respective product or service become less sensitive to competing offers. In other words, successful differentiation decreases price sensitivity in a given market segment. As a result, it provides a competitive advantage, since the differentiated products or services are no longer seen as perfect substitutes for those of rival firms.

Consider a customer in a wine shop deciding between two wines, A and B. If the customer has no prior information about either option, both wines appear equally attractive. The choice, therefore, is random. Suppose the customer selects wine A. Future shoppers may then notice that wine A's shelf is less full, inferring that its popularity signals higher quality. Consequently, they too are more likely to choose wine A. This behavior illustrates bounded rationality, where individuals make decisions based primarily on the observable actions of others [40–43]. Such “naïve” decision-making tends to occur in markets characterized by asymmetric information between producers and consumers. Since most wine buyers are initially unin-

formed about quality, they rely on signals, such as expert reviews or production method, to infer it. In this context, credible signals that are easily understood by consumers become crucial. Winery owners can thus choose among various signaling strategies to distinguish themselves from competitors and maximize profits.

This study draws on a large dataset of wines from the eight largest wine-growing regions in Germany. It identifies two distinct differentiation strategies: the exclusivity strategy and the sustainability strategy. These approaches have received limited attention in prior research but are credible because they involve substantial initial investments in either *social capital* (e.g., gaining entry to selective associations) or *human capital* (e.g., acquiring expertise in sustainable production techniques). According to Barney [44], firms that possess resources that are valuable, rare, inimitable, and non-substitutable can achieve and maintain a sustainable competitive advantage. While firms pursuing cost leadership typically rely on standardized, mass-produced products, those seeking differentiation-based advantage must focus more closely on the quality and allocation of resources devoted to customer service and product excellence [45].

3. DATA AND METHODS

We use the prestigious “Gault Millau” guide for the years 2010 to 2017, including 51,069 different wines produced by 1,396 wineries in the eight largest wine-growing regions of Germany.

It is imperative to note that the scope of our analysis is constrained to wines that have been meticulously selected for inclusion in this esteemed compendium, thereby constituting a select, quality-filtered subset of the market. Consequently, the findings of this study pertain to the functionality of quality signals among wines that have already passed an editorial quality threshold, rather than across the full quality distribution within each region.

The 2010–2017 period was selected as the subject of analysis due to the availability of the most recent complete Gault Millau data at the time of analysis. It is acknowledged that this period predates the acceleration of consumer interest in sustainable wines observed after 2018 [24]. Consequently, the estimates obtained may be regarded as conservative lower bounds on current sustainability premiums.

3.1 Regional classification

The classification of these regions is determined by two primary criteria: the quality of the wines pro-

duced, as indicated by the yield per hectare, and the number of members of the “Verband Deutscher Prädikatsweingüter” (VDP; Association of German Quality Wine Producers) per 1,000 hectares of cultivated land⁷. The initial cluster encompasses the regions of Mosel, Nahe, and Rheingau, which are regarded as high-quality. The subsequent cluster comprises Baden, Franken, and Württemberg, which are classified as intermediate in quality. The final cluster consists of the regions Pfalz and Rheinhessen, which are considered low-quality (see Figure 1, Tables 1 and 2). We deliberately excluded from our analysis the small regions of Ahr, Hessische Bergstraße, Mittelrhein, Saale-Unstrut, and Sachsen that together account for less than 3 percent of the acreage in Germany (see Table 1).

We cluster regions rather than employing individual region fixed effects because our theoretical framework predicts differences in signaling returns based on regional quality environments. This theoretical framework suggests that different signaling returns are contingent upon regional quality differences. The incorporation of region-fixed effects would effectively address the variation under investigation. This clustering approach, therefore, enables testing of the hypothesis that signal effectiveness varies systematically with the collective reputation of the regional context.

3.2 Variable definitions

Production Methods: A five-category system is employed to categorize these products: conventional (reference), self-declared organic, certified organic, self-declared biodynamic, and certified biodynamic. Certified organic producers hold EU organic certification. Certified biodynamic producers are recognized by Demeter. Self-declared producers are identified by Gault Millau editors as following either organic or biodynamic practices without formal certification, based on winery visits and producer communications.

⁷ A potential concern here is collinearity: Our clustering scheme is primarily based on VDP density while at the same time individual VDP membership is included as an independent variable in the cluster-specific regressions. This, however, should not be a problem since individual wineries cannot apply for membership in VDP, but are invited by incumbents to join the organization. VDP members have a significantly higher individual reputation than non-members (see footnote 9 on p. 109) and, therefore, carefully select new members. In general, the individual reputation of new members is at least as high as the average reputation of the incumbents [14]. On the other hand, wineries leaving VDP have recently experienced a decrease in their reputation and have, therefore, become a threat to the organization's reputation (the annual number of entries and exits is quite similar, resulting in a stable membership of around 200 wineries).

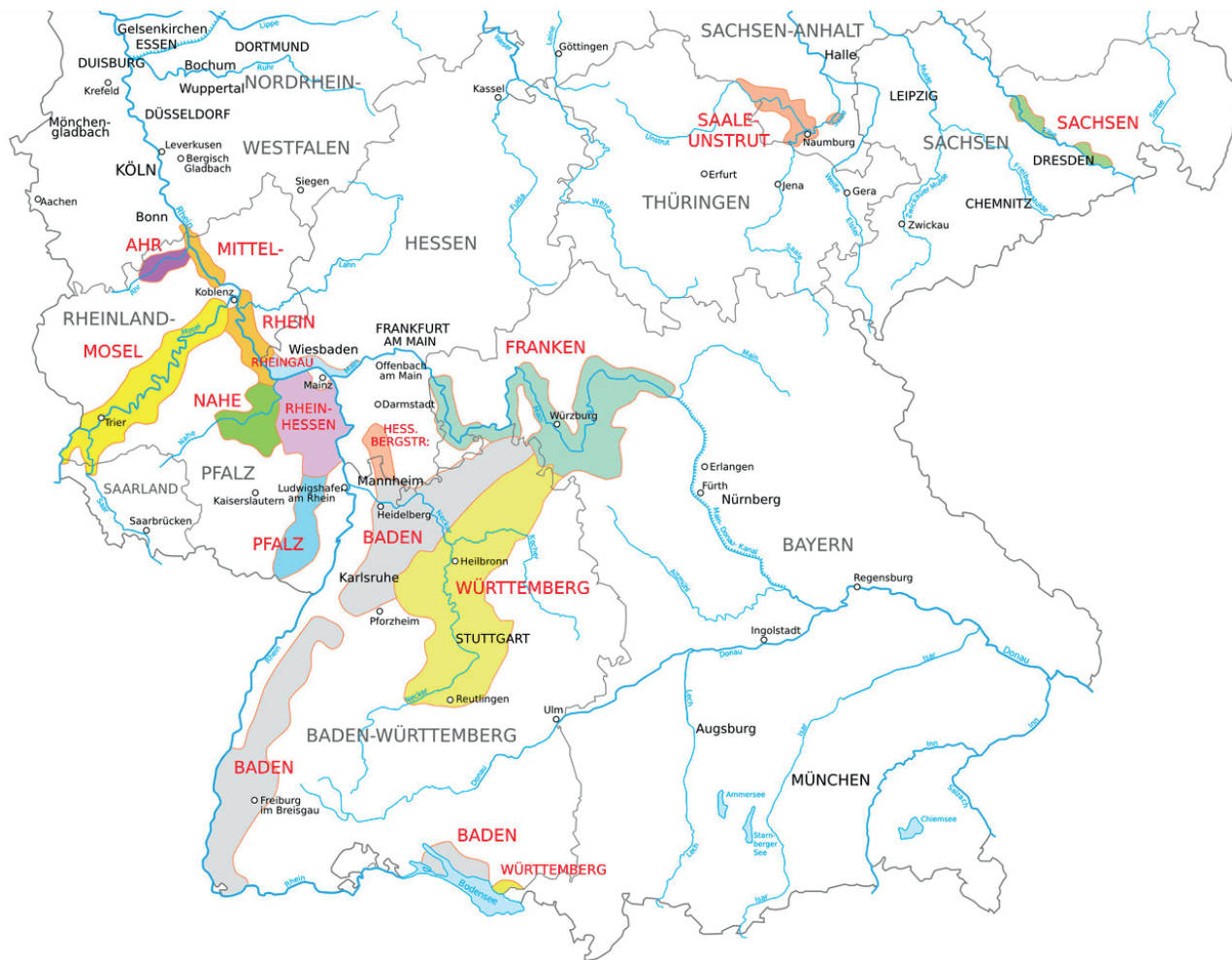


Figure 1. The wine growing regions of Germany. <https://www.vino-culinario.de/weinbau-weinkultur/weinregionen/deutschland/>.

Individual Reputation: Gault Millau employs a scale ranging from 0.5 to 5 to assign grape ratings, analogous to star ratings in restaurant guides or points in other wine rating systems. The presence of one grape indicates a satisfactory producer, whereas the presence of five grapes indicates an exceptional, world-class winery. The model incorporates dummy variables for each rating level, with the “promising newcomer” category (0.5 grapes) serving as the reference point.

VDP Membership: A binary indicator of membership in the Verband Deutscher Prädikatsweingüter.

Re-entry: A binary indicator for wineries previously included in the guide. It then disappeared, and subsequently returned, thereby capturing the phenomenon of reputation recovery or resurgence.

3.3 Empirical approach

We estimate two sets of models. First, probit models examine determinants of sustainable production adoption. In the probit specifications, cluster 3 (Pfalz/Rheinhessen, the low-quality cluster) serves as the reference category, with individual region dummies capturing within-cluster variation. Second, hedonic price regressions estimate returns to quality signals.

The hedonic specification is:

$$\ln(\text{Price}_{ijt}) = \alpha + \beta_1 \text{Production}_j + \beta_2 \text{Reputation}_j + \beta_3 \text{VDP}_j + \gamma X_{ijt} + \delta_t + \varepsilon_{ijt}$$

where i indexes wines, j indexes wineries, and t indexes years. We estimate random-effects models to account for winery-level heterogeneity, clustering standard errors at the winery level.

Table 1. Size and reputation of wine growing regions in Germany.

Region	Size (hectares)	Acreage cultivated by wineries listed in Gault Millau
Cluster 1 (16,000 hectares)		
Mosel	9,000	21
Nahe	4,000	27
Rheingau	3,000	58
Cluster 2 (33,000 hectares)		
Baden	16,000	35
Franken	6,000	55
Württemberg	11,000	22
Cluster 3 (51,000 hectares)		
Pfalz	24,000	17
Rheinhessen	27,000	12
Excluded Regions (2,900 hectares)		
Ahr	600	90
Hessische Bergstraße	500	11
Mittelrhein	500	31
Saale-Unstrut	800	16
Sachsen	500	50

Table 2. Typology of wine growing regions in Germany.

Cluster	Percent of Acreage	Yield per Hectare	Percent Organic/Biodynamic	Members in VDP	VDP members per 1,000 hectares
Cluster 1	16	69	8	72	4.5
Cluster 2	33	75	12	66	2.0
Cluster 3	49	93	11	45	0.9
Total	98	85	10	199	1.9

We acknowledge that VDP membership and organic/biodynamic certification are endogenous decisions. Wineries self-select into these categories based on unobserved characteristics that likely correlate with both quality and price. For instance, producers who prioritize quality may be more inclined to seek VDP membership and consequently produce wines of a higher caliber, which can command premium prices regardless of membership.

Absent valid instrumental variables, regression discontinuity designs, or selection corrections, the estimated price premiums should be interpreted as conditional associations rather than causal effects. The premium estimates may partially reflect pre-existing quality differences among adopters rather than the marginal value of certification per se. Future research with quasi-experimental variation in certification eligibility could address this limitation.

4. RESULTS

Table 3 presents the descriptive statistics of the data set used to estimate the two sets of models. It is noteworthy that wines from the Pfalz and Rheinhessen regions (cluster 3) are underrepresented in relation to their acreage in Germany (49% of the total, as shown in Table 1) compared to the 35% representation of wines in the sample. Conversely, wines from the Mosel, Nahe, and Rheingau regions (cluster 1) are overrepresented, given their 15% share of total acreage in Germany (Table 1), which is lower than the 28% representation of wines in the sample. This pattern aligns with our quality classification. However, it should be interpreted as reflecting editorial preferences rather than validating our approach.

The vast majority of these enterprises are family-run businesses, with a significant number of them having a history that spans centuries. The 26-percentage share of wines produced by VDP members indicates that these wineries are massively over-represented in the wine guide that was used as the data source for this study. Furthermore, an examination of the mean and standard deviation reveals that both variables exhibit significant skewness, with the standard deviation being 2 to 3 times greater than the respective mean⁸.

Table 3. Descriptive statistics.

Variable	Mean	Std. Dev.	Min.	Max.
Founding Year	1788	226	817	2014
Family Owned	0.91	---	0	1
Cooperative	0.03	---	0	1
VDP member	0.26	---	0	1
Baden	0.12	---	0	1
Franken	0.17	---	0	1
Württemberg	0.07	---	0	1
Mosel	0.13	---	0	1
Nahe	0.06	---	0	1
Rheingau	0.09	---	0	1
Pfalz	0.18	---	0	1
Rheinhessen	0.17	---	0	1
Acreage	26.30	66.67	0.30	1,450
Bottles per Year	203,736	697,130	2,900	1,600,000
Price per Bottle	12.75	9.63	3.10	430.00

⁸ Figure A1 shows that in cluster 1 nearly 90 percent of the wines are conventionally produced while in cluster 3 the respective share is 73 percent only. On the other hand, 20 percent of the wines in cluster 3 are organic and 8 percent are biodynamic wines (the respective percentage shares in cluster 1 are 7 percent and 3 percent). Figure A2 displays the means of the bottle prices by cluster and method of production, Figure A3 the kernel density estimation of log of bottle price by cluster.

Table 4. Determinants of the adoption of organic or biodynamic practices.

Model	(1)	(2)	(3)	(4)
Dependent Variable	Self-declared Organic	Certified Organic	Self-declared Biodynamic	Certified Biodynamic
Founding Year	0.000625*** (0.0000411)	0.000581*** (0.0000432)	0.000685*** (0.0000727)	0.000474*** (0.0000855)
Family Owned	0.170*** (0.0335)	0.178*** (0.0348)	0.800*** (0.0733)	---
Cooperative	0.933*** (0.0787)	0.516*** (0.0815)	---	---
Franken	-0.392*** (0.0256)	-0.402*** (0.0280)	-0.418*** (0.0422)	-0.251*** (0.0540)
Baden	-0.321*** (0.0227)	-0.102*** (0.0234)	-0.109*** (0.0341)	0.111*** (0.0393)
Württemberg	-0.642*** (0.0326)	-0.324*** (0.0324)	-0.762*** (0.0662)	-0.233*** (0.0664)
Mosel	-0.628*** (0.0303)	-0.568*** (0.0334)	-0.454*** (0.0535)	-0.815*** (0.110)
Nahe	-0.771*** (0.0439)	-0.525*** (0.0443)	0.0132 (0.0514)	0.352*** (0.0543)
Rheingau	-0.843*** (0.0314)	-0.731*** (0.0338)	-0.795*** (0.0560)	-0.261*** (0.0569)
VDP member	0.574*** (0.0182)	0.533*** (0.0189)	0.614*** (0.0277)	0.128*** (0.0348)
Acreage	-0.00295*** (0.000842)	0.00303*** (0.000828)	0.0288*** (0.00188)	0.0347*** (0.00203)
Bottles per Year	-5.95e-08 (9.21e-08)	-0.000000567*** (9.47e-08)	-0.00000372*** (0.000000300)	-0.00000397*** (0.000000318)
Year Dummies	included	included	included	included
Constant	-2.050*** (0.0868)	-2.348*** (0.0909)	-3.844*** (0.166)	-2.990*** (0.170)
N	35,078	35,078	33,768	30,923

Standard errors (clustered at winery id) in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4 displays the results of our probit estimations regarding the selection of production methods. It appears that firms in the low-quality cluster 3 exhibit a notably higher propensity to adopt organic or biodynamic practices as a competitive strategy. This observation is supported by the negative and statistically significant nature of 17 of the 18 coefficients denoting location in cluster 1 or 2 regions. Furthermore, empirical evidence suggests that older firms and family-owned businesses are more likely to adopt organic or biodynamic production methods. Cooperatives are also more likely to produce according to organic standards, primarily to improve their rather poor reputation [e.g., 46,47]. While acreage is positively and significantly associated with the adoption of sustainable practices, annual bottle production is negatively associated with it. Finally, members of the VDP are more likely to employ sustainable produc-

tion methods, encompassing both organic and biodynamic practices.

Looking at Table 5, it appears that – as expected – the returns to organic/biodynamic wine production vary considerably across the clusters (as does the likelihood of adopting organic/biodynamic practices). In low quality regions, their adoption seems to pay off, while in high quality regions other strategies (such as lobbying for VDP membership) are more rewarding⁹. In low quality regions, the adoption of organic/biodynamic standards helps to differentiate oneself from the competition, while in high quality regions VDP membership serves exactly the same purpose. From a consumer perspective,

⁹ In each of the three clusters, the average individual reputation of VDP members is twice as high as the reputation of non-members. In cluster 1, the respective values are 3.01 and 1.55, in cluster 2 they are 1.50 and 2.94 and, finally, in cluster 3 they are 1.46 and 3.35 (always on a 5-point scale).

Table 5. Random- effects estimation results of determinants of bottle prices.

Model	(1.1)	(1.2)	(1.3)
Average Quality	High	Medium	Low
Dep. Variable: Log(Bottle Price)	Cluster 1	Cluster 2	Cluster 3
Self-Declared Organic (1=yes)	0.000699 (0.0422)	0.0392* (0.0209)	0.0467*** (0.0160)
Certified Organic (1=yes)	0.0176 (0.0360)	0.0572** (0.0245)	0.0485* (0.0271)
Self-Declared Biodynamic (1=yes)	-0.0154 (0.0535)	-0.00706 (0.0356)	0.157*** (0.0404)
Certified Biodynamic (1=yes)	0.0943 (0.0947)	0.0376 (0.0349)	0.0876** (0.0403)
VDP Member (1=yes)	0.156*** (0.0345)	0.0908*** (0.0242)	0.0993*** (0.0323)
Individual Reputation 1	0.0621*** (0.0189)	0.0501*** (0.0137)	0.0802*** (0.0173)
Individual Reputation 2	0.113*** (0.0225)	0.0929*** (0.0187)	0.115*** (0.0212)
Individual Reputation 3	0.162*** (0.0263)	0.0996*** (0.0227)	0.172*** (0.0263)
Individual Reputation 4	0.164*** (0.0478)	0.0942*** (0.0325)	0.194*** (0.0469)
Individual Reputation 5	0.233*** (0.0665)	0.151*** (0.0325)	0.249*** (0.0471)
Re-entry (1=yes)	0.0741 (0.0597)	0.0202 (0.0241)	0.0875* (0.0530)
Alcohol	-0.514*** (0.0487)	-0.665*** (0.0522)	-0.221*** (0.0711)
Alcohol ²	0.0282*** (0.00219)	0.0330*** (0.00214)	0.0151*** (0.00291)
Storage Potential (in years)	0.129*** (0.00385)	0.143*** (0.00392)	0.187*** (0.00557)
Barrique (1=yes)	0.134*** (0.0188)	0.139*** (0.0130)	0.136*** (0.0131)
Cooperative (1=yes)	-0.119 (0.0803)	-0.0864*** (0.0196)	-0.236*** (0.0327)
Publication Year Dummies		Included	
Harvest Year Dummies		Included	
Quality Dummies		Included	
Type Dummies		Included	
Style Dummies		Included	
Grape Dummies		included	
Constant	3.384*** (0.289)	4.746*** (0.331)	2.000*** (0.438)
<i>N of Wines</i>	14,504	18,312	18,253
<i>N of Wineries</i>	500	449	447
<i>Wines per Winery</i>	1-118	1-160	1-170
<i>R2 within</i>	58.4	62.6	62.7
<i>R2 between</i>	67.0	69.1	65.0
<i>R2 overall</i>	64.0	66.8	67.2

Standard errors (clustered at winery id) in parentheses; * $p < .10$, ** $p < 0.05$, *** $p < 0.01$.

the price premium for organic and biodynamic wines is zero in cluster 1 (Mosel/Nahe/Rheingau), moderate in cluster 2 (Baden/Franken/Württemberg) and substantial in cluster 3 (Pfalz/ Rheinhessen). Thus, the lower the average quality in a particular region, the higher the price premium charged by organic/biodynamic producers. In other words: In low quality regions organic and biodynamic production (whether certified or not) serves as a quality signal, whereas this is not the case in regions with a high average reputation (similar results are presented by Delmas and Lessem [48] for the different wine growing regions in California).

The variable most strongly associated with bottle prices is, however, a wine-maker's individual reputation. In a low- as well as in a high-quality environment, each additional grape awarded by the experts of the wine guide is associated with a similar increase in bottle prices¹⁰. In cluster 2, denoting an intermediate level of regional quality, this association is smaller, yet still economically highly relevant. Thus, investing in individual reputation and – particularly in the case of cluster 1 – membership in VDP pays off the most. However, since the talent required to obtain a four- or five-grape rating, is scarce, the costs are simply too high for most of the winemakers. A rational utility-maximizing individual, who knows his talent level relative to that of his competitors will stop investing in the acquisition of additional reputation at the point where the expected marginal returns are identical with the expected marginal costs¹¹.

Table 6 displays the additional revenues that can be generated by moving from traditional to organic or biodynamic wine-making and by becoming a VDP member. It appears that in high-quality cluster 1 the adoption of organic and biodynamic practices are not associated with measurable additional revenues. Given the rather small size of the wineries in cluster 1, VDP membership is associated with additional revenues of 2€ per bottle. In cluster 3 – the low-quality environment – biodynamic practices show the largest positive association with revenues, irrespective of whether the winery is certified or not. In the case of self-declared biodynamic production the surprisingly strong effect is driven by 27 different firms, ruling out any outlier effect¹².

¹⁰ Reference category are the wineries that are included as “promising newcomers” with half a grape. In some exceptional cases, however, even newcomers are listed in the guide with one or two grapes.

¹¹ The coefficients of the control variables (alcohol content, storage potential, wine aged in an oak barrel, winery is a cooperative) have the expected signs and are almost always statistically significant (with similar findings Kugel et al. [49]).

¹² Further analyses of the productivity and/or profitability of wineries in Germany and Italy are provided by Bennett and Müller Loose [51] as well as Perucchini et al. [52].

Table 6. Simulation of additional revenues by type of producer (in €).

Type of Producer	Collective Reputation of Cluster		
	High	Medium	Low
	Mosel/Nahe/ Rheingau	Baden/ Franken/ Württemberg	Pfalz/ Rheinhesen
Self-declared organic	0	170,000	100,000
Certified organic	0	260,000	100,000
Self-declared biodynamic	0	0	310,000
Certified biodynamic	0	0	170,000
VDP member	210,000	360,000	180,000
Bottles per Year	110,000	330,000	150,000

Numbers are based on the respective coefficients displayed in Table 5, multiplied by the average number of bottles produced per year. The coefficients were corrected using the method suggested by Halvorsen and Palmquist [50] and rounded for ease of presentation

5. CONCLUSION AND IMPLICATIONS

We expand the existing empirical literature in two ways: First, we identify the factors that drive the choice of organic or biodynamic production methods for certified and non-certified firms. Then, we estimate the price premium that organic and biodynamic producers, as well as VDP members, charge for their products in three different wine region clusters. Rather than asking consumers about their willingness to pay for organic or biodynamic wines, we examine the revealed preferences of presumably profit-maximizing entrepreneurs.

In a highly competitive environment like the wine industry, where even the largest producers have negligible market shares and imports account for more than half of total consumption, high-quality producers must distinguish themselves from low-quality firms. The best way to do so is to invest in building an individual reputation. However, the second-best alternative for high-quality firms depends on the business environment in which they operate. While adopting organic or biodynamic is not associated with a measurable price premium in a high-quality environment, it is associated with a substantial premium in a low-quality environment, consistent with a competitive-advantage interpretation.

These findings challenge the traditional assumption that a signal is universally credible due to the costs of its production. Instead, our estimates suggest that, depending on the market environment, the same signal can be meaningfully associated with firm performance or show no detectable association at all¹³.

¹³ Using a large dataset with detailed information on 9,096 German

Admittedly, our findings may be difficult, if not impossible, to generalize. The wine market is heavily regulated everywhere, and the rules differ greatly from country to country. Thus, replicating our study with data from countries such as Austria, Italy, and France, for which the same wine guide has long been available, would either support or refute our conclusions based on German data.

Our results suggest context-specific strategies for wine producers. In established, high-quality regions, the best use of resources is building an individual reputation and pursuing elite association membership. While sustainable production may be worthwhile for non-pecuniary reasons, it is unlikely to generate significant price premiums. In regions with a weaker collective reputation, sustainable production is an effective differentiation strategy. Premiums are observed in association with both certified and self-declared sustainable practices, with the association being stronger for certification.

Several limitations warrant emphasis. First, our sample comprises wines selected for inclusion in the Gault Millau guide, which represents a quality-filtered subset. Our findings pertain to how signals function among the top wineries in Germany, not across the full market¹⁴. Second, we cannot establish causal effects. VDP membership and certification decisions are endogenous, so estimated premiums may reflect pre-existing quality differences rather than the value of membership or certification itself. Third, the period from 2010 to 2017 predates the recent acceleration in consumer sustainability preferences. Current premiums for sustainable production may exceed our estimates. Fourth, while theoretically motivated, our clustering approach involves researcher judgement. Fifth, our findings may not generalize beyond Germany. Replicating the study with data from Austria, Italy, or France will either confirm the external validity of our results or reveal a German peculiarity.

AUTHOR CONTRIBUTIONS

Conceptualization, B.F., D.K., R.S. and C.S.B.; methodology, B.F., D.K. and C.S.B.; formal analysis, B.F. and

high-ability students, Frick et al. [53] find that following the Bologna reforms, high-ability students extended their stays and completed degrees abroad (instead of doing exchange semesters). No such changes in behavior are to be observed in the overall student population. Thus, given the changes in the environment, completing a degree abroad has become the new labor market signal for the ‘international qualification’ of high-ability students.

¹⁴ In 2023 – the most recent year for which the data is available – slightly more than 14,200 wineries existed in Germany. Thus, the sample used here includes the top 10 percent according to the evaluations provided by Gault Millau.

R.S.; data curation, B.F.; writing – original draft preparation, D.K. and C.S.B.; writing – review and editing, B.F., R.S. and D.K.. All authors have read and agreed to the published version of the manuscript.

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APPENDIX

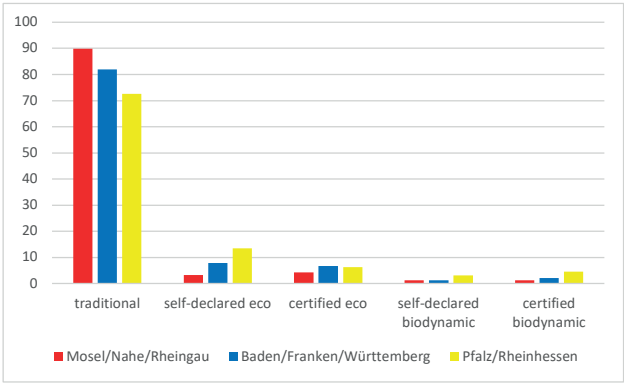


Figure A1. Wines by type of production.

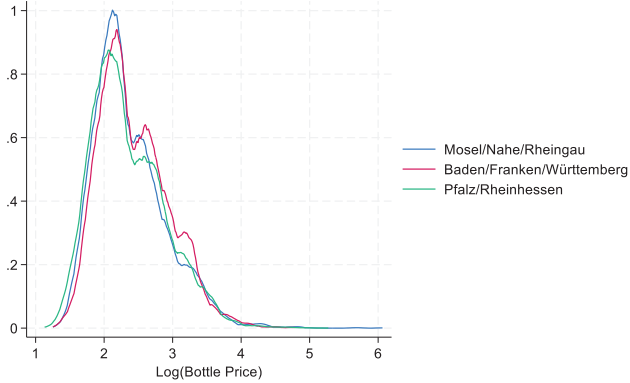


Figure A3. Distribution of Log(Bottle Price) across clusters.

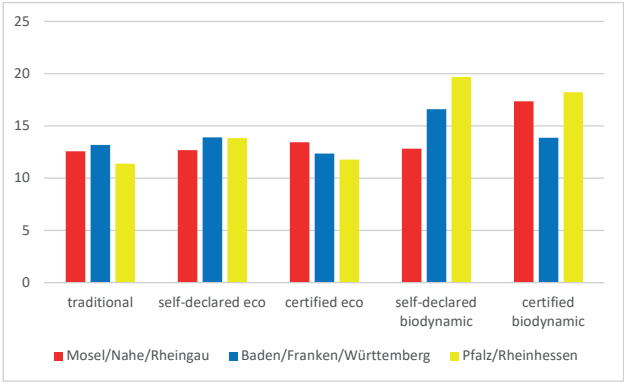


Figure A2. Average bottle prices by type of production.



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Digital Engagement without Online Purchasing? Age Differences in Gin Channel Choice in Italy

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Abstract. Younger consumers are frequently portrayed as inherently digital and online-oriented buyers. However, empirical evidence suggests that digital engagement does not necessarily translate into online purchasing behavior, particularly in multichannel and food-related contexts. This study investigates purchasing channel choices among gin consumers in Italy, a market characterized by gradual development, strong social connotations, and increasing digital visibility. Using data from a nationwide online survey (n = 945 gin drinkers), we examine how sociodemographic characteristics, consumption habits, and social media engagement relate to channel selection. Results show that younger consumers, despite higher levels of social media use, are significantly less likely to purchase gin online and predominantly rely on supermarkets. In contrast, middle-aged consumers display stronger interest in premium products and a greater propensity toward online purchasing. Moreover, time spent on social media is negatively associated with online channel choice, challenging the assumption that digital natives are systematically online buyers.

Keywords: gin market, channel choice, online purchasing, digital engagement, age difference.

1. INTRODUCTION

In recent years, consumer behavior research has increasingly portrayed younger consumers as inherently digital and online-oriented buyers [1]. High levels of digital literacy, pervasive use of social media, and constant exposure to online content have often been interpreted as direct predictors of online

purchasing behavior [2]. However, this assumption may oversimplify the relationship between age, digital engagement, and actual transaction choices, as empirical evidence suggests that digital engagement often influences pre-purchase stages rather than final purchasing behavior, particularly in multichannel and food-related contexts [3]. This apparent mismatch between digital engagement and purchasing behavior calls for a more nuanced understanding of how consumers navigate across channels.

In this perspective, the growing body of literature on multichannel and omnichannel retailing suggests that consumers frequently separate information search from purchase decisions [4,5]. Digital channels and social media are often used for inspiration, while physical retail formats continue to play a central role at the point of purchase [6–10]. This distinction is especially relevant for food and beverage products, where routine purchasing habits, immediacy, and contextual factors remain highly influential [11]. In this domain, consumption choices are also shaped by the interplay between hedonic and health-oriented motivations, as well as by the importance attributed to extrinsic product attributes [12]. This complexity becomes even more critical when focusing on younger consumers, who are often assumed to translate their high digital engagement into online purchasing behavior.

Within this debate, younger consumers represent a particularly interesting and underexplored segment. While they are among the most active users of digital platforms [13,14], several studies suggest that digital engagement does not necessarily translate into higher online purchasing, especially for products characterized by occasional consumption, social connotations, or regulatory constraints, such as alcoholic beverages [4,15,16]. As a result, the widespread equation “young consumers = online buyers” deserves closer empirical scrutiny.

In this context, identifying a suitable empirical setting becomes crucial to test the apparent disconnect between digital engagement and purchasing behavior. Gin is a particularly suitable case study for testing young consumers’ preference for online shopping. Positioned at the intersection of experimentation, social consumption, and everyday retail availability, the category enables the analysis of how younger consumers move across supermarkets, online environments, and specialty stores. Gin consumption is increasingly shaped by digital communication and social media narratives, which play a central role in influencing perceptions and meanings, though they do not necessarily translate into online purchasing behavior.

This perspective is especially relevant in the Italian context, where interest in gin has developed more

gradually and later than in early-mature markets such as the United Kingdom and Northern Europe. In Italy, the expanding appeal of gin among younger consumers is closely linked to the emergence of locally rooted products that reinterpret traditional ingredients and regional identities, further reinforcing the hybrid nature of the category, combining experimentation, social consumption, and broad retail accessibility [17]. This pattern stands in contrast to the documented decline in younger consumers’ interest in wine, which has been attributed to changing lifestyles, shifting socialization practices and a weakening symbolic attachment to traditional alcoholic beverages [18]. The increase of Italian craft gin brands can be framed within the expansion of the spirits sector through the use of distinctive ingredients and fabrication narrative on geographically embedded resources to construct unique product identities. Therefore, the incorporation of Mediterranean herbs, citrus fruits and plants can be interpreted as a form of “place-based branding,” whereby the product becomes a vehicle for expressing regional culture and biodiversity [19,20] and consumers attribute value to products that embody geographical origin and cultural heritage [21,22]. Gin’s strong association with cocktail culture further reinforces this dimension, positioning it within social and experiential consumption contexts characterized by customization, conviviality and taken together all these elements reinforce the hybrid nature of gin as a category, which embodies experimentation in flavors and recipes, sociability through cocktail culture. Unlike more traditional alcoholic beverages, whose consumption is often governed by established contexts, gin benefits from a flexible consumption occasion, allowing it to bridge artisanal production, fashionable lifestyles and mass-market availability.

In this respect, gin appears to respond more effectively to younger consumers’ demand for novelty, flexibility, and identity expression, positioning itself as a contemporary alternative within the alcoholic beverage landscape.

Taken together, these elements highlight a gap between digital engagement and actual purchasing behavior, particularly among younger consumers and in product categories characterized by hybrid consumption patterns.

Against this background, the present study focuses explicitly on young gin consumers to examine how sociodemographic characteristics, consumption habits, and digital engagement jointly shape purchasing channel choices. By integrating channel choice more explicitly into the analysis of youth consumption behavior, this paper aims to contribute to the literature in two main ways. First, it provides empirical evidence on whether younger consumers can genuinely be considered online-

oriented buyers in the gin market. Second, it sheds light on the role of social media and digital engagement in shaping pre-purchase versus transaction-stage decisions.

By doing so, the study makes three specific contributions to the literature. First, it challenges the widespread assumption that younger consumers are inherently online-oriented buyers by providing empirical evidence from a real consumption context. Second, it disentangles digital engagement from actual purchasing behavior, showing that social media exposure does not translate into online channel choice. Third, it contributes to multichannel consumer research by highlighting the role of product-specific and life-cycle factors in shaping channel decision.

2. LITERATURE BACKGROUND

Young consumers are widely described as digitally native, permanently connected, and deeply embedded in social media ecosystems [23]. Digital platforms structure large portions of their everyday lives, mediating not only social interaction but also access to information and symbolic consumption practices [24]. Within this framework, younger cohorts are frequently portrayed as natural adopters of digital technologies and, by extension, as structurally inclined toward online purchasing channels [1,25]. This narrative has become increasingly dominant in both academic and managerial discourse, often reinforcing the implicit assumption that digital exposure and transactional behavior are closely aligned [1,4].

However, some research problematizes this linear interpretation, highlighting how digital engagement often remains confined to symbolic, informational, or pre-purchase stages, while actual transaction decisions continue to be shaped by contextual, product-specific, and situational factors [3,11]. High levels of digital engagement do not necessarily translate into a systematic preference for online purchasing, nor do they imply a reduced role for physical retail environments.

Some studies highlight a persistent disconnect between digital familiarity and actual buying behavior, suggesting that young consumers selectively appropriate digital tools, especially for food and beverage, depending on the stage of the decision-making process and the nature of the product [26–29]. In this perspective, social media platforms function primarily as symbolic arenas where meanings, tastes, and consumption-related identities are negotiated, while the act of purchasing may still be anchored in more traditional channels [30–32]. This phenomenon is consistent with evidence of an attitude–behavior gap, whereby stated preferences and intentions

may diverge from actual choices, especially in food and beverage markets characterized by habitual routines and contextual constraints [33].

Supermarkets, in particular, continue to occupy a pivotal position due to their embeddedness in daily life, their capacity to accommodate unplanned purchases, and their compatibility with time-constrained consumption contexts [34]. The persistence of physical retail should not be interpreted as a rejection of digitalization. Rather, it reflects the differentiated roles that channels play depending on product characteristics and situational factors [35].

Alcoholic beverages provide a particularly rich context in which to explore these dynamics [18,36–38].

The expanding literature on social media influencers further complicates the relationship between digital engagement and purchasing behavior. Numerous studies document the ability of influencers to shape consumer attitudes, preferences, and purchase intentions by leveraging credibility, identification, and perceived authenticity [39–42]. Meta-analytical evidence confirms that influencer marketing can be effective, particularly when trust and product–endorser fit are high [43]. However, other contributions emphasize that influencer-driven engagement often stimulates interest, curiosity, or aspirational desire without necessarily translating into concrete purchasing behavior, especially in categories subject to normative constraints or situational barriers [44,45].

In alcohol-related contexts, this gap between influence and action appears particularly salient. Social media content contributes to shaping imaginaries of consumption, reinforcing associations with sociability, experimentation, and lifestyle positioning [32]. At the same time, some studies highlight how alcohol consumption is deeply embedded in life-course dynamics and age-specific socialization processes, with patterns of initiation, frequency, and symbolic meaning varying significantly across cohorts [46]. Early exposure and peer-group influence have been identified as key drivers in the formation of drinking norms among younger individuals, particularly in contexts where alcohol functions as a marker of belonging and identity construction [47,48]. Conversely, more mature consumers tend to display more stabilized routines and attribute-based evaluations, often linked to quality cues, origin, and brand reputation [49,50].

Yet, empirical evidence suggests that such influence operates primarily at the pre-purchase stage, affecting awareness, consideration, and perceived value rather than channel choice or final transaction. This finding aligns with earlier research on alcohol advertising and counter-advertising, which demonstrates that media exposure can

modify attitudes and norms without producing proportional changes in actual consumption behavior [51,52].

Taken together, the literature suggests that digital engagement should not be equated with transactional orientation [3]. Social media influence is multifaceted, indirect, and strongly stage-specific, interacting with product symbolism, consumption context, and individual dispositions [4,53].

These insights are particularly relevant for hybrid categories, such as gin, that combine elements of experimentation, social consumption, and everyday retail accessibility [29,37]. By explicitly integrating purchasing channel choice into the analysis of youth consumption behavior, the present study responds to calls for more nuanced, category-sensitive approaches and contributes to a more critical understanding of the limits and possibilities of digitalization in contemporary food and beverage markets [35].

3. MATERIALS AND METHODS

The study adopts a non-probability sampling approach, with respondents recruited on a convenience basis according to criteria of accessibility and availability. Data were collected through a nationwide online survey of Italian gin consumers conducted between June and September 2025. The questionnaire was administered via Google Forms and disseminated through multiple social media channels, which are widely used in social science research as effective tools for participant recruitment due to their broad reach [54].

Survey dissemination combined public posts and targeted invitations circulated through the authors' networks, with repeated sharing over time to enhance participation. Respondents were also encouraged to further distribute the survey within their personal networks, resulting in a combined convenience-snowball sampling strategy. This approach is commonly adopted in exploratory consumer research aimed at identifying behavioral patterns and socio-demographic heterogeneity rather than producing statistically representative estimates.

Several measures were implemented to mitigate potential sampling and reporting biases. Participation was voluntary and anonymous, attitudinal constructs were measured using validated Likert-type scales, and consistency checks were applied to identify and exclude incomplete or unreliable responses. In addition, dissemination across heterogeneous networks helped limit the over-representation of specific social groups. Accordingly, the study does not aim for population representativeness but rather to capture structured behavioral patterns within the sampled population.

A total of 945 questionnaires from gin consumers were collected, while 143 non-gin respondents were not considered.

The empirical strategy is designed to investigate systematic differences in consumption behavior and purchasing channel choice across consumer segments. In particular, the analysis focuses on three dimensions: (i) socio-demographic characteristics, with a specific emphasis on age groups; (ii) consumption-related habits and preferences; and (iii) patterns of social media use and perceived digital influence.

The dataset is used to test two core hypotheses. First, whether younger consumers are more likely to engage in online purchasing. Second, whether higher levels of social media engagement are associated with online channel choice. These hypotheses allow for a direct empirical assessment of the commonly assumed link between digital nativity and online purchasing behavior.

To address these research questions, the analysis relies on chi-square tests of association, which are particularly suitable for examining relationships between categorical variables and for identifying statistically significant differences across groups [55]. This method allows for a systematic comparison of purchasing behaviors, consumption patterns, and digital engagement across age cohorts.

In addition, cross-tabulation analyses are used to explore the interaction between variables, including controlling for age effects when examining the relationship between social media engagement and purchasing behavior. This approach enables a more nuanced interpretation of observed associations and helps isolate the role of key explanatory factors.

Given the objective of identifying structured behavioral differences rather than estimating causal relationships, the analysis focuses on descriptive and associative statistical techniques [56]. This approach is consistent with multichannel consumer research, where the emphasis is on detecting patterns, segment heterogeneity, and behavioral regularities across groups.

This methodological framework enhances the interpretability of differences across consumer segments and allows for a robust empirical assessment of the relationship between age, digital engagement, and purchasing channel choice.

4. RESULTS

The sample is composed of 945 gin-drinkers of age 18 or older. Table 1 summarizes the socio-demographic characteristics of the sample. The sample shows a strong prev-

Table 1. Characteristics of the sample.

Variable	Class	Observations
Age	18-25	657
	26-35	135
	36-50	102
	51 or older	51
Sex	Male	258
	Female	687
Education	Middle school diploma	41
	High school diploma	585
	Bachelor's degree	216
	Master's degree or higher	103

alence of female respondents; therefore, the results may be affected by a gender imbalance and may not be fully generalizable to the population of Italian gin consumers.

The first part of the questionnaire examined differences in gin consumption across age groups. The main results are reported in Table 2. Data support the conclusion that gin consumption variables change with age. χ^2 association tests allowed us to reject the null hypothesis of independence between age and all gin consumption variables (Table 2).

Consumers aged between 18 and 25 drink gin less often than all other groups except consumers aged 51 or older. They are more focused on price, less willing to pay a premium for quality gin, more influenced by social context, and less interested in origin, branding, and even quality.

As expected, age groups differ in the use of social media. Data in Table 3 suggest that younger respondents use different media. Age group 18-25 is keener on TikTok, 26-35 is associated with Instagram, while older respondents are with Facebook. Also, younger respondents spend more time on social media, on average. Middle-aged groups are more likely to be exposed to gin advertising and promotion on social media than others.

The dataset can be used to test the study hypothesis about young consumers and online purchases. Table 4 illustrates the distribution of respondents by age and preferred shopping outlet for gin (bars, locals, and other social outlets are excluded). A χ^2 association test rejected the null hypothesis of independence between age and shopping outlet at a 99% confidence level.

Supermarkets are age group 18-25 preferred shopping outlet. Only 2.6 per cent of youngest respondents prefer online shopping, the lowest results among the age group. This result might be explained either by a preference for “anonymous” shopping outlets, that allow young consumers to access gin without discovering their pref-

Table 2. Sample statistics of gin consumption (percent values, numbers in parentheses are p-values from a χ^2 association test).

	Age groups				
	18-25	26-35	36-50	51+	Total
<i>How often do you drink gin? (0.001)</i>					
Never/Rarely	48.2	33.3	43.1	62.7	46.3
Once a month	20.1	18.5	15.7	19.6	19.4
Twice a month	14.8	20.0	13.7	2.0	14.7
Once a week	12.9	23.0	18.6	13.7	15.0
More than once a week	4.0	5.2	8.8	2.0	4.6
Total	100.0	100.0	100.0	100.0	100.0
<i>What is your favorite gin? (0.001)</i>					
Don't know	25.7	11.9	12.7	15.7	21.8
No preferences	26.0	16.3	13.7	27.5	23.4
International brands	29.4	21.5	15.7	13.7	25.9
Local or national brands	4.1	7.4	10.8	11.8	5.7
Premium / craft	14.8	43.0	47.1	31.4	23.2
Total	100.0	100.0	100.0	100.0	100.0
<i>What is your most important driver when purchasing gin? (0.001)</i>					
1. Price	76.7	54.1	41.2	33.3	67.3
2. Packaging	4.4	5.9	3.9	3.9	4.6
3. Friends, Experts	3.2	5.9	14.7	13.7	5.4
4. Alcohol content	0.5	0.7	0.0	0.0	0.4
5. Ingredients, Flavor	2.1	8.1	8.8	7.8	4.0
6. Brand	11.6	19.3	20.6	27.5	14.5
7. Origin	1.5	5.9	9.8	13.7	3.7
8. Social media promotion	0.0	0.0	1.0	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0
<i>Are you willing to pay a price premium for a premium gin? (0.001)</i>					
No, I always look for best prices	16.1	9.6	5.9	9.8	13.8
I am not interested in premium gin	17.2	6.7	6.9	7.8	14.1
Up to a point	45.8	52.6	49.0	37.3	46.7
Always	9.9	21.5	27.5	27.5	14.4
Only if advised by a trusted source	11.0	9.6	10.8	17.6	11.1
Total	100.0	100.0	100.0	100.0	100.0
<i>What brought you to drinking gin? (0.001)</i>					
Personal curiosity	7.6	15.6	11.8	39.2	10.9
Friends/social context	63.0	55.6	57.8	45.1	60.4
Experiences in bars/locals	27.7	28.1	28.4	15.7	27.2
Packaging and design	1.2	0.0	1.0	0.0	1.0
Post or stories on social media	0.5	0.0	0.0	0.0	0.3
Influencers or brand ambassadors	0.0	0.7	1.0	0.0	0.2
Total	100.0	100.0	100.0	100.0	100.0

erences to family or by social consumption resulting in opportunity purchasing rather than in planned behavior. Yet, further research is needed to support these speculations. Noticeably, age groups 26-35 and 36-50 exhibit a relative preference for online purchases.

The second study hypothesis is that engagement in social media is associated with online consumption. As

Table 3. Use of social media (percent values, numbers in parentheses are p-values from a χ^2 association test).

	Age group				Total
	18-25	26-35	36-50	51+	
<i>What social media do you use? (0.001)</i>					
1. No social media	0.3	3.7	2.9	13.7	1.8
2. Instagram	15.1	32.6	11.8	13.7	17.1
3. Facebook	0.3	2.2	10.8	21.6	2.9
4. Instagram, TikTok	43.1	19.3	2.9	0.0	33.0
5. Instagram, Facebook	0.8	4.4	32.4	7.8	5.1
6. TikTok	12.5	2.2	2.9	2.0	9.4
7. All	28.0	35.6	36.3	41.2	30.7
Total	100.0	100.0	100.0	100.0	100.0
<i>How much time do you spend on social media? (0.001)</i>					
Zero	0.3	3.7	2.9	13.7	1.8
Less than 1 hour	2.0	8.1	22.5	39.2	7.1
Between 1 and 2 hours	30.4	46.7	60.8	35.3	36.3
Between 2 and 4 hours	44.6	28.9	10.8	5.9	36.6
More than 5 hours	22.7	12.6	2.9	5.9	18.2
Total	100.0	100.0	100.0	100.0	100.0
<i>Are you exposed to gin advertising on social media? (0.001)</i>					
Never	15.1	12.6	8.8	33.3	15.0
Seldom	35.2	25.2	25.5	33.3	32.6
Sometimes	38.5	43.7	35.3	21.6	38.0
Often	8.7	13.3	25.5	11.8	11.3
All the times	2.6	5.2	4.9	0.0	3.1
Total	100.0	100.0	100.0	100.0	100.0

expected, the data in Table 5 do not support the hypothesis. Because younger respondents spend more time on social media and have the lower share of online purchases, we found a negative association between the two variables (p-value of χ^2 association test 0.001).

To control for the age effect, we compute the percentage of respondents who prefer to shop for gin online (vs. other outlets) by age group and time spent on social media. Results are reported in Table 6. Even within age groups, the association between online shopping and time spent on social media is not supported.

Table 4. Preferred shopping outlet for gin, by age group (percent values).

Shopping outlet	Age group				Total
	18-25	26-35	36-50	51+	
None of these options	40.2	36.3	25.5	35.3	37.8
Supermarkets	46.9	33.3	30.4	31.4	42.3
Specialty stores	10.2	17.0	30.4	29.4	14.4
Online	2.6	12.6	12.7	3.9	5.2
Other stores	0.2	0.7	1.0	0.0	0.3
Total	100.0	100.0	100.0	100.0	100.0

Finally, we investigated if younger consumers were more affected by social media campaigns than older respondents. Table 7 does not support any association between age and the self-reported effect (p-value of χ^2 association test 0.085). Yet, when asked if social media affect gin consumption of youngest generations, the perception of elder respondents is of a larger effect than younger ones (Table 8, p-value of χ^2 association test 0.001).

5. DISCUSSION

The analysis confirms that age plays a central role in shaping gin consumption patterns, preferences, and purchasing behavior. The rejection of the null hypothesis of independence between age and all gin consumption variables indicates that gin consumption is not homogeneous across cohorts but evolves significantly over the life course, age is a key discriminating variable in the gin market as it emerges also by the existing literature on alcohol consumption that showed how it can be attributed to a range of demographic and social factors [57].

In this paper, younger consumers (18–25) are found to be occasional gin drinkers, with lower consumption frequency than middle-aged groups. Their behavior is strongly price-oriented and socially driven: they show

Table 5. Preferred outlet by time spent on social media (per cent values).

Time spent on social media per day	Preferred shopping outlet					Total
	No purchase	Supermarket	Specialty store	Online	Other	
Zero	29.4	41.2	23.5	5.9	0.0	100.0
Less than 1 hour	31.3	31.3	28.4	9.0	0.0	100.0
Between 1 and 2 hours	35.0	36.4	19.8	8.2	0.6	100.0
Between 2 and 4 hours	37.9	50.3	8.7	2.9	0.3	100.0
More than 5 hours	46.5	42.4	8.7	2.3	0.0	100.0
Total	37.8	42.3	14.4	5.2	0.3	100.0

Table 6. Per cent share of respondents preferring online shopping by age group and time spent on social media per day.

Time spent on social media per day	Age Group			
	18-25	26-35	36-50	51+
Zero	0.0	20.0	0.0	0.0
Less than 1 hour	23.1	0.0	4.3	10.0
Between 1 and 2 hours	3.5	17.5	16.1	0.0
Between 2 and 4 hours	2.0	5.1	18.2	0.0
More than 5 hours	0.7	17.6	0.0	0.0

Table 7. Do you think social media affected your gin choice? (per cent values by age group).

	Age Group				Total
	18-25	26-35	36-50	51+	
Not at all	63.0	51.9	49.0	58.8	59.7
Marginally	21.8	25.9	26.5	19.6	22.8
A little	12.0	16.3	15.7	11.8	13.0
Quite	1.4	3.0	3.9	3.9	2.0
Completely	1.8	3.0	4.9	5.9	2.5
Total	100.0	100.0	100.0	100.0	100.0

partial interest in premium products, brand reputation, origin, and product quality, while the social setting is the dominant driver of drinking [58, 59]. This profile suggests that gin is primarily consumed as a social good. As age increases, consumption patterns become more controlled and thoughtful. Respondents in the 26–35 and 36–50 age groups drink gin habitually, show stronger preferences for premium products, and are more willing to pay a premium price for quality. These consumers also attach greater importance to brand, origin, and expert recommendations, indicating a shift from opportunistic consumption toward a more informed and intentional purchasing process. Consumers aged 51 or older, while drinking gin less frequently, appear relatively quality-oriented, proposing a mature drinking style driven more by curiosity and experience than by social influence. Interestingly, higher time spent on social media does not result into greater exposure to gin-related advertising. Instead, respondents in the mid-age groups report higher exposure to gin promotion on social media. This outcome is consistent with alcohol brands' preference for targeting consumers with greater purchasing power and a greater willingness to pay a premium for quality rather than those with the highest social media engagement [60,61].

The results challenge the common assumption that younger consumers are more inclined toward online

Table 8. Do you think that social media shape gin consumption of young people? (per cent values).

	Age group				Total
	18-25	26-35	36-50	51+	
Not at all	7.2	5.2	2.0	3.9	6.1
Marginally	32.6	27.4	13.7	9.8	28.6
A little	10.0	7.4	10.8	15.7	10.1
Quite	37.1	39.3	54.9	41.2	39.6
Completely	13.1	20.7	18.6	29.4	15.7
Total	100.0	100.0	100.0	100.0	100.0

purchasing. Despite their high social media engagement, respondents aged 18–25 show the lowest preference for online shopping and rely primarily on supermarkets for gin purchases. This pattern may reflect a preference for familiar, “anonymous” purchasing environments or the predominantly social nature of gin consumption among this age group, leading to opportunity rather than planned purchases. Then, supermarkets are a convenient and anonymous source of low-priced gin. However, this conclusion remains speculative and warrants further investigation.

In contrast, consumers aged 26–35 and 36–50 exhibit a stronger preference for online shopping, consistent with their higher interest in product differentiation, premium offerings and planned consumption. This supports the idea that online purchasing is associated more with involvement and product knowledge than with age per se.

The second study hypothesis, testing a positive relationship between social media engagement and online consumption, is clearly not supported. On the contrary, a negative association emerges. Respondents who spend more time on social media are less likely to purchase gin online. Importantly, this relationship persists even after controlling for age, indicating that social media engagement and online purchasing are not complementary behaviors in this context. The analysis of perceived social media effect reveals an interesting asymmetry. Self-reported influence of social media on personal gin choices does not differ significantly by age, with most respondents reporting limited or no impact. However, when evaluating the influence of social media on younger generations, older respondents perceive a substantially stronger effect than younger consumers themselves.

This divergence suggests the presence of a perception bias, whereby individuals tend to moderate media influence on their own behavior while attributing greater exposure to others, particularly younger people. This might be an additional motivation explaining why younger consumers are not a primary target for gin's

online advertising campaign. It also suggests that the impact of social media marketing may be indirect or unconscious.

The findings highlight the importance of age-based segmentation in the gin market: younger consumers appear less responsive to quality cues, branding, and digital commerce, while middle-aged consumers represent the most attractive segment for premium products and online channels.

6. CONCLUSION

This study contributes to the literature on multi-channel consumer behavior by providing empirical evidence that younger consumers cannot be uncritically characterized as online-oriented buyers. The findings point to a clear distinction between digital engagement and actual purchasing behavior, suggesting that the commonly assumed correspondence between younger age cohorts and online purchasing does not systematically hold in real consumption contexts.

From a managerial standpoint, the results highlight the importance of adopting more articulated and channel-specific strategies. While digital environments play a relevant role in shaping awareness and pre-purchase processes, physical retail channels continue to retain a central function at the transaction stage, particularly for younger consumers. This evidence calls for moving beyond simplified, age-based segmentation and for developing approaches that more carefully account for consumption patterns and product-specific characteristics.

The study is not without limitations. In particular, the use of non-probability sampling and self-reported data may constrain the generalizability of the results. Future research could address these aspects by relying on more representative samples and by extending the analysis to different product categories, in order to assess the robustness and broader applicability of the findings.

Overall, the study offers evidence that age and digital engagement influence consumer behavior along distinct dimensions, contributing to a more refined understanding of multichannel dynamics within the food and beverage sector.

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Wine Quality as a Source of Information Asymmetry: Signals, Screens, and the Role of Emerging Technologies

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Abstract. Wine quality is a multidimensional and contested concept that generates persistent information asymmetries among producers, consumers, experts, and regulators. This review synthesizes multidisciplinary evidence from economics, marketing, sensory science, and digital innovation to examine how wine quality's intrinsic, extrinsic, institutional, and cultural dimensions interact with mechanisms of signalling and screening. Using a structured conceptual review and systematic evidence mapping of 76 peer-reviewed studies, the paper identifies where traditional mechanisms – such as price, reputation, expert ratings, geographical indications, and certification schemes – mitigate uncertainty and where they merely relocate it along the value chain. The analysis introduces the notion of layered systems of trust, showing that each corrective instrument reduces one type of asymmetry while generating dependencies elsewhere. Emerging digital tools, particularly blockchain and related traceability technologies, offer complementary ways to enhance transparency and governance but also create new informational challenges around data input and interoperability. The paper concludes that wine markets will continue to rely on hybrid constellations of traditional and technological signals, underscoring the need for governance frameworks that integrate digital innovation with the preservation of wine's sensory, cultural, and institutional complexity.

Keywords: wine quality, information asymmetry, signalling, screening, blockchain, transparency, digital innovation.

1. INTRODUCTION

Wine quality is one of the most debated and least consensual concepts in agri-food research. Scholars, regulators, and practitioners have long recognized that it is not reducible to a single objective measure but is instead the outcome of diverse physical, sensory, cultural, and economic factors. Charters and Pettigrew emphasize its multidimensional nature, noting that intrinsic

sic attributes such as balance or complexity interact with extrinsic ones such as brand reputation, geographical origin, and price [1,2]. Oczkowski shows that these elements influence not only consumer perceptions but also the price formation process in wine markets [3]. More recent studies highlight the growing importance of credence signals, such as sustainability or organic certification, which consumers cannot easily verify on their own [4].

Classic sensory and market studies underscore this multidimensionality and the limits of verification: sensory foundations [5], extrinsic cue effects [6], and the inconsistency of expert systems [7,8]. Price can both reveal and distort perceived quality [9,10].

This multidimensionality creates conditions of information asymmetry, a core concern in economics since Akerlof's seminal "market for lemons" [11]. Producers typically hold superior information about production practices, vineyard provenance, and cellar techniques, while consumers and even regulators must rely on incomplete or imperfectly verifiable signals. Spence's theory of signaling and Stiglitz's work on screening illustrate the mechanisms through which such asymmetries may be mitigated, but in the case of wine these tools rarely eliminate uncertainty altogether [12,13]. Instead, information asymmetries are often relocated along the value chain: reliance on critics, for example, reduces uncertainty for consumers but introduces opacity regarding the independence or consistency of expert evaluations [14]. Evidence of judge inconsistency and expert bias further motivates the need to consider multiple signals rather than a single gatekeeper [15–18].

The persistence of these asymmetries has far-reaching consequences. They can undermine consumer trust, distort market efficiency, and complicate regulatory enforcement. At the same time, they stimulate the emergence of signals and institutional arrangements designed to bridge gaps in knowledge, such as geographical indications [19], expert ratings [20], and certifications [21]. Their effectiveness varies with governance and enforcement [22–25]. More recently, digital innovations such as crowdsourced ratings and blockchain-based traceability systems have been promoted as responses to these enduring challenges [26–28].

The aim of this paper is to advance the understanding of wine quality as a multidimensional construct by examining how its different dimensions may generate information asymmetries, and by critically assessing the effectiveness and limitations of mechanisms designed to mitigate them.

To operationalize this aim, the paper adopts a structured conceptual review with systematic evidence mapping, integrating insights from economics, marketing,

sensory science, and digital innovation. Unlike previous studies that typically emphasize a single mechanism or stakeholder perspective, this review develops an integrative framework that connects the dimensions of wine quality to information asymmetries, signals, and mitigation strategies. Blockchain applications in the wine sector are used as illustrative cases to highlight the potential and limits of emerging solutions.

By doing so, the paper contributes to the broader literature on information economics and agri-food systems. It clarifies the conceptual foundations of wine quality, synthesizes evidence on the instruments used to overcome asymmetries, and illustrates how digital innovations reshape – but do not fully resolve – the dynamics of trust and transparency in wine markets.

Although the multidimensionality of wine quality is well established, its analytical relevance lies in the way each dimension generates distinct informational frictions for different stakeholders. By synthesizing how intrinsic, extrinsic, and institutional attributes map onto specific asymmetries, and how mitigation mechanisms interact across the value chain, the paper reduces conceptual complexity and provides a structured foundation for answering the following three exploratory research questions:

- 1) What is the relationship between different dimensions of wine quality and the occurrence of information asymmetries?
- 2) Which signals and screening mechanisms mitigate these asymmetries, and with what limitations?
- 3) How can emerging solutions, particularly blockchain technology, contribute to addressing these challenges?

The rest of this paper is structured as follows. Section 2 introduces the methodology and outlines the review process. Section 3 discusses wine quality as a multidimensional construct. Section 4 applies theories of information asymmetry, signaling, and screening to the wine sector. Section 5 synthesizes findings on how different mechanisms mitigate or relocate asymmetries. Section 6 turns to emerging digital solutions, with blockchain as an illustrative case. Section 7 concludes by summarizing key insights, highlighting limitations, and suggesting directions for future research.

2. METHODOLOGY

To answer these research questions, the paper adopts a structured conceptual review combined with systematic evidence mapping, following methodological guidance from Snyder [29] and Jaakkola [30]. A structured conceptual review synthesizes diverse theoretical and empirical

insights to develop integrative explanations for complex phenomena; in this case, how different dimensions of wine quality generate information asymmetries and how mitigation mechanisms function. It differs from a systematic review or meta-analysis in that the underlying literature spans heterogeneous constructs, disciplinary approaches, and outcome measures.

A formal meta-analysis is therefore not feasible because the underlying studies span heterogeneous constructs, outcome measures, and methodological designs across sensory science, marketing, economics, and digital innovation. These studies do not report commensurable effect sizes or statistical parameters that would allow quantitative aggregation. Instead, systematic evidence mapping was employed to document the scope, characteristics, and thematic patterns of the literature in a transparent and replicable manner, enabling conceptual integration while retaining systematic search, screening, and coding procedures.

The review proceeded in three steps. First, a search strategy was conducted in two leading academic databases, Scopus and Web of Science, complemented by snowballing from reference lists and the author's ongoing research portfolio. For transparency and replicability, the complete search strings used in the Scopus and Web of Science queries were as follows:

Scopus query

TITLE-ABS-KEY ("wine quality" AND ("information asymmetry" OR "asymmetric information" OR signaling OR screening OR "quality signal*" OR "credence" OR "geographical indication*" OR certification OR "expert rating*" OR "consumer preference*"))

Web of Science query:

TS=("wine quality" AND ("information asymmetry" OR "asymmetric information" OR signaling OR screening OR "credence good*" OR "quality signal*" OR "geographical indication*" OR certification OR "expert rating*" OR "consumer preference*"))

Inclusion criteria were defined *ex ante*. A study was included if it met all of the following conditions:

- (1) addressed wine quality either directly (intrinsic, extrinsic, institutional, cultural) or as an outcome variable;
- (2) examined, explicitly or implicitly, a form of information asymmetry, signaling, or screening relevant to wine markets;

- (3) offered empirical or conceptual insights that helped answer at least one of the three research questions;
- (4) was published in a peer-reviewed journal, conference proceeding, or recognized scholarly outlet.

Exclusion criteria were: (a) papers focused solely on oenology without informational or economic implications; (b) purely technical chemistry or viticulture studies; (c) duplicate records; and (d) non-scholarly sources.

The initial query yielded five core articles explicitly linking wine quality to information asymmetry. Broader searches identified an additional 21 related studies. A complementary query using the paired terms "wine quality" and "information asymmetry" uncovered 29 further articles. Finally, snowballing and the author's curated library added 44 unique studies. After removing duplicates, the final dataset consisted of 76 relevant articles, covering disciplines such as agricultural economics, marketing, sensory science, sociology, and food policy (see Annex III – List of Reviewed Articles with Data Sources, Sample Size and Methods).

Second, a screening and inclusion procedure ensured that only studies addressing at least one of the guiding research questions were retained. Titles and abstracts were reviewed to exclude irrelevant material, followed by full-text examination.

Third, all included articles were coded into an evidence matrix that captured bibliographic information, the rationale for inclusion, the specific research question(s) addressed, the type of signal or screening mechanism studied (for example, price, critic ratings, geographical indications, certifications, peer reviews, eco-labels, or weather proxies), the stakeholder perspective emphasized, and any methodological contributions or noted biases. The coded evidence base was analyzed to identify recurring themes, complementarities, and contradictions. Rather than reporting studies individually, the synthesis was organized into thematic clusters corresponding to the types of signals and screening mechanisms. This approach made it possible to visualize relational dynamics across the wine value chain, highlight where mitigation efforts relocate asymmetries rather than eliminate them, and prepare the ground for the results presented.

By structuring the literature in this way, the review ensures transparency and replicability while remaining tailored to the purpose of conceptual integration. The method allows us to map systematically how information asymmetries are addressed in the wine sector and to identify both the effectiveness and limitations of existing mechanisms. This forms the empirical foundation for the synthesis presented in the following chapters.

3. WINE QUALITY AS A MULTIDIMENSIONAL CONSTRUCT

This section provides the analytical foundation for addressing Research Question 1 by showing how intrinsic, extrinsic, and institutional attributes of wine quality give rise to distinct forms of information asymmetry. Among agri-food products, wine stands out for the extent to which its quality resists clear definition, with scholars and practitioners offering diverging interpretations across disciplines and contexts. Unlike commodities with standardized attributes, wine quality is inherently multidimensional: it combines observable characteristics with subjective judgments, cultural codes, and institutional guarantees.

Systematic reviews confirm the absence of a unifying definition and show that researchers apply diverse operationalizations depending on disciplinary perspective and research context [31]. This diversity is not merely academic – it reflects the reality of wine markets where producers, critics, and consumers operate with different, sometimes conflicting, notions of what constitutes quality, further complicated by the number of different actors along the wine value chain (see Annex I).

Economics and marketing studies often approach wine quality through its extrinsic cues and market outcomes. Price is widely studied as a signal because it correlates with some quality attributes but only imperfectly, as hedonic analyses show [3,6]. Blind-tasting evidence demonstrates that higher prices do not necessarily translate into greater sensory enjoyment [8], and price formation often incorporates external influences such as expert ratings [9]. Experimental work also indicates that consumers sometimes treat price as an indicator of expected quality, though this effect varies by experience level and price tier [10].

Reputation, whether of brands, producers, or entire regions, plays a similarly important role. Meta-analyses reveal that reputation effects influence willingness-to-pay across countries and market segments, though explanatory power diminishes in oversaturated or fragmented markets [32]. Expert ratings and wine guides also figure prominently in this literature. Studies document the impact of scores on price formation and consumer choice [33,20], yet the reliability of such ratings is contested. Both Ashton and Dubois highlight inconsistencies within and across experts, while Hodgson demonstrated low repeatability in blind tasting [15, 34, 7]. Marketing studies further show that awards and competitions affect perceived quality but often reflect selective participation rather than objective superiority [24]. As a result, economics and marketing perspectives highlight

the importance of extrinsic and reputational signals but also underscore their limitations: they reduce some uncertainties while introducing new forms of opacity.

Sensory science and oenology focus on the intrinsic dimensions of wine quality. Foundational work attempted to systematize sensory evaluation, combining expert panels with statistical analysis [5]. Since then, research has expanded into chemometrics, machine learning, and predictive modeling. Recent work demonstrates how chemical composition and volatile compounds can be linked to sensory outcomes, while other studies show correlations between intrinsic attributes and price formation [35,36]. Despite these advances, sensory-based assessments face two fundamental challenges. First, variability among tasters undermines claims of objectivity [16,17]. Second, even when sensory results are robust, translation into consumer markets is problematic. Most consumers lack the expertise to interpret chemical or sensory datasets, and even expert language requires interpretation within cultural frames. Thus, while oenology and sensory science strengthen the objective measurement of wine quality, their findings do not directly resolve the uncertainties that structure wine markets.

Another body of literature examines the institutional dimensions of wine quality, especially geographical indications (GIs), certification schemes, and cooperative governance. GIs are designed to reduce uncertainty about origin and production methods. Empirical studies suggest they can sustain price premia and consumer trust [37,19]. Yet their effectiveness depends on credible enforcement and on consumer recognition of the label [23]. Weak oversight or label proliferation can dilute their signaling function. Certification schemes (e.g., organic, biodynamic, sustainability, fair trade) extend this logic into credence attributes. While they offer screens for consumers and marketing leverage for producers, they also risk greenwashing if auditing is weak or standards are inconsistent [21]. Cooperative governance adds another institutional dimension: cooperatives can strengthen collective reputation and bargaining power but are vulnerable to principal-agent problems where individual incentives diverge from collective goals [38-40]. Overall, institutional perspectives highlight that wine quality is not only a matter of product attributes but also of rules, governance, and collective organization.

Beyond economics, sensory science, and institutions, cultural and sociological research emphasizes that wine quality is also a socially constructed category. Studies argue that quality is embedded in narratives of authenticity, identity, and heritage [41, 42]. Consumer studies show that perceptions of natural wine, for example, often rest less on sensory characteristics than on symbolic

associations of purity and resistance to industrialization [42]. Online platforms amplify these dynamics: peer reviews, influencer endorsements, and social media narratives all contribute to shaping how quality is perceived, often blurring the boundary between intrinsic experience and symbolic meaning [26].

Following Nelson's typology, wine combines features of search goods (e.g., grape variety, packaging), experience goods (taste and complexity revealed during consumption), and credence goods (origin, sustainability claims not directly verifiable by consumers) [43]. This hybridity explains why uncertainty is structural rather than incidental in wine markets and why wine quality, being multidimensional, contested, and only partially observable, systematically generates information asymmetries between stakeholders. Consumers, regulators, and intermediaries must rely on signals and assurances because quality cannot be fully observed directly. As Akerlof demonstrated, such information problems create conditions for adverse selection, while Nelson's framework further explains why uncertainty is persistent [11,43]. These product characteristics form the conceptual foundation for the following chapter, which examines how theories of information asymmetry, signaling, and screening apply to wine.

4. INFORMATION ASYMMETRIES AND MITIGATION IN WINE MARKETS

4.1 Information asymmetries in wine markets

This section develops the mechanisms through which these asymmetries arise and are mitigated, thereby setting up the structured answer to the first and second research questions. Building on the trust properties outlined above, economic theory provides a formal framework for understanding how wine's multidimensional quality creates and sustains information asymmetries. Akerlof's "market for lemons" demonstrated how hidden information about product quality can lead to adverse selection, market inefficiencies, and even collapse [11]. Applied to wine, this dynamic highlights the risk that consumers, unable to distinguish reliably between high- and low-quality bottles, may underpay for superior wines, thereby discouraging producers from investing in quality-enhancing practices. Studies of wine markets confirm this mechanism: for example, Oczkowski shows the limits of price as a reliable indicator of quality, while Schamel demonstrates how competitions and awards function as corrective signals that help counteract adverse selection [3,24].

Nelson distinguished between search goods (attributes observable prior to purchase), experience goods (attributes revealed only through consumption), and credence goods (attributes not verifiable even after use) [43]. Wine combines all three. This classification has been widely applied in wine research, emphasizing the hybrid nature of wine quality and the governance challenges that follow [1,2, 40–42,44–46].

Darby and Karni underscored the specific challenges of credence goods, where even after consumption consumers cannot validate certain claims, leaving asymmetry unresolved [45]. In the case of wine, this applies to attributes such as organic production, sustainability, or terroir authenticity, which cannot be verified without institutional guarantees. Empirical studies highlight both the potential and the fragility of these mechanisms: certification opacity enables greenwashing, while consumers must ultimately place their trust in regulators and auditors, thereby relocating rather than eliminating asymmetry [21,22].

Later contributions emphasized the role of reputation and governance in stabilizing markets. Shapiro and Tirole demonstrated how reputational equilibria can support trust under conditions of repeated interaction and credible sanctioning [46,47]. In wine markets, reputation has been shown to be central in sustaining quality expectations across vintages and regions. Gergaud et al. [20] find that both brand and critic reputation strongly influence price formation, while Frick and Simmons demonstrate, using a dataset of 1,300 Mosel Rieslings, that reputation effects are powerful but vary in strength across different contexts, vintages, and consumer groups [32].

Finally, Spence's theory of signaling and Stiglitz's work on screening explain how asymmetries may be mitigated through observable actions or institutional arrangements [12,13]. Producers signal hidden quality by investing in branding, entering competitions, or positioning their wines at higher price points. Consumers and regulators, in turn, rely on screening mechanisms such as certification, audits, or geographical indications to extract information about unobservable attributes. Castriota et al. show that expert scores operate as signals influencing consumer behaviour, while Menapace and Moschini analyse how GIs function as institutional screens that reduce uncertainty about provenance. Together, these studies illustrate the relevance of signaling and screening mechanisms for structuring information flows in wine markets. [33,19].

The multidimensionality of wine quality gives rise to different levels of knowledge amongst actors leading to information asymmetries at multiple stages of

the value chain: For instance, vineyard practices (e.g., yields, pesticide use, terroir management) are largely invisible to consumers and difficult for regulators to monitor comprehensively. Cellar processes (fermentation techniques, additives, blending) remain proprietary to producers and are not observable to outsiders. Distribution and logistics (storage, transport, relabelling) create asymmetries between distributors, retailers, and end-users. Consumption and evaluation are mediated by critics and experts, who reduce consumer uncertainty but introduce opacity regarding independence, methodology, and consistency.

These asymmetries are not isolated but layered, as informational advantages shift from one actor to another. Figure 1 provides a schematic overview of examples of how asymmetries manifest across the wine value chain: At the first level the stage and its respective owner (e.g., grape grower at the vineyard or the producer at the cellar stage) along the wine supply chain are located. This connects on the third level with the respective information asymmetry (e.g., superior provenance information of the grape grower or the producer regarding the exact tasting profile of its wine). At the same time, it connects to the affected actors on the second level (grape buying wineries or the wine buying consumer) suffering from inferior knowledge.

Thus, in answer to the first research question, the analysis shows that the multidimensionality of wine quality systematically gives rise to information asymmetries across all stages of the value chain. These asymmetries are layered, as informational advantages shift from one actor to another, and they affect producers, consumers, regulators, and intermediaries in distinct but interrelated ways.

4.2 Mitigation of information asymmetries in wine markets

This subsection contributes directly to the second research question by evaluating how traditional signals and screening mechanisms reduce, relocate, or exacerbate information asymmetry. To mitigate these information asymmetries, the general theories of signaling and screening take on distinctive forms in wine:

- Signaling: Producers rely on costly strategies such as pricing above the market average, investing in branding, or entering competitions to demonstrate hidden quality attributes. Reputation functions as a cumulative signal across vintages and markets.
- Screening: Regulators and consumers employ institutional mechanisms – certifications, GIs, audits, or sustainability labels – that extract credible information. These mechanisms reduce uncertainty but depend on consumer recognition and trust in enforcement bodies.

While effective in some contexts, both approaches face limitations: signals can be mimicked, and screens can be gamed.

Price has long been considered the most immediate extrinsic signal of wine quality. Empirical studies confirm that higher prices often correlate with higher-rated wines [3], but this relationship is far from perfect. Meta-analyses demonstrate wide variation in explanatory power across regions and vintages [32]. Price is also subject to speculative dynamics, especially in fine wine markets, where it may reflect scarcity or prestige rather than intrinsic quality.

Reputation serves as a stabilizing signal, allowing consumers to rely on accumulated credibility of brands, producers, or regions [46]. Regional reputations, such as Bordeaux or Napa, provide collective benefits but can be

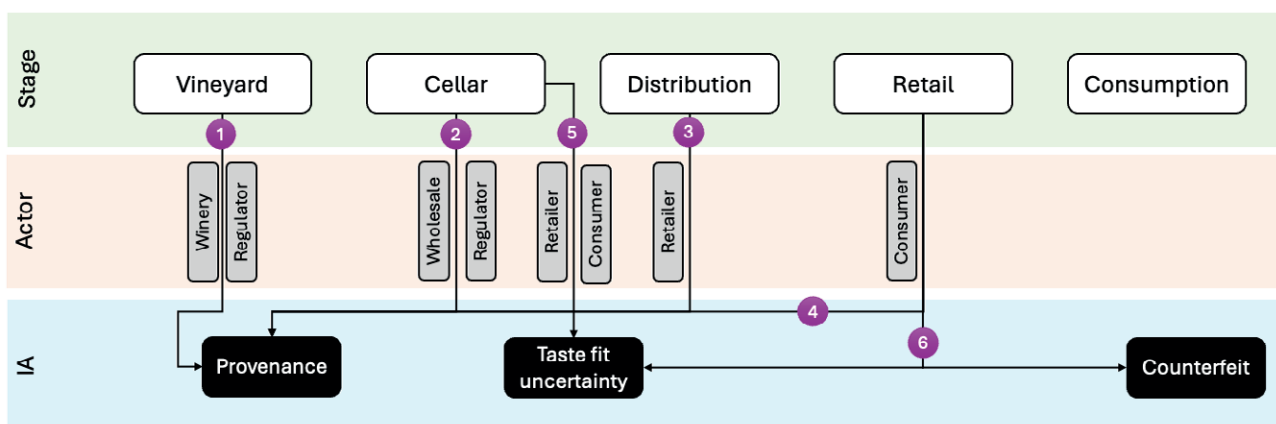


Figure 1. Schematic overview of interplay across Stages, Actors and IAs (Source: authors).

undermined by scandals or overproduction. Reputation is slow to build but can be quickly damaged, illustrating both its power and fragility.

Expert ratings remain a cornerstone of wine evaluation. Castriota et al. [33] and Gergaud et al. [20] show that ratings strongly influence consumer choices and price formation. Yet critics themselves are sources of asymmetry. Studies highlight inconsistency across judges [15], low repeatability [7], and biases linked to style preferences or conflicts of interest [34]. Competitions and awards provide additional signals. While they democratize recognition, participation is selective and may favour producers with resources to enter multiple contests. Research on competition outcomes shows they influence consumer willingness-to-pay but are not reliable indicators of intrinsic quality [24]. Sommeliers and wine merchants also act as intermediaries, offering guidance to consumers but introducing asymmetry about their motivations, expertise, and potential commercial bias.

Geographical indications (PDOs, PGIs) and certification schemes (organic, biodynamic, fair trade, sustainability) serve as institutional screens. They reduce uncertainty about provenance or production methods, and studies confirm that they sustain consumer trust and price premia when enforcement is credible [37, 19]. However, weak enforcement or label proliferation undermines their credibility [3]. In secondary markets, platform-level verification at auctions acts as a screen, increasing sale probabilities and prices [48, 49].

Cooperatives represent another form of institutional arrangement. They can enhance collective reputation, stabilize supply, and strengthen bargaining power. Yet they are prone to principal-agent dilemmas: members may have incentives to shirk quality standards while benefiting from collective reputation [38, 39]. Case studies illustrate that cooperative governance structures vary widely in their effectiveness [40]. Thus, institutional mechanisms mitigate some asymmetries but introduce new governance challenges.

Digital platforms such as Vivino expand consumer access to peer evaluations, democratizing wine criticism [26]. They provide real-time data on consumer preferences but also create new asymmetries: algorithms shape visibility, popular wines are disproportionately favoured, and reviews may be manipulated.

Studies of natural wine illustrate how digital discourse reshapes consumer expectations: perceived authenticity often matters more than sensory evaluation [42]. This highlights the tension between symbolic and sensory dimensions in digital peer ratings. While they increase participation, they also amplify herding effects and reinforce existing hierarchies.

Scientific advances allow increasingly detailed measurement of wine attributes. Chemometrics and machine learning models predict sensory outcomes or consumer preferences from chemical data [35]. Structured sensory panels provide robust assessments under controlled conditions [36]. Yet these approaches remain costly, inaccessible to most consumers, and fail to capture subjective or cultural interpretations of quality.

These mechanisms are summarized in Table 1, which maps the major information asymmetries in the wine sector, the corresponding signals and screens, and their effectiveness. In this review, “effectiveness” refers to the extent to which a mitigation mechanism reduces information asymmetry by increasing the credibility, interpretability, or reliability of quality-related information for the relevant stakeholders. The classifications reported in Table 1 are based solely on empirical evidence presented in the reviewed studies.

Accordingly, in answer to the second research question, the evidence indicates that while a wide range of signals and screening mechanisms provides partial relief from information asymmetry, none is sufficient on its own. Price and reputation stabilize expectations but are vulnerable to speculation and shocks. Expert ratings and competitions democratize evaluation but suffer from inconsistency and bias. Institutional arrangements such as GIs, certifications, and cooperatives offer governance-based solutions, yet their effectiveness depends on credible enforcement and internal incentive alignment. Digital platforms expand participation but create new algorithmic and symbolic asymmetries. Even scientific measurement leaves unresolved the gap between objective data and subjective experience.

Taken together, these mechanisms form layered systems of trust. They mitigate uncertainty at one level while often generating new dependencies at another. This relocation dynamic will be explored further in the synthesis section.

5. SYNTHESIS OF FINDINGS

5.1 Layered nature of asymmetries

The review confirms that information asymmetries in wine are not confined to a single stage of the value chain but occur simultaneously and interactively across vineyard, cellar, distribution, and consumption. Mechanisms designed to mitigate these asymmetries rarely function in isolation. Instead, they form layered arrangements of trust, where consumers, producers, regulators, and experts rely on multiple overlapping signals and screens to stabilize expectations. These dynamics

Table 1. Wine quality information asymmetries, stakeholders, and mitigation strategies.

Stage	Information Asymmetry	Stakeholders Affected	Description & Examples	Traditional Mitigation Instruments	Effectiveness*
Vineyard	Vineyard practices	Grape growers ↔ wineries / co-ops	Growers know pruning, soils, treatments; buyers lack full visibility.	Organic / sustainability certifications; audits.	p
Vineyard	Yield & harvest timing	Grape growers ↔ wineries / co-ops	Overstated yields; altered harvest timing; limited real-time oversight.	Pre-harvest contracts; field inspections; yield monitoring.	p
Vineyard	Use of inputs (pesticides, irrigation, GMOs)	Grape growers ↔ regulators / consumers	Undocumented inputs undermine health / sustainability claims.	Lab testing; certification; residue checks.	y
Vineyard	Origin of grapes (parcel / site specificity)	Grape grower ↔ winery	Privileged knowledge of plots / blocks; buyers learn post-harvest.	PDO / harvest records; GI labels; audits.	p
Vineyard	Origin of grapes (regulatory compliance)	Producer ↔ regulator	Verification of declared source for blends / subregions.	Harvest reports; certification of origin; audit trails.	y
Vineyard	Origin of grapes (consumer-facing)	Producer ↔ consumers / distributors / experts	Consumers rely on labels; limited independent verification.	PDO / PGI labels; external certification bodies.	n
Cellar	Sensory quality	Producer ↔ consumer / distributor	Intrinsic quality not fully revealed pre-purchase.	PDO tasting panels; expert reviews; consumer tastings.	n
Cellar	Winemaking methods (fermentation, additives)	Wineries ↔ distributors / retailers / consumers	Use of additives / stabilizers may be undisclosed.	Labelling laws; ingredient disclosure; lab tests.	y
Cellar	Aging & maturation	Wineries ↔ critics / consumers	Barrel types and duration selectively disclosed; affects perceived quality.	Technical sheets; PDO rules; certification panels.	p
Cellar	Microbial / chemical stability	Wineries ↔ distributors / retailers	Spoilage or instability risks not fully revealed.	Lab testing; certification; bottling audits.	y
Distribution / Wholesale	Storage & transport conditions	Distributors / logistics providers ↔ retailers / wineries / consumers	Temperature shocks / handling degrade quality; documentation rare.	Cold-chain protocols; temperature / shock loggers; logistics documentation.	p
Distribution / Wholesale	Sustainability compliance	Wineries ↔ regulators / certifiers	Claims may not match actual practices; audit intensity varies.	Third-party certification; periodic audits.	p
Distribution / Wholesale	Supply-chain traceability	Producers / distributors ↔ retailers / consumers	Opacity on relabelling, repackaging, or alteration in transit.	Batch records; serialisation; track-and-trace systems.	p
Distribution / Wholesale	Market demand & pricing trends	Distributors / brokers ↔ wineries	Intermediaries may withhold demand / price info from producers.	Transparent brokerage; market research; data-sharing.	n
Distribution / Wholesale	Counterfeiting & fraud	Distributors / importers ↔ retailers / consumers	Fake wines or misrepresented vintages enter the market.	Tamper-evident packaging; NFC / RFID; authentication seals.	p
Retail	Tasting uncertainty (experience good)	Consumers (and retailers)	Intrinsic quality unknown pre-purchase.	Competitions; critic scores; in-store tastings; peer reviews.	n
Retail	Expert / critic opacity	Consumers	Methods, biases, and incentives of experts unclear.	Multiple guides; blind tastings; disclosure norms.	n
Retail	Branding vs. actual quality	Producers / retailers ↔ consumers	Reputation inflates signals beyond intrinsic quality.	Independent reviews; rating platforms; comparative tastings.	n
Consumption	Aging potential claims	Wineries / critics ↔ consumers	Longevity claims may be overstated; hard to verify ex ante.	Expert consensus; retrospective evaluations; cellar studies.	n
Consumption	Resale value & investment risk	Auction houses / collectors ↔ investors / consumers	Secondary market lacks transparency; speculative bubbles.	Price-tracking services; verified histories; condition reports.	p

*Effectiveness legend: y = largely effective; p = partially effective; n = limited or none.

reflect the trust properties of wine: because many quality attributes are credence-based and cannot be directly verified by consumers, asymmetries are layered and persist across the value chain.

5.2 The relocation effect

A consistent pattern across the literature is that mechanisms intended to reduce asymmetries rarely eliminate uncertainty; rather, they tend to relocate it. For instance, expert ratings reduce consumer uncertainty but create opacity regarding the independence and consistency of critics [34, 15]. Geographical indications reduce uncertainty about provenance but shift reliance onto regulatory bodies and their enforcement capacity [22, 23]. Digital platforms democratize access to consumer evaluations but introduce new risks of manipulation, bias, and herding [26]. This relocation effect is a direct consequence of wine's hybrid character as a search, experience, and credence good: signals that resolve one dimension of uncertainty inevitably leave others unresolved.

5.3 Effectiveness of traditional mechanisms

Table 2 synthesizes evidence on how different facets of wine quality generate information asymmetries, the

signals and screens most often applied to mitigate them, and the consequences documented in the literature.

This highlights that no single mitigation mechanism is sufficient (see Annex II for the extended matrix underlying this table, which details additional mechanisms and literature coverage). Instead, instruments complement one another, creating layered trust systems. At the same time, this layering explains why asymmetries persist: each solution leaves residual uncertainty or introduces new dependencies. The uneven effectiveness of these mechanisms underlines that they respond to different facets of wine quality: experience attributes such as taste drive reliance on critics, while credence attributes such as provenance or sustainability require institutional validation.

5.4 Stakeholder implications

The persistence and relocation of asymmetries affect stakeholder groups in distinct ways. For producers, the challenge lies in balancing traditional extrinsic signals such as price, branding, and awards with institutional and digital mechanisms. These instruments provide credibility and facilitate market access, but they also expose wineries to reputational risks and generate additional compliance costs. Consumers, in turn, benefit from an expanding range of signals yet face ongoing uncertainty about their credibility and consistency. Deci-

Table 2. Linking wine quality facets to IAs, signals / screens, and consequences

Information Asymmetry	Stakeholders Affected	Signals / Screens	Consequences if Unresolved
Provenance of grapes and wine	Wineries, regulators, distributors, consumers	PDO / GI labels, certification, audits, branding	Misrepresentation of origin; dilution of PDO; fraud
Tasting uncertainty (sensory quality)	Consumers, retailers	Expert scores, competitions, tastings, peer reviews	Adverse selection; consumer disappointment; reliance on critics
Expert / critic opacity	Consumers, wineries, retailers	Multiple guides, blind tastings, aggregation methods	Bias, conflict of interest, loss of credibility
Certification opacity (organic, sustainability, fair trade)	Consumers, regulators	Third-party audits, eco-labels, certification schemes	Greenwashing, erosion of trust in sustainability claims
Storage and transport conditions	Distributors, retailers, consumers	Logistics documentation, cold-chain protocols, brand reputation	Quality degradation, spoilage, hidden faults
Counterfeiting and fraud	Premium producers, regulators, consumers	Authentication seals, bottle design, brand reputation	Market distortion, erosion of consumer trust, reputational damage
Market demand and pricing trends	Producers, distributors	Price signals, market reports, branding	Misallocation of supply, speculative bubbles
Reputation and peer ratings	Consumers, wineries	Online platforms (e.g., Vivino), consumer reviews	Herding effects, bias toward popular wines, marginalization of niche producers
Aging potential and investment value	Consumers, investors, critics	Expert consensus, vintage charts, secondary market data	Overstated longevity claims, speculative risk, loss of value

sion-making is therefore mediated by trust in intermediaries – critics, certifications, or digital platforms – each of which carries its own limitations. Regulators play a pivotal role in institutional screening through geographical indications, certification schemes, and auditing procedures. Their effectiveness, however, is constrained by resources, enforcement capacity, and the degree of consumer trust in oversight institutions; weak enforcement quickly undermines credibility. Finally, experts and intermediaries continue to translate sensory complexity into accessible judgments, but their role is increasingly contested. A lack of transparency in scoring systems undermines their legitimacy, while the rise of digital platforms redistributes evaluative authority to consumer collectives and peer-based reviews. These implications ultimately derive from the trust properties of wine: producers hold privileged knowledge of credence attributes, consumers struggle with experience attributes, and regulators seek institutional solutions to bridge these gaps.

5.5 Research gaps and evolving directions

The synthesis also reveals several important gaps in the existing literature. Conceptually, the link between the multidimensionality of wine quality and the persistence of asymmetries remains insufficiently conceptualized, with few studies offering a formal analytical framework. Although the relocation effect is frequently observed, it is rarely developed into an explicit conceptual framework. Empirically, research has concentrated on consumer-facing mechanisms, while asymmetries arising in vineyards, cellars, and logistics chains are comparatively underexplored. Cross-country comparisons and longitudinal studies are particularly scarce. Methodologically, many contributions isolate single mechanisms, whereas comparative and mixed-method approaches that capture interactions between signals and screens are still rare. Finally, significant governance gaps remain. The effectiveness of geographical indications, certifications, and cooperative arrangements varies across contexts, and while several studies document positive outcomes, empirical evidence remains uneven.

5.6 Implications for emerging solutions

Taken together, the findings show that wine markets operate within layered but fragile architectures of trust. Traditional and modern mechanisms mitigate uncertainty, but their effectiveness is uneven, and their interaction frequently relocates rather than resolves asymmetry.

These limitations have motivated exploration of emerging digital solutions such as blockchain, AI, IoT sensors, and online platforms. These tools promise new forms of transparency and accountability, yet they also raise challenges of governance, adoption, and interoperability. The next chapter turns to blockchain as an illustrative case, situating it within this broader landscape of technological innovation.

6. EMERGING TOOLS FOR TRANSPARENCY

This section addresses the third research question by examining how emerging digital solutions – particularly blockchain – may complement traditional mechanisms in mitigating information asymmetries.

The persistence of information asymmetries, even in the presence of layered trust systems, has stimulated interest in new digital solutions. These tools promise to improve transparency, accountability, and traceability along the wine value chain. While they cannot replace traditional mechanisms, they may complement them by addressing specific weaknesses or by creating new ways of communicating information to consumers and regulators.

6.1 Blockchain as an illustrative case

Among emerging technologies, blockchain has attracted particular attention as a potential tool for addressing information asymmetries in wine and agri-food markets. Originally introduced as the architecture underpinning cryptocurrencies [50], blockchain has since been conceptualized as a distributed ledger technology enabling transparent, tamper-resistant record-keeping [51]. Management scholars describe it as both a technological and an institutional innovation: it does not simply store data but reconfigures governance by shifting trust from centralized authorities to decentralized networks [52].

In the wine sector, blockchain pilots illustrate how these features can be mobilized to enhance transparency [53,27,28]. Projects have been launched to document vineyard provenance, track cellar practices, and verify distribution and storage conditions. By linking these records to consumer-facing tools such as QR codes or NFC tags, blockchain promises to strengthen the credibility of claims about origin, authenticity, and sustainability. Comparable initiatives in the agri-food sector confirm its potential: Behnke and Janssen [54], for example, show how blockchain improves traceability in supply chains where credence attributes dominate, from organic food to fair-trade coffee.

Yet the technology has clear limitations. It does not address subjective quality assessments such as taste or style, depends heavily on reliable initial data entry (“garbage in, garbage out”), and introduces new challenges around governance, interoperability, and adoption costs. For smaller producers in particular, the financial and technical barriers can be substantial.

Blockchain therefore exemplifies the relocation rather than elimination of information asymmetry: while it enhances trust in provenance and certification, it shifts uncertainty to the reliability of data inputs and the governance of digital infrastructures.

6.2 Digital innovation beyond blockchain

Blockchain is only one part of a wider landscape of digital innovation in wine and agri-food markets. Digital platforms and social media have become highly influential in shaping perceptions of wine quality. Platforms such as Vivino provide consumers with access to peer-based reviews and crowd-sourced ratings, broadening participation but also amplifying herding effects and algorithmic bias [26]. Similar dynamics are evident in wine tourism, where TripAdvisor reviews strongly influence winery image and consumer trust [55]. These studies confirm that digital platforms democratize evaluation processes, but they also introduce new asymmetries regarding visibility, manipulation, and the credibility of user-generated content [14,34].

Artificial intelligence (AI) represents another emerging tool, offering predictive models that link intrinsic attributes to market outcomes. Ferreira et al. [35] demonstrate how chemometric and machine learning techniques can predict sensory quality from chemical composition, while Corsi and Ashenfelter [36] show how intrinsic datasets can be related to price formation. More recent contributions explore AI-based forecasting of wine market demand and consumer preferences [56]. While these applications highlight the potential of AI to generate new forms of knowledge, they also raise concerns about algorithmic transparency, training data biases, and the interpretability of results for non-specialists.

Internet of Things (IoT) sensors are increasingly integrated into vineyard management and logistics chains, enabling real-time monitoring of production and distribution conditions. Pilot studies show that IoT can enhance traceability and quality control in vineyards and cellars, particularly when combined with blockchain infrastructures [27,57]. In broader agri-food contexts, IoT applications are being deployed to strengthen transparency and consumer trust, though they raise questions about data ownership, privacy, and the cost of adoption [54].

Together, these tools demonstrate that digital innovation extends beyond blockchain, offering new opportunities to address asymmetries but also introducing fresh challenges of governance, interpretation, and inclusivity.

6.3 Stakeholder implications and mitigation of information asymmetries

The rise of digital solutions carries implications for all stakeholders. Producers gain new opportunities to signal authenticity and sustainability, but face added accountability and compliance costs. Consumers access more verifiable information but must still navigate a landscape of overlapping and sometimes conflicting signals. Regulators may benefit from more efficient oversight but must also invest in standard-setting, interoperability, and digital literacy. Experts and intermediaries see their roles shifting, as technical verification complements rather than replaces sensory judgment and cultural interpretation.

In answer to the third research question, the review indicates that emerging digital solutions – most notably blockchain – can complement traditional mechanisms by strengthening provenance claims, enhancing traceability, and increasing regulatory oversight. Yet they do not eliminate asymmetries altogether; instead, they relocate them into new domains such as data input, governance, and interoperability.

Taken together, these digital solutions illustrate how both traditional and emerging mechanisms remain anchored in wine’s product characteristics: some address experience attributes through evaluation and scoring, while others target credence attributes through certification and traceability. Yet none can eliminate the structural uncertainties that arise from wine’s multidimensional quality.

Emerging tools illustrate both the promise and the limits of digital innovation in addressing information asymmetries. They enhance transparency, but none provides a definitive solution. Rather, they complement traditional mechanisms within layered systems of trust, while simultaneously relocating uncertainty into new domains such as data governance, algorithmic design, and digital adoption.

7. CONCLUSION

This paper set out to advance the understanding of wine quality as a multidimensional construct by examining how it systematically generates information asymmetries and by assessing the effectiveness and limita-

tions of mechanisms – both traditional and emerging – for mitigating them. The analysis was guided by three research questions, which can now be addressed in turn.

First, regarding the relationship between wine quality dimensions and the occurrence of information asymmetries, the review shows that multidimensionality systematically produces asymmetries across all stages of the value chain. These asymmetries are layered and relational, shifting informational advantages between producers, consumers, regulators, and intermediaries.

Second, with respect to signals and screening mechanisms, the review finds that while instruments such as price, reputation, expert ratings, certifications, and geographical indications provide partial relief from asymmetry, none eliminates it fully. Instead, they function as layered trust systems: effective in some contexts but relocating uncertainty to others.

Third, concerning the potential of emerging solutions, the analysis indicates that digital tools – most notably blockchain – can complement traditional mechanisms by strengthening provenance claims, enhancing traceability, and supporting regulatory oversight. Yet these technologies do not eradicate asymmetries; they shift them into new domains of data input, governance, and interoperability.

Taken together, these findings underscore that information asymmetry is not incidental but a structural feature of wine markets. While both traditional and emerging mechanisms contribute to its mitigation, they cannot resolve it entirely. The persistence of asymmetry points to the need for layered systems of trust.

Broader implications follow from this. For researchers, the results highlight the value of integrating information economics with wine studies. Conceptually, the link between multidimensional quality and persistent asymmetry deserves deeper theorization, especially around the relocation effect. Empirically, research remains concentrated on consumer-facing mechanisms, while vineyard, cellar, and logistics asymmetries are underexplored. Methodologically, comparative and longitudinal approaches that capture interactions across signals, screens, and digital tools are needed.

For industry stakeholders, the findings underscore that no single signal suffices. Producers, distributors, and retailers must combine traditional and digital instruments – price and reputation, institutional arrangements, expert systems, and new technologies – into layered trust configurations. For consumers, the practical message is that trust in wine markets is constructed through multiple overlapping signals rather than guaranteed by any single one.

For policymakers and regulators, the persistence of asymmetry calls for supportive governance frameworks. These include credible enforcement of geographical indications and certifications, harmonized standards for digital tools, and capacity-building measures that allow small and medium-sized producers to participate without disproportionate burdens. Promoting digital literacy, interoperability, and transparent auditing processes will be essential to ensure that emerging tools function effectively and equitably.

Ultimately, the findings underline that wine quality cannot be reduced to a single technical or institutional dimension but must be understood as the outcome of interacting intrinsic, extrinsic, institutional, and cultural factors. Emerging technologies may enhance transparency and accountability, yet they cannot substitute for the symbolic and experiential aspects that shape how quality is perceived and valued. For research, this suggests the need to examine how digital and institutional instruments interact with cultural and sensory dimensions; for practice and policy, it points to the challenge of designing governance frameworks that integrate technological innovation with the preservation of wine's multidimensional character.

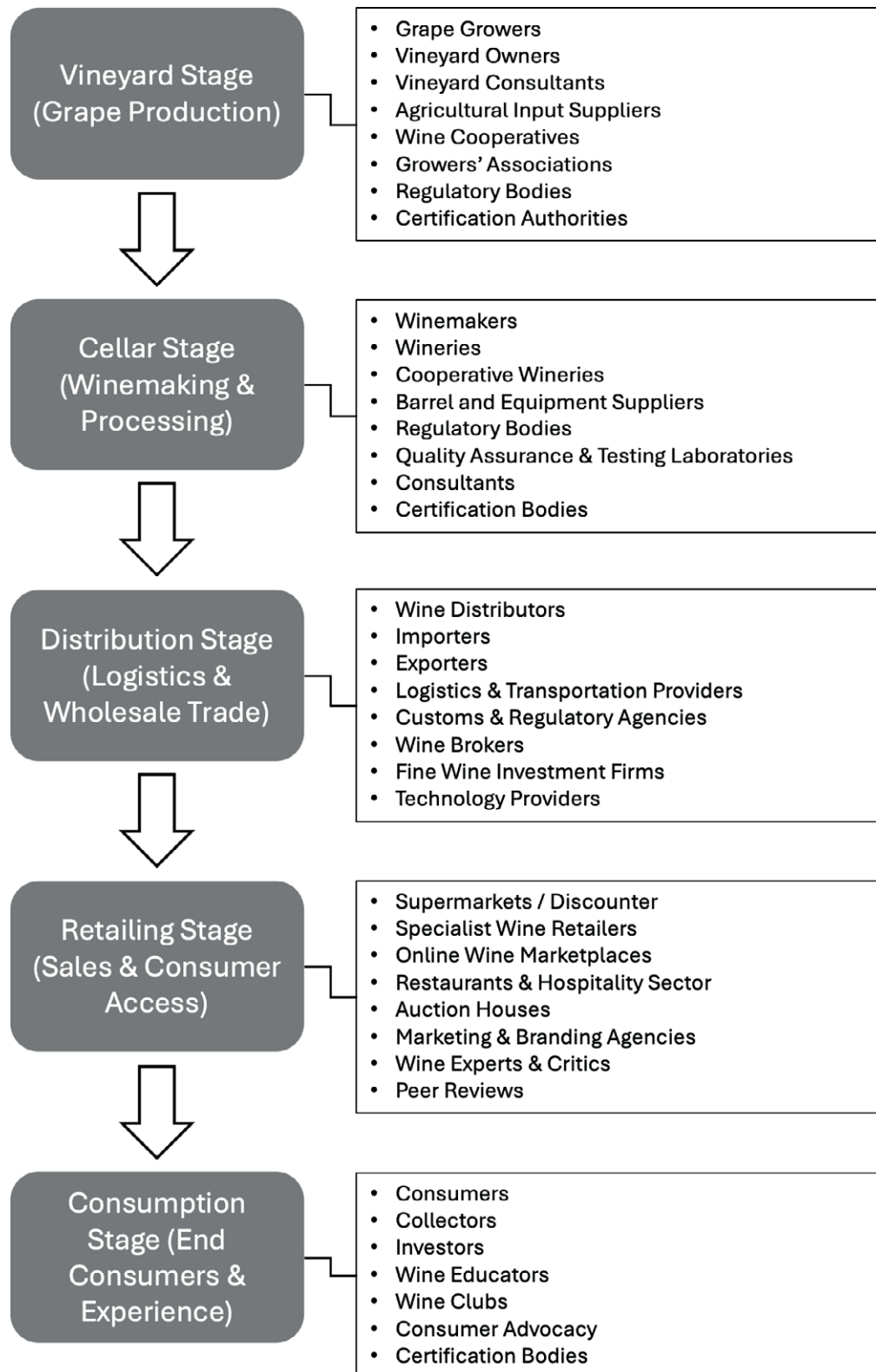
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ANNEX I. WINE VALUE CHAIN AND STAKEHOLDERS (SOURCE: AUTHORS)



ANNEX 2. INFORMATION ASYMMETRIES ALONG THE WINE VALUE CHAIN: STAKEHOLDERS, MITIGATION, EFFECTIVENESS, AND RESEARCH GAPS

IA (concise)	Where it occurs	Primary stakeholders affected	Existing mitigation instruments (signals / screens)	Effectiveness (why)	What's missing (practice & research gaps)	Literature coverage
Taste fit uncertainty (experience good)	Pre-purchase	Consumers, retailers	Blind tastings; sampling (by-the-glass / miniatures); style descriptors; lab / sensory metrics; AI palate matching	Medium – Sampling works but is costly; descriptors can be vague; lab metrics not widely understood	Low-cost sampling models; consumer-friendly sensory vocabularies; validation of AI matchers	High
Expert panel variability	Competitions, guides	Producers, consumers	Calibration protocols; double-blind panels; rater reliability checks	Medium – Improves consistency but variance remains	Transparent rater reliability reporting; cross-panel benchmarking	Medium
Vintage variability signals	Vineyard-consumer	Consumers, traders	Vintage charts; winemaker notes; weather summaries	Low-Medium – Coarse signals; regional averages hide site specifics	Block-level vintage reporting; links to measurable parameters	Low
Provenance / origin misrepresentation	Vineyard, cellar, logistics	Consumers, importers, regulators	PDO / PGI rules; audits; pack IDs; tax stamps; geo-tags; QR traceability	Medium – Works where enforcement is strict; weak otherwise	Automated geo-capture; harmonised enforcement; SME-friendly compliance	Medium
Single-vineyard / cru claims	Labeling	Consumers, regulators	Site registries; cadastral maps; parcel IDs; certification	Medium – Good where codified; limited elsewhere	Global minimum definitions; parcel-level data sharing	Low
Varietal / blend composition opacity	Cellar, label	Consumers, regulators	Label rules; lab tests (isotopes / DNA); audits	Medium – Detectable, but testing is episodic	Routine, randomised lab surveillance; cheaper assays	Medium
Process integrity (organic / biodynamic)	Farming & cellar	Consumers, regulators, buyers	Third-party seals; inspections; input logs	Medium – Seal trust varies; audits costly for SMEs	Tiered fees; multi-standard interoperability; longitudinal outcomes	Medium
Additives / processing aids transparency	Cellar	Consumers (allergens), regulators	Ingredient / e-label rules; lab certificates	Low-Medium – Info exists but not salient; exemptions apply	Clearer, harmonised e-labels; consumer comprehension studies	Emerging
Sulphites / allergen comprehension	Label	Consumers	Mandatory declarations; QR e-labels	Medium – Present but poorly understood	Risk-communication design; cross-country harmonisation	Low-Medium
Sustainability / CO ₂ claims (greenwashing risk)	Value chain	Consumers, buyers, regulators	LCA labels; third-party eco-seals; GHG protocols	Low-Medium – Method variance + data gaps	Standardised scopes / boundaries; auditable datasets; SME toolkits	Emerging
Cold-chain & storage conditions	Logistics & retail	Importers, retailers, consumers	Temperature loggers; shock sensors; condition clauses; QR logs	Medium – Sensors help; adoption uneven	End-to-end sensor coverage; alerts integrated with trade docs	Low
Counterfeit / refill fraud	Secondary markets, horeca	Consumers, brand owners	Tamper seals; NFC / RFID; serialisation; forensic packaging	Medium-High – Works when combined; criminals adapt	Secure consumer verification flows; law-enforcement bridges	Medium
Old-vintage authenticity	Auctions / collectors	Collectors, traders	Provenance dossiers; capsule / cork forensics; isotope tests	Medium – Expertise-heavy; testing expensive	Shared provenance registries; lower-cost assays	Low-Medium
Rating opacity & pay-to-play risk	Media / platforms	Consumers, producers	Disclosure rules; firewalling ad / editorial; method notes	Low-Medium – Compliance uneven; consumers rarely see methods	Standardised rater transparency; reliability metrics in outputs	Low-Medium

IA (concise)	Where it occurs	Primary stakeholders affected	Existing mitigation instruments (signals / screens)	Effectiveness (why)	What's missing (practice & research gaps)	Literature coverage
Medal proliferation ("vanity awards")	Competitions	Consumers	Hierarchies of competitions; disclosure of win base size	Low – Signal dilution common	Minimum standards for award use; comparability frameworks	Low
Online herding & review manipulation	Marketplaces / apps	Consumers, small producers	Verified-purchase badges; anti-spam ML; median / trimmed means	Medium – Helps, but herding persists	Causal tests of display algorithms; audit trails for review edits	Emerging
Price opacity & margins (retail / HoReCa)	Retail / restaurant	Consumers, producers	RRP guidance; menu transparency norms	Low – Wide dispersion; strategic pricing	Transparent reference pricing; fair-pricing guidelines	Low
Distributor / private-label opacity	Wholesale / retail	Consumers, producers	PL disclosure rules; lot codes	Low-Medium – Rules vary; branding obscures origin	Clear PL provenance norms; buyer education	Low
Aging potential / drinking window claims	Marketing	Consumers	Back-label guidance; critic windows	Low – High uncertainty; bottle variation	Data from cellaring studies; predictive models	Low
"Natural / low-intervention" ambiguity	Positioning	Consumers, regulators	Voluntary charters; community seals	Low – No global standard	Baseline definition; cross-market recognition	Emerging
No / low-alcohol process disclosure	Tech / process	Consumers, regulators	Process icons; e-labels	Low-Medium – New category; weak familiarity	Clear typology & claims limits; sensory expectations research	Emerging
Closure type misinference	Packaging	Consumers, producers	Education; neutral communications	Low – Strong priors / country effects	Cross-cultural guidance; blind-trial communications	Low
Health & wellbeing narratives	Marketing	Consumers, regulators	Advertising codes; claim bans	Medium – Enforcement deters extremes	Digital ad enforcement; cross-border consistency	Medium
Traceability system integrity (GIGO)	Data governance	All	Blockchain / ERP logs; audits; IoT sensors	Medium – Immutable ≠ truthful	Automated data capture; governance; independent oracles	Emerging
Standards & interoperability gaps	Ecosystem	Producers, tech firms, regulators	GSI; EPCIS; data standards initiatives	Low-Medium – Fragmented uptake	Common schemas; open APIs; regulator-backed baselines	Emerging
Consumer data / privacy in transparency apps	Apps / UX	Consumers	GDPR / consent tools; privacy policies	Medium – Legal compliance; low literacy	Privacy-by-design patterns; trust labels	Low

ANNEX 3. LIST OF REVIEWED ARTICLES WITH DATA SOURCES, SAMPLE SIZE AND METHODS

Study	Data sources	Sample size	Methods
Angelini et al. (2025). Cumulative information on quality and willingness to pay: a study on wine evaluation	Experimental tasting data collected from 38 subjects at a public event; evaluations of 6 wines with sequential information disclosure	38 participants evaluating 6 wines in structured tasting experiment	Bayesian linear mixed models estimated via INLA with random and spatial effects.
Bazen et al. (2024). The role of customer and expert ratings in a hedonic analysis of French red wine prices from 'gurus'	Hedonic dataset of French red wines with expert scores, Vivino ratings and wine attributes.	36,970 wines.	Hedonic price regressions with robustness checks and subsamples.
Bodington (2020). Rate the Raters: A Note on Wine Judge Consistency	2019 California State Fair wine competition; judge ratings and wines entered.	54 judges; 2,811 wines.	Correlation matrices and coefficients of multiple correlation to measure judge consistency.
Cai, Ma & Su (2016). Effects of member size and selective incentives of agricultural cooperatives on product quality	Survey of apple marketing cooperatives in Shandong province, China.	135 cooperatives.	Principal component analysis to build quality index; OLS regressions of quality on member size and selective incentives.
Carayol & Jackson (2024). Finding the Wise and the Wisdom in a Crowd: Estimating Underlying Qualities of Reviewers and Items	Over 45,000 Bordeaux en primeur expert reviews plus Judgement of Paris data and prices.	45,000+ ratings; additional Paris tasting data.	Two-stage weighted least squares to estimate item qualities and reviewer bias/accuracy; Monte Carlo simulations.
Carter (2015). Constructing Quality: Producer Power, Market Organization, and the Politics of High Value-Added Markets	Historical documents, regulations and interviews on French and Italian wine sectors.	Not applicable (qualitative case work).	Qualitative institutional and political-economy analysis.
Castellano & Khelladi (2015). The influence of the territory on legitimacy and price: application to the French wine sector	Secondary data on French wine prices and AOC/AOP territorial/legitimacy indicators.	Panel of French wines (N not reported in excerpt).	Hedonic price models including territorial legitimacy variables.
Castriota, Curzi & Delmastro (2013). Tasters' bias in wine guides' quality evaluations	Italian Guida Veronelli ratings 2004–2009 with taster IDs and wine characteristics.	Multi-year panel; exact N not in excerpt.	Fixed-effects regressions and variance decomposition to identify taster generosity and bias.
Charters (2011). The territorial brand in wine	Interviews and focus groups with consumers, producers and mediators in Australia.	105 informants.	Qualitative thematic analysis using NUD*IST; development of perceived quality models.
Charters (2004). Perceptions of wine quality	Google Ngram data; British newspaper articles; interviews; Decanter magazine case.	Multiple text corpora; N not given.	Quantitative linguistic analysis and qualitative textual analysis; mixed-method interpretation.
Charters & Harding (2024). The irresistible rise of the notion of terroir	Focus groups and interviews with consumers, producers and mediators.	103 participants.	Qualitative coding of intrinsic quality dimensions; comparison by involvement level.
Charters & Pettigrew (2006). Conceptualizing product quality: the wine case	Interviews with wine consumers on quality perceptions.	60 consumers.	Qualitative thematic analysis; development of interactionist model of quality.
Charters & Pettigrew (2007). The dimensions of wine quality	Focus groups and interviews with Australian wine drinkers including tastings.	Sample size not reported (approx. few dozen participants).	Thematic analysis; identification of intrinsic and extrinsic quality dimensions and segments.
Charters & Pettigrew (2003). The intrinsic dimensions of wine quality	Case study of Champagne using interviews, internal documents and prior studies.	Not reported (multiple interviews and sources).	Qualitative case study; thematic content analysis; framework for strong territorial brands.
Charters & Spielmann (2014). Characteristics of strong territorial brands: The case of Champagne	Authors' accumulated empirical work and literature on wine regions and branding.	Not applicable (conceptual).	Conceptual framework for territorial brands in wine.

Study	Data sources	Sample size	Methods
Chon, Gergaud & Heo (2025). An empirical investigation of wine sales as a driver of financial performance in restaurants	Proprietary restaurant panel data on wine sales, wine lists and financial outcomes.	Multi-restaurant, multi-period panel (N not reported).	Panel regressions with fixed effects analysing impact of wine sales on restaurant performance.
Codron, Montaigne & Rousset (2012). Quality management and contractual incompleteness: grape procurement for high-end wines in Argentina	Field interviews and contract information for high-end wine grape procurement in Argentina.	Several cooperative and producer cases.	Double principal-agent and contract-theory analysis; qualitative case comparison.
Corduas, Cinquanta & Ievoli (2013). The importance of wine attributes for purchase decisions: A study of Italian consumers' perception	Questionnaire on importance of wine attributes (Likert scales) among Italian consumers.	192 consumers.	CUB models for ordinal responses; analysis of uncertainty/feeling components and covariate effects.
Corsi & Ashenfelter (2019). Predicting Italian wine quality from weather data and expert ratings	Regional vintage-level Italian weather variables and expert quality scores.	Multi-decade panel of vintages by region (N not given).	Regression models predicting scores from weather and other controls.
Corsinovi & Gaeta (2015). Managing the Quality Wines beyond Policies and Business Strategies	EU GI policy documents and historical development of Super Tuscan wines; literature.	Not applicable.	Conceptual framework combining quality economics, GI regulation and strategic positioning; qualitative analysis.
Costanigro, Dubois, Gracia & Cardebat (2025). The Information Value of Geographical Indications	Literature and illustrative GI, price and rating data for wines.	Not applicable (primarily conceptual).	Information-economics modelling of GIs as quality signals; conceptual policy analysis.
De Nicoló (2025). Wine ratings and commercial reality	Judgement of Paris data; Bordeaux en primeur scores and prices; Italian ratings database.	Several datasets including JP 21 wines and thousands of Bordeaux/Italian observations.	ANOVA, quantile regressions, finite mixture models and hedonic price regressions; construction of equivalence classes.
Delmas (2021). Sustainable practices and product quality: Is there value in eco-label certification? The case of wine	French wine guide ratings matched with organic, biodynamic and other eco-label certifications.	128,182 wines.	Regression models estimating eco-label effects on expert scores controlling for wine attributes.
Dubois (2023). Experience goods and the role of experts: recommendation effects on wine purchasing decision	Bibliographic review of research on wine critics, guides and competitions.	267 papers (1970–2020).	Integrative literature review; historical and structural analysis of evaluation markets.
Dubois (2021). The market for wine quality evaluation: evolution and future perspectives	Theoretical and empirical literature on experience goods and wine.	Not applicable.	Conceptual synthesis and classification of experience goods and expert roles.
Dubois, Cardebat & Georgantzis (2025). External evaluations under quality uncertainty: the market for wine ratings	Same 267-paper database plus conceptual information on rating providers.	Not empirical (conceptual).	Integrative review; conceptual modelling of evaluation markets and digital transformation.
Fanasch & Frick (2020). The value of signals: Do self-declaration and certification generate price premiums for organic and biodynamic wines?	German wine price data 2010–2017 with organic/biodynamic status, self-declaration, certification and reputation.	55,500 wines from 1,514 wineries over 8 years.	Hedonic price models and quantile regressions to estimate signaling premia.
Fantechi et al. (2025). Sustainable wine – consumer preferences for environmental labels	Discrete choice experiment with Italian wine consumers on environmental labels.	300 consumers.	Discrete choice models with latent class analysis to identify preference segments.

Study	Data sources	Sample size	Methods
Ferreira, Lourenço-Gomes & Costa Pinto (2022). How does self-reported knowledge influence the effect of extrinsic cues on wine choice? A qualitative approach	Focus groups with red-wine consumers in four Portuguese regions.	5 focus groups; 45 consumers.	Qualitative content analysis and thematic coding of cue use and knowledge effects.
Ferro & Benito Amaro (2018). What factors explain the price of top quality wines?	Wine Spectator Top 100 US lists 2003–2016 with prices, ratings and wine characteristics.	1,400 wines.	Hedonic OLS regressions of log price on quality scores and wine/producer attributes.
Frick (2020). The Legacy of Gurus: The Impact of Armin Diel and Joel Payne on Winery Ratings in Germany	Longitudinal winery ratings from Gault Millau and Vinum guides around editorial changes.	All wineries rated in both guides over key years (hundreds of wineries).	Econometric analysis of rating changes linked to editor/taster changes.
Gergaud, Ginsburgh & Moreno-Ternero (2021). Wine Ratings: Seeking a Consensus among Tasters via Normalization, Approval, and Aggregation	Literature from Web of Science, Scopus, JSTOR, ProQuest and ScienceDirect on wine price determinants.	46 empirical studies (1998–2018).	Systematic literature review and categorisation of determinants (origin, ratings, objective quality, labels, other).
Giua, Salvatici, Vaquero-Piñeiro & Solazzo (2025). Do Territories with Geographical Indications Trade Better?	Judgement of Paris ratings; 2018 Bordeaux en primeur expert ratings.	JP: 20 wines × 11 judges; en primeur: dozens of wines rated by five experts.	Normalization, approval voting and aggregation procedures to form consensus scores.
Gál (2020). The Determinants of Wine Prices: A Systematic Literature Review	Panel of Italian municipalities with PDO status and export data for wine and agri-food, 2004–2018.	Approx. 8,000 municipalities over 15 years.	Propensity score matching and difference-in-differences to estimate GI impacts on exports.
Hanf (1990). Zur Bedeutung von Vertrauenseigenschaften für den Wettbewerb auf Lebensmittelmärkten	Theoretical literature on credence attributes and illustrative food market cases.	Not applicable.	Micro-economic and institutional analysis of credence attributes and vertical contracts; conceptual discussion.
Hanf & Iselborn (2014). How to deal with quality problems of German wine cooperatives – A double principal-agent approach	Conceptual discussion supported by examples from German and Austrian wine cooperatives.	Not applicable.	Double principal-agent framework applied to wine cooperatives; qualitative discussion of solutions.
Hanf & Kühl (2005). Branding and Its Consequences for German Agribusiness	Literature and industry examples on branding and food safety in German agribusiness.	Not applicable.	Conceptual analysis of branding as governance for credence attributes; discussion of vertical coordination.
Hanf & Schweickert (2014). Cooperatives in the balance between retail and member interests	In-depth interviews and survey evidence on German wine cooperatives plus market data.	Qualitative sample of cooperative managers/members (N not specified).	Qualitative analysis of member vs customer orientation; conceptual discussion of branding and territory.
Kaimann & Spiess Bru (2024). Sounds too feminine? Blind tastings, phonetic gender scores, and the impact on professional critics	Wine Enthusiast blind-tasting data with wine names, critic gender and attributes.	18,609 wines; 31,058 tasting observations (2011–2016).	Quasi-experimental design; regressions including phonetic gender scores and interactions.
Kaimann, Spiess Bru & Frick (2023). Ratings meet prices: The dynamic relationship of quality signals	Wine Enthusiast ratings and listed prices for worldwide wines over 20 years.	13,911 tasting observations on 8,444 wines.	Panel regressions and two-stage least squares modelling dynamic relationship between ratings and prices.
Kleinhans (2018). Reputation and Status in the High-Quality Wine Industry	Bordeaux high-quality wine prices, Parker scores, classifications and secondary-market data.	Several thousand wine–vintage observations across multiple essays.	Hedonic and panel regressions; event-study analyses of status and reputation effects.

Study	Data sources	Sample size	Methods
Kopsacheilis, Analytis, Kaushik, Herzog, Bahrami & Deroy (2024). Crowdsourcing the assessment of wine quality: Vivino ratings, professional critics and the weather	Vivino ratings for Bordeaux red wines, professional critics' scores and local weather station data.	Portfolio of Bordeaux reds with many thousands of Vivino ratings (exact N in paper).	Correlation analysis and panel/time-series regressions of Vivino vs critic ratings and weather variables.
Kramer, Adamashvili, Vrontis, Hanf & Galati (2024). The dual role of blockchain in mediating credence attributes and moderating sensing capabilities in the wine sector	Longitudinal single-case study of Costaflores Organic Winery using internal data and interviews.	One focal winery; multiple informants over time.	Exploratory longitudinal case study; process tracing and qualitative content analysis framed by dynamic capabilities.
Lee (2024). Expert wine reviews: exploring trends in wine quality indicators	Wine Spectator Top 100 lists and online database 1988–2021.	3,400 wine reviews (Top 100 × 34 years).	Descriptive statistics and regression analysis of trends in style, region, price and quality indicators.
Li (2022). Information asymmetry in supply chains and blockchain technology: An empirical examination	Semi-structured interviews with firms in blockchain-enabled and traditional supply chains plus documents.	13 interviewees across two supply chains.	Qualitative case study with thematic coding; signalling-theory framing of blockchain effects.
Livat (2019). Do denominations of origin provide useful quality signals?	Monthly wholesale prices for red wines from 11 Bordeaux denominations plus controls.	Panel of 11 DOs with monthly observations 1999–2014.	Time-series/panel econometric models testing the signalling role of DOs.
Lopez-Bayón (2020). In search of agri-food quality for wine: Is it enough to join a geographical indication?	Peñín Spanish Wine Guide 2006 and Ministry of Agriculture data on Spanish PDO wineries.	327 wineries; 1,951 bottled PDO wines.	Cross-sectional OLS and limited dependent variable models relating governance and GI type to expert scores.
López-Bayón et al. (2016). Influence of governance structure on the effectiveness of quality standards: The case of Geographical Indications	Spanish bottled GI wine producers using Peñín Guide scores and administrative data.	Panel/cross-section of GI wineries and their wines (N reported in article).	Econometric models of quality and performance as functions of GI membership and complementary practices.
Ma, Mao, Cao, Luo, Gupta & Wang (2024). From Vineyard to Table: Uncovering Wine Quality for Sales Management through Machine Learning	Structured dataset of Portuguese red wines with physicochemical measures and expert scores.	1,599 wines.	Ensemble machine learning combining SVM, RNN, ELM and Random Forest to predict quality classes.
Martínez-Navarro & Sellers-Rubio (2024). Three decades of research on wine marketing	Bibliographic records on wine marketing from Web of Science and Scopus.	1,135 documents (1990–2022).	Bibliometric performance analysis and science mapping using co-word analysis and bibliographic coupling.
Masset et al. (2022). Fine wine pricing in Switzerland	Swiss winery price lists and attributes for fine wines 2014–2018.	2,454 wines from 149 wineries.	Multivariate OLS hedonic regressions and analysis of currency and expert-coverage shocks.
Mastrobuoni, Peracchi & Tetenov (2014). Price as a Signal of Product Quality: Some Experimental Evidence	Wine tasting experiment with non-professional consumers plus Altroconsumo rating-price data.	Experiment: dozens of participants × 4 wines; large observational panel from magazine.	Experimental discrete-choice models and nonlinear price-perceived-quality analysis; comparison with observational data.
Migliaccio & Tucci (2020). Economic assets and financial performance of Italian wine companies	Historical French district-level data on prices and quantities for >250 appellation wines around 1935 law.	Panel of districts and appellations over several decades.	Difference-in-differences-style econometrics and welfare calculations of information asymmetry costs.
Mérel, Ortiz-Bobea & Paroissien (2019). How Big Is the 'Lemons' Problem? Historical Evidence From French Appellation Wines	Balance sheets and income statements of Italian wine firms (Ateco 2007 codes) 2008–2017.	Unbalanced panel: 199–245 firms per year over 10 years.	Financial ratio analysis and time-series graphics of profitability, capital structure and liquidity.

Study	Data sources	Sample size	Methods
Nacka et al. (2016). Young consumers' preferences for Macedonian wine	Survey of visitors at Skopje Wine Winter Festival 2014.	420 respondents.	Descriptive statistics and chi-square tests on preferences and quality perceptions by age.
Oczkowski (2016). Identifying the Effects of Objective and Subjective Quality on Wine Prices	Australian premium wine prices with expert scores and objective quality proxies (weather, producer).	Cross-section/panel of premium wines (N not reported in excerpt).	Hedonic price models distinguishing objective and subjective quality; OLS and alternative specifications.
Oczkowski & Pawsey (2019). Community and Expert Wine Ratings and Prices	Australian wines with matched expert ratings, community online ratings and prices.	Several hundred to a few thousand wines.	Hedonic price regressions comparing explanatory power of expert vs community ratings.
Okhunjanov, McCluskey & Mittelhammer (2024). Wine prices and weather: Are cult wines different?	Panel of U.S. cult and non-cult wines with release and secondary-market prices, scores and weather.	Panel of wines across multiple vintages and regions (N not given).	Fixed-effects panel regressions of prices and scores on weather; comparison of cult vs non-cult sensitivity.
Oleksy et al. (2021). On Fine Wine Pricing across Different Trading Venues	Liv-ex and related data on Bordeaux fine wine trades across auctions, electronic exchange and OTC.	Large transaction dataset (N not reported).	Hedonic price models by venue; analysis of effects of aging, ratings, bottle size, flaws and volume.
Palumbo & Mazzoli (2022). Online Wine Ratings Determinants: The Case of Red Wines From Apulia	Vivino data on Apulian red wines including ratings, prices, vintages, varieties and wineries.	947 wines; 19 vintages; 165 wineries; 19 grape varieties.	OLS regressions of normalised Vivino ratings on price and wine characteristics.
Parga-Dans & Alonso González (2018). From paper to soil: the impact of new EU alcoholic drinks labeling regulations for wine regions	EU policy documents on alcohol labelling, consumption data and literature on wine regions.	Not applicable (conceptual).	Policy and conceptual analysis of labelling, information asymmetries and regional impacts.
Parga-Dans, Alonso González & Otero-Enríquez (2022). The role of expert judgments in wine quality assessment: the mismatch between chemical, sensorial and extrinsic cues	304 Spanish wines in OCU 2020 guide with sensory scores, chemical analysis and extrinsic cues.	304 wines.	ANOVA and related analyses comparing contributions of chemical, sensory and extrinsic cues.
Paroissien & Visser (2020). The Causal Impact of Medals on Wine Producers' Prices	Producer–wholesaler transaction data for Bordeaux wines matched to medals from 11 competitions.	Thousands of transactions; subset of medal-winning wines.	Transaction-level regression with timing of medals; causal interpretation via pre/post medal comparisons.
Priilaid et al. (2009). Follow the leader: How expert ratings mediate consumer assessments of hedonic quality	Tasting-room experiment where subjects rate 7 Merlot wines blind and then sighted with Platter score.	32 participants; 7 wines; 224 paired blind–sighted observations.	Within-subject experimental analysis; regressions of sighted ratings on blind ratings and expert scores.
Psychogiou & Tsoulfas (2024). Critical Factors Affecting Trust in the Wine Supply Chain in Greece: A Grey DEMATEL Approach	Expert questionnaires evaluating 14 trust factors in Greek wine supply chain.	8 experts.	Grey DEMATEL approach to derive causal structure among trust factors.
Schatt-Weisskopf et al. (2025). Unveiling the collective reputation effect of French wines	Financial data for 559 French wine companies 2014–2023 (4,776 firm-year observations).	559 firms; 4,776 firm-years.	Panel regressions of margins and ROA on region (collective reputation) and firm characteristics.
Scozzafava, Gerini, Boncinelli, Contini & Casini (2021). How much is a bottle of conventional, organic or biodynamic wine worth? Results of an experimental auction	Non-hypothetical Vickrey auctions for Chianti DOCG wines plus post-auction questionnaires.	100 Tuscan wine consumers; 8 sessions; 9 bids each.	Paired t-tests, repeated-measures ANOVA and random-effects Tobit models of WTP.

Study	Data sources	Sample size	Methods
Smith & Bentzen (2011). Which factors influence the quality of wine produced in new cool climate regions?	Danish vineyard data on plots, grapes, grower experience and awards at Danish Wine Contest.	Panel of growers/wines over several years (hundreds of observations).	Econometric models (logit/probit and OLS) linking awards/quality to terroir and management factors.
Solis (2024). The Global Wine Glass	Legal and economic texts, antitrust case law, industry statistics on wine production/trade.	Not applicable.	Doctrinal economic-legal analysis of international wine markets and regulation.
Troiano et al. (2020). Consumers' perception of conventional and biodynamic wine as affected by information	Laboratory tasting experiment with Italian consumers evaluating conventional vs biodynamic wines under different information conditions.	101 consumers.	Descriptive statistics and non-parametric tests (e.g. Wilcoxon) comparing liking across information treatments.
Ugochukwu (2015). Essays on Collective Reputation and Authenticity in Agri-Food Markets (PhD Thesis)	Ontario LCBO wine data with VQA status and winery/product characteristics.	1,023 wines.	Binary probit model of VQA certification decisions with marginal effects and robustness checks.
Ugochukwu et al. (2016). Determinants of wineries' decisions to seek VQA certification in the Canadian wine industry	LCBO Canadian wine retail data including prices, varieties, VQA status and sales volumes plus conceptual chapters.	1,537 wine observations in main empirical chapter.	Hedonic price models and discrete-choice/probit models for certification decisions; robustness tests.
Verdú Jover, Lloréns Montes & Fuentes (2004). Measuring perceptions of quality in food products: the case of red wine	Consumer survey on intrinsic and extrinsic quality perceptions for red wine in Spain.	161 consumers.	Exploratory factor analysis and structural equation modelling to develop and validate a 7-dimension quality scale.
Viviani (2010). Impact of the Certification Process Reliability on Producers and Consumers of Wine	Theoretical model parameters; no observed data.	Not applicable.	Analytical micro-economic modelling of certification with imperfect reliability; comparative statics and welfare analysis.
Whitnall & Alston (2025). Climate, weather, and collective reputation: Implications for California's wine prices and quality	Wine Spectator ratings and K&L auction prices for California wines plus PRISM weather and climate data at AVA level.	44,570 WS ratings and 47,842 auction price observations.	Semi-log panel regressions of prices and ratings on climate and weather with AVA, variety and vintage fixed effects.



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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

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A Bibliometric and Thematic Analysis of Crisis Research in the Wine Industry: Trends and Future Perspectives

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Abstract. This study systematically maps the academic literature on crises in the wine industry and reveals the field's intellectual structure. Simultaneously, it identifies the dominant themes, trends, and future research directions in crisis-focused studies within the wine industry, thereby providing a reference framework for academics and industry stakeholders. A total of 470 articles published between 1991 and 2026 in the WoS and Scopus databases were included in this analysis. Performance analysis, science mapping, and thematic analysis were conducted using Biblioshiny, an R-based tool. In addition, the types of crises addressed in crisis-focused research in the wine industry and their areas of impact were evaluated using content analysis. The findings indicate that climate crises and pandemics are the most extensively studied crises. Furthermore, based on an evaluation of 146 sampled publications, it is observed that these crises are primarily examined in terms of their impacts on organizational/managerial and production domains. These findings suggest the need to evaluate the interactions between sudden and unexpected crises and slow-onset, long-term crises, such as climate change, as well as the broad impacts of marketing activities across different domains. This study is the first bibliometric analysis of crises in the wine industry. It provides an integrated perspective of the field and offers an original contribution by outlining potential directions for future research.

Keywords: wine industry, wine business, crisis management, bibliometric analysis, research trends.

1. INTRODUCTION

The wine industry is a sector with deeply rooted traditions that have been largely preserved in grape cultivation and wine production processes [1]. Therefore, wine is a product closely intertwined with culture and has high economic value [1–2]. Nevertheless, the wine industry, like all sectors, is affected by crises, global threats, and a challenging competitive environment [3].

In this context, understanding the nature of the crises faced by the wine industry is important. A crisis is a multidimensional and complex phenomenon [4]. In general, crises are urgent, uncertain, and high-risk problems

that need to be overcome [5] and can potentially lead to severe operational, financial, and social consequences [6]. Factors such as climate change, population growth, and digitalization indicate that more frequent, intense, and harmful crises will occur than ever before [7-8]. The wine industry, owing to its unique structure, is more vulnerable to natural events such as extreme weather conditions, earthquakes, and volcanic disasters [9]. For example, grapes used in wine production require suitable environmental conditions [10], and issues such as climate change negatively affect the harvest quantity and quality [11]. Moreover, pandemics, economic shocks, and energy crises highlight the need for adaptive strategies in the wine industry.

Crises in the wine industry typically affect both production and market dynamics of wine. Market-related crises generally arise from declining wine consumption in traditional countries, increasing international competition, a lack of global regulation, and insufficient policies in the wine industry [12]. In particular, small businesses are more vulnerable to crises, and their resilience often depends on cooperation between public and private sector actors [9]. These characteristics make the wine industry an important example for examining crisis dynamics, management strategies and sectoral resilience.

Despite the increasing interest in crises in the wine sector, the literature is fragmented. Existing studies have focused on specific types of crises, regional impacts, and particular business strategies. This situation prevents a systematic understanding of the relevant literature on the topic. In particular, no study has been found that comprehensively mapped the evolution of academic research on crises in the wine industry and identified underexplored areas. Addressing this gap is important for both theoretical knowledge and practical guidance for future research. In addition, this gap must be addressed to support stakeholders in developing effective crisis preparedness and response strategies.

To address this gap, the present study is the first to conduct a bibliometric analysis of 470 articles published between 1991 and 2026 and indexed in the Web of Science (WoS) and Scopus databases. In addition, crisis impact areas were comparatively examined based on a selected sample of the identified publications. In this context, trends, thematic clusters, and temporal developments of research on crises in the wine sector were identified. In addition, recommendations for academics and practitioners are provided. This study makes a unique contribution to enhancing the wine industry's capacity to anticipate, respond to, and recover from crises and serves as a guide for future academic research.

2. RESEARCH METHODOLOGY

This study employs a bibliometric approach to examine crises in the wine industry, with crisis types systematically classified through content analysis. Bibliometric analysis, when conducted using a validated database, allows a comprehensive and objective evaluation of relevant literature, encompassing both performance analysis and science mapping [13-14].

Performance analysis evaluates productivity within a research field, using outputs such as the number of publications by authors, journals, or years, while science mapping visualizes the intellectual structure of the field, facilitating understanding of its evolution and emerging trends [15-16].

2.1 Research questions

This study addresses the following research questions:

RQ1. What is the bibliometric performance of publications on crises in the wine industry in terms of annual publication trends, core journals identified through Bradford's Law, and the most influential articles based on local citation values?

RQ2. How are the keyword networks structured in these publications?

RQ3. Which types of crises are addressed in the literature, and how are their impacts distributed across the main functional areas of the wine industry?

RQ4. What are the future research trends in the wine industry crisis literature?

2.2 Database

The Web of Science (WoS) and Scopus databases were selected because of their comprehensive coverage of publications related to the wine industry. Both databases serve as primary sources for bibliometric research and continue to evolve while maintaining their leading positions in academic indexing [17].

2.3 Screening criteria

In this study, keywords were selected based on a thorough review of the literature. The initial search was conducted on October 2, 2025. In the WoS database, a comprehensive search was performed using the keywords (wine* AND crisis*) in all fields. The search was subsequently updated on February 25, 2026, in both WoS and Scopus databases. In both databases, the

search was applied to the title, abstract, and keywords using the following query:

("wine industry" OR "wine sector" OR "winery" OR "wine business" OR "wine tourism") AND (crisis OR Covid-19 OR pandemic OR "climate change" OR shock*)

These keywords were chosen to capture crises occurring within the wine industry and their impact on the sector, in line with the objectives of this study. The asterisk (*) at the end of a word enables the capture of multiple variants of that term (e.g., crises, shocks, shocking, shockwave, and shocked). These terms were included to ensure the retrieval of studies referring to more specific types of disruptions (e.g., financial crises, political crises, economic crises, or internal and external shocks).

Non-English publications, book chapters, editorials, abstracts, and book reviews were excluded, leaving only English-language journal articles on crises in the wine industry. Early access articles with DOI citations were also included.

2.4 Data analysis

Duplicate publications were removed using End-Note, and author names, journal titles, and keywords were standardized. Synonymous keywords, alternative spellings, and singular/plural forms were consolidated to ensure consistency.

Performance analysis and science mapping were conducted with Biblioshiny v.5.2.0, a web interface for the R package Bibliometrix, providing bibliometric functionalities such as network analysis and thematic mapping [18].

In the performance analysis, research trends were evaluated using publication years, the most-cited journals, most-cited authors, and keyword networks. The conceptual structure of crisis-focused publications in the wine industry was mapped using thematic mapping.

A two-stage approach was followed in the content analysis, with Microsoft Excel 2016 used in both stages of the analysis. In the first stage, all reviewed publications were classified according to the type of crisis addressed. In the second stage, for the selected sample, the impact of crises on specific areas of the wine industry was identified using a functional classification of the wine industry based on key operational and managerial areas. Following these steps, the findings were assessed within a comparative and synthesizing framework. The titles, abstracts, and keywords of the publications were examined for both stages.

3. RESULTS

The reporting of this study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [19]. PRISMA provides researchers with a structured framework to ensure transparent and comprehensive reporting of findings (Figure 1).

A total of 306 publications from the WoS database and 480 from the Scopus database remained after excluding non-English publications and non-article document types. Subsequently, 87 publications identified through the literature review and the first WoS search were manually added. After combining all records, duplicate publications ($n = 282$) were removed, leaving 591 articles. The titles, abstracts, and keywords of these articles were screened. At this stage, one publication was found to be non-English and four publications were not articles; these were excluded from the analysis. Subsequently, 116 publications were excluded because they were not related to the wine industry or did not address a crisis situation in the wine industry, leaving 470 articles for the final assessment.

3.1 Performance evaluation

The annual distribution of publications included in this bibliometric analysis is presented in Figure 2.

Figure 2 shows the annual number of scientific publications on crises in the wine industry from 1991 to March 2026, which is increasing. The highest number of publications was recorded in 2023 ($n = 65$), 2024 ($n = 62$), and 2025 ($n = 56$). The number of publications has increased noticeably since 2013. Given that the present study includes publications up to March 2026, the number of articles for the full year may be higher. Each publication has received an average of 22.87 citations, indicating a relatively good average citation value.

Using Bradford's Law of Scattering [21], core journals were identified. Zone 1 includes the most frequently cited journals, and the top five journals are listed in Table 1. The findings highlight the central role of these journals in the wine industry.

The authors with the highest number of publications in the dataset are listed in Table 2. These authors can be considered the most productive researchers in this field. Simultaneously, they play an important role in the development of literature on the wine industry and crisis-related studies.

The local citation value shown in the table indicates the number of times a publication was cited by other documents within the analyzed dataset. This value reflects a publication's influence and significance within a specific

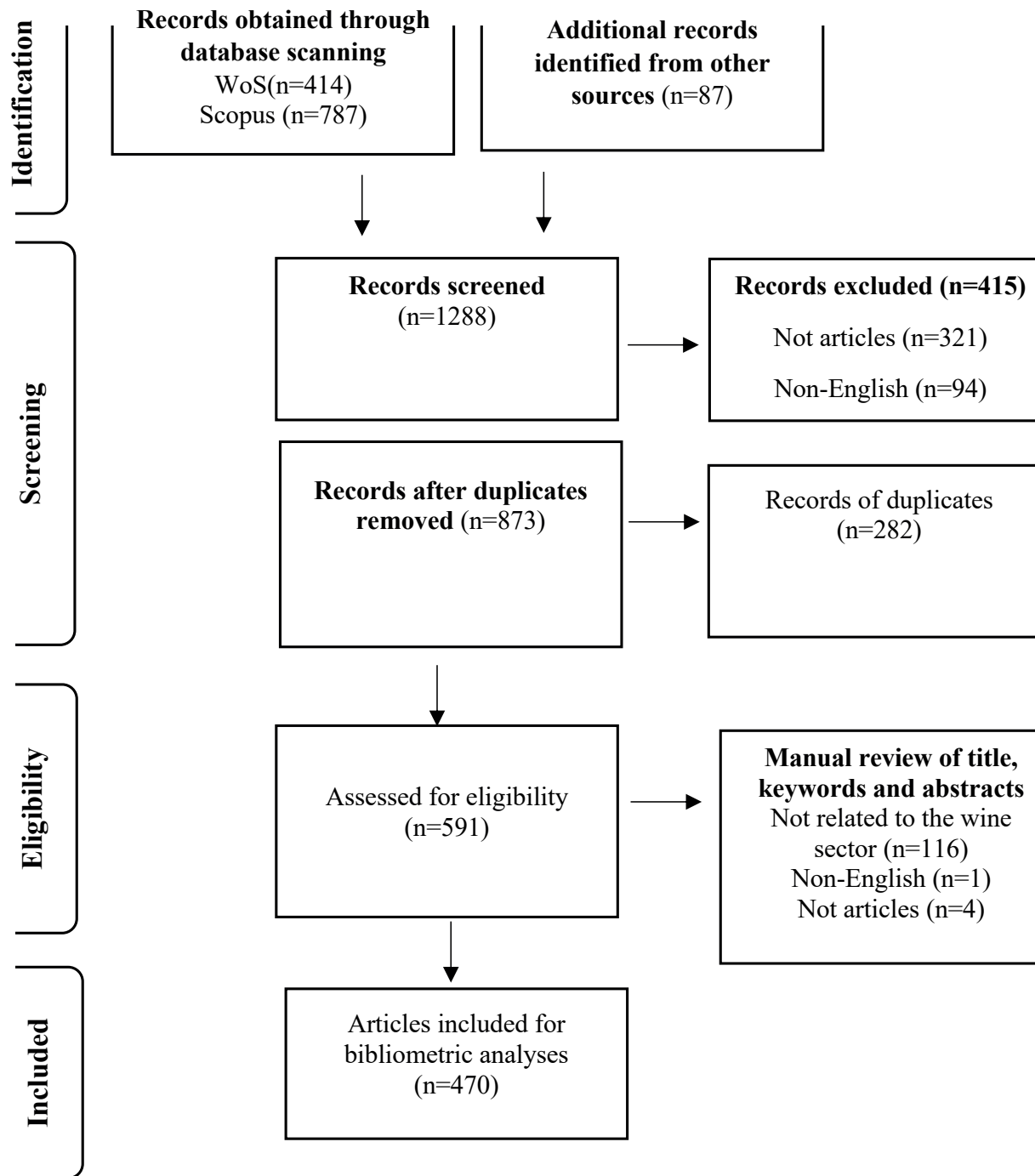


Figure 1. Prisma diagram (based on [20]).

research field. The “articles fractionalized” indicator distributes each publication among the authors according to the number of co-authors, providing a more balanced measure of individual research contribution. The most productive authors in the dataset are Abel Duarte Alonso,

Hélder Fraga, and João A. Santos, each with 10 publications. However, Fraga and Santos had the highest impact within the dataset, with 258 local citations for their most-cited collaborative publication. This highlights their central role in the wine industry crisis literature.

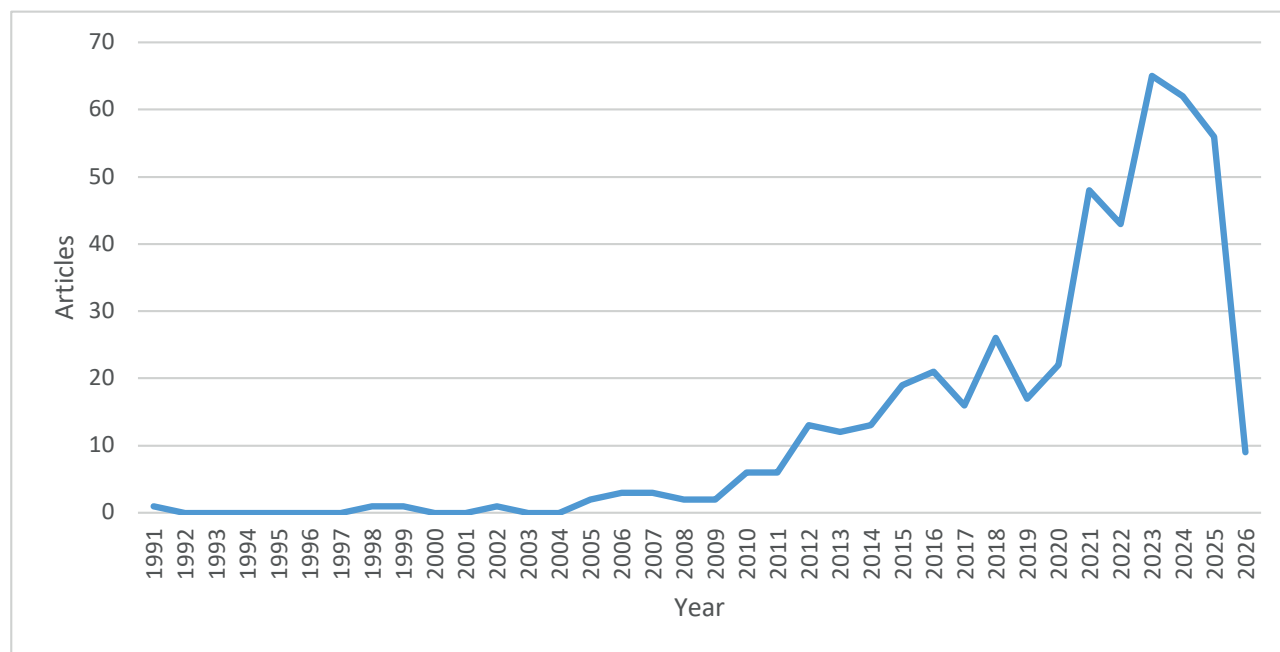


Figure 2. Number of publications per year. Source: Author.

Table 1. Most cited journals according to Bradford's Law.

Sources	Rank	Frequency	Cumulative frequency	Zone
International Journal of Wine Business Research	1	16	16	Zone 1
Oeno One	2	16	32	Zone 1
Sustainability	3	16	48	Zone 1
Wine Economics and Policy	4	16	64	Zone 1
Australian Journal of Grape and Wine Research	5	13	77	Zone 1

Source: Author.

Table 2. Most productive and influential authors in wine industry crisis research.

Author	Articles	Most cited publication	Local citations	Articles fractionalized
Abel Duarte Alonso	10	Resilience in the Context of Italian Micro and Small Wineries: an Empirical Study	59	4.48
Hélder Fraga	10	Modelling Climate Change Impacts on Viticultural Yield,	258	2.09
João A. Santos	10	Phenology and Stress Conditions in Europe		2.13
João Rebelo	9	Did Wine Consumption Change during the Covid-19 Lockdown in France, Italy, Spain, and Portugal?	27	1.83
Kym Anderson	8	Covid-19 and Global Beverage Markets: Implications for Wine	18	3.83

Source: Author.

3.2 Science mapping

The keyword co-occurrence network of the 470 publications included in this bibliometric analysis is presented in Figure 3.

Figure 3 shows the four main thematic keyword clusters identified in the literature on wine industry crises. In the first cluster, the keywords climate crisis, viticulture, Vitis, impact, and quality had the highest connections with other keywords. The climate crisis

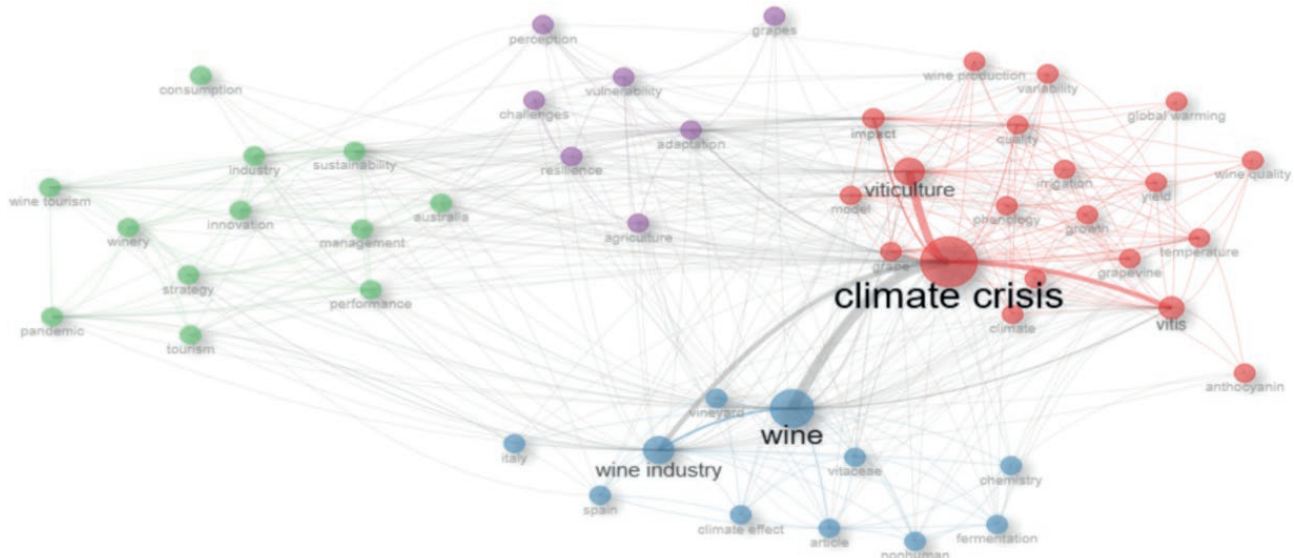


Figure 3. Co-occurrence network. Source: Author.

emerged as the most central term. In the second cluster, wine, wine industry, vineyard, article, and Spain were the most connected keywords. This indicates a focus on the wine industry and shows that wine is a central term linking multiple topics. In the third cluster, sustainability, pandemic, wine tourism, performance and innovation were the keywords with the highest connectivity. This reflects the significant influence of the pandemic and wine tourism in the literature. Finally, in the fourth cluster, adaptation, agriculture, vulnerability, perception, and resilience were the most influential keywords. These terms emphasize adaptive strategies and resilience in agriculture.

3.3 Content analysis

3.3.1 Types of crises in the wine industry

This section examines the most frequently studied crisis types in the literature and highlights their relative importance distribution.

The crisis types used in the content analysis were determined based on the nature of the crises frequently addressed in the literature and their impact on the wine industry. To better understand the impact and management of crises, they are commonly classified according to their causes (e.g., pandemics, external shocks, wars, political crises, financial crises, climate change, energy crises, and natural disasters) [14] and their effects (e.g., production shutdowns, demand shocks, and logistical disruptions) [15]. Depending on their causes, crises can

be internal or external. External shocks, such as pandemics or rapid technological transitions, occur beyond the control of firms [16]. Internal shocks, including excessive risk-taking, lack of preventive policies, and deficiencies in crisis management, may also lead to crises [17].

Each publication was classified according to the primary crisis type. The classification criteria were as follows:

- Climate change refers to the long-term impact of weather patterns.
- A pandemic refers to an infectious disease outbreak that directly affects human health and society.
- Financial and economic crises encompass economic downturns, financial disruptions, and market contractions.
- Disasters refer to natural events such as earthquakes, floods, wildfires, and epidemic diseases.
- Political crises encompass political instability, elections, protests, and decision-making deadlocks arising from political disputes.
- War refers to national or international armed conflict.
- Internal shocks include management failures originating within organizations, risky decisions, and deficiencies in crisis management processes.
- Terrorism refers to violent acts.
- Multiple crises include publications addressing more than one type of crisis in a single study.

Each article was categorized based on its title, abstract, and keywords. In cases of ambiguity, the full texts were examined to ensure accurate classification.

This approach enhanced the reproducibility of the classification process and ensured the methodological transparency.

Table 3 presents the classification of the publications included in the bibliometric analysis according to the types of crises.

Table 3 provides a systematic overview of the scope and impact of the different types of crises in the wine industry. According to the literature, the most frequently addressed crises are climate-related, pandemics, and financial crises, whereas war, terrorism, and internal shocks have been examined less extensively. This pattern reflects the prioritization of crises with broad and global impacts as the primary risks for the sector. Wine producers have developed strategic responses to these crises, focusing on resilience and adopting sustainability-oriented practices. Conversely, less frequently studied crisis types tend to have localized or specific effects, representing potential research gaps for future studies. Furthermore, political and cultural crises affect the industry beyond economic dimensions, influencing labor rights, migration, and cultural identity, thereby highlighting the multi-layered nature of crises in the wine industry.

3.3.2 Impact areas of crises

This section focuses on the main areas affected by crises within the wine industry. A stratified sampling approach was used to assess which areas of the wine industry were affected by crises in the publications examined. Stratified sampling involves dividing the population into categories based on a variable relevant to the research and then randomly selecting units from each category [38]. During content analysis, the analytical framework can be narrowed depending on the study objectives and the theoretical foundations of the presumed effects [39]. In this study, care was taken to ensure that the number of units selected from the subgroups was proportional to the population and that no subgroup was overrepresented compared to the others [40].

Following Olson [39], a stratified random sampling approach was employed. Publications were grouped by crisis type and time period (1991–1999, 2000–2019, and 2020–2026). For each group containing eight or more publications, a random number was assigned to each publication. The publications were then sorted in ascending order according to these numbers, and the first 25% were selected. Groups with fewer than eight publications were fully included to avoid disproportionate sampling in very small groups and to preserve the representation of less frequently studied crisis types. This procedure ensured that the sample represented

both the diversity of crisis types and their temporal distribution while also guaranteeing the inclusion of smaller subgroups. Applying this procedure resulted in the selection of 146 publications, representing approximately 31% of the total 470 publications.

The impact levels of crises were coded using a functional categorization of the wine industry, covering key stages such as production, distribution, marketing, tourism, management, and policy. This categorization was informed by prior studies that describe the wine industry as a set of interconnected activities [41–43]. This framework allows for the objective coding of how different crises affect various areas of the wine industry.

Six core categories were defined for the analysis:

- Production encompasses grape cultivation and wine-making. Within this scope, viticulture, grape yield, and quality control processes are included.
- Processing and supply refers to the distribution and logistics processes in the wine industry.
- Marketing and sales include retailing and consumer behaviors. This scope covers brand management, sales channels and customer demand.
- Wine tourism and hospitality involve festival participation, tastings, vineyard tours and tourist experiences.
- The organizational/managerial category includes management strategies and crisis management.
- Finally, policy and regulation encompass regulatory frameworks, policy interventions, and certification requirements.

This classification aims to provide a comprehensive understanding of how crises affect the different dimensions of the wine industry.

Table 4 presents the classification of the publications included in the bibliometric analysis according to the impact areas of crises in the wine industry.

In general, crises affecting the wine industry have the potential to impact all functional areas of the sector, from production to consumption. According to Table 4, the publications included in the current research sample indicate that the crises they address affect the production, processing, and supply, marketing and sales, wine tourism and hospitality, organizational/managerial, and policy and regulatory areas. Operational crises, particularly those related to climate change, have emerged as the most influential factors affecting production processes. This highlights the critical risk posed by climate change to grape cultivation and winemaking processes and reflects the efforts of researchers to implement preventive measures in this area. In contrast, global crises, such as pandemics, have significant effects on marketing, tourism, and organizational resilience. Political and war-related crises predomi-

Table 3. Classification of crises and their scope in wine industry studies.

Type of crisis	Number of articles (n)	Representative publications ^a	Overview
Climate change	297	[11, 22-23]	– Climate change affects grape development, yield, and quality. – It encourages adaptation strategies such as drought-tolerant varieties, irrigation, and canopy management. – Climate change encourages the adoption of environmental sustainability practices. – It impacts economic performance and regional competitiveness. – It shapes growers' perceptions and policy decisions.
Pandemic	74	[24-26]	– The COVID-19 pandemic affects wine tourism and consumer behavior. – It drives digital marketing and virtual tasting innovations. – It challenges small and rural wineries' resilience and crisis management. – It influences production and sales performance. – It shapes industry recovery strategies and stakeholder perceptions. – The wine industry is affected by financial markets, which can have positive or negative impacts.
Financial/economic crisis	52	[27-29]	– Overproduction and low vineyard prices can further worsen economic crises. – To counter rising foreign competition, the wine industry should emphasize sustainable production, marketing innovation, and supply chain integration. – Developing simple, recognizable, and strong brands while ensuring quality enhances global competitiveness. – For small and medium-sized enterprises, highlighting the country of origin can increase resilience during crises.
Multi-Crises	28	[30-31]	– The wine industry has faced economic, political, environmental, and cultural challenges. – In a global context, these crises have varying effects in different regions. – Producers have developed strategic responses and resilience policies to address these challenges. – Digital transformation and innovation are employed to mitigate the impact of crises and achieve competitive advantages. – The wine industry is vulnerable to natural disasters, extreme weather, and pest or disease outbreaks.
Disasters	8	[32-33]	– Historical crises, such as phylloxera epidemics and lead-adulterated wine, have had economic and social impacts. – Resilience depends on enterprise size, ownership, and structure and can be strengthened through preparedness and risk management. – Legal, institutional, and socioecological measures help sustain production during disasters.
Political crisis	5	[34]	– The wine industry has been a site of economic, cultural, and political crisis. – Colonial relations and state intervention are the primary sources of these crises. – International trade and embargoes have significant economic impacts. – Labor rights, migration, and human rights are directly linked to the wine production process. – Wine also serves as a symbol of cultural identity and is a focal point in political debates.
War	3	[35]	– War crises negatively impact production, exports, and market access in the wine industry. – Government support, international collaboration, and adherence to standards facilitate recovery and enhance resilience.
Internal shocks	2	[36]	– Internal shocks arise from factors such as declining consumption, rising competition, price fluctuations, and export challenges, and can be mitigated through flexible stakeholder management. – Scandal-related shocks can be managed using effective media and crisis response strategies.
Terrorism	1	[37]	– Terrorist incidents can adversely affect the wine industry, given its reliance on tourism. – Between 2010 and 2017, attacks in Paris reduced tourist numbers, though redirection to safer destinations like rural wine tourism partially mitigated these effects.

^a Representative publications were selected based on citation counts in WoS. For less common types, all publications are included.

Source: Author.

Table 4. Distribution of crisis impacts across functional areas in wine industry studies

Crisis Type	Sample Size (n)	Production	Processing & Supply	Marketing & Sales	Wine Tourism & Hospitality	Organizational / Managerial	Policy & Regulatory
Climate Change	80	50	4	2	1	22	1
Pandemic	20	0	0	5	6	9	0
Financial/ Economic	17	0	0	8	0	8	1
Disasters	8	1	1	1	0	4	1
Multi-Crises	8	0	0	3	0	3	2
Political	7	0	0	0	0	3	4
War	3	0	0	1	0	2	0
Internal Shock	2	0	0	0	1	1	0
Terrorism	1	0	0	0	1	0	0
Total	146	51	5	20	9	52	9

nantly impact the organizational/managerial domain. For instance, climate change predominantly affects production (50 out of 80 articles), whereas pandemic crises primarily impact wine “tourism and hospitality” and “organizational management” (6 and 9 out of 20 articles, respectively), highlighting the differential patterns of crisis impact across functional areas. These findings provide a comprehensive understanding of how crises propagate across functional areas in the wine industry and identify critical areas for risk management and future research.

Finally, when examining the impact areas of crises, it is evident that the organizational/managerial and production domains are the most affected areas (out of 146 publications, 52 address organizational/managerial aspects and 51 focus on production). These findings highlight the need for targeted risk management strategies that address both operational vulnerabilities and managerial resilience in the wine industry. The publications sampled within the scope of the current study are presented in Appendix.

The findings presented in Table 3 and Table 4 enable a holistic evaluation of crises in the wine industry and their impacts. Long-term crises, such as the climate crisis, which develop beyond the control of businesses and generally progress slowly, and sudden shock-inducing crises, such as pandemics or war, share the common feature of producing uncertain effects in terms of their local and temporal impacts. Nevertheless, considering the prior effects of crises, they contain effective foresight for strategic approaches that require preparedness. Although they differ in their forms of emergence, these crises can directly or indirectly affect the fundamental areas of the wine industry, such as production processes, market demand, supply chains, management structures, and working conditions. These crises may emerge simultaneously or in overlapping periods, creating cascading effects that trigger each other.

In this context, the effects of crises on the wine industry should not be evaluated only as singular and independent events but as a multilayered structure that is in mutual interaction. For example, production problems arising from the climate crisis can create cascading effects in different areas of the wine industry, from supply chain disruptions to pricing mechanisms and market imbalances to consumer behavior. These findings show that crises in the wine industry can be conceptually grouped according to their internal and external characteristics and areas of impact. However, new approaches are needed to evaluate them within a more holistic framework. Thus, the effects of crises can be evaluated not only as separate outcomes of each individual event but also within a set of processes that feed and transform each other. For example, the impact of climate change on the wine industry can be addressed not only through production loss but also by analyzing the reciprocal relationships between supply chains, prices, and consumer behavior. Indeed, different types of crises can create interconnected effects in the wine industry and generate a systemic risk based on mutual interaction.

4. THEMATIC FRAMEWORK FOR FUTURE RESEARCH DIRECTIONS

Figure 4 presents a thematic mapping aimed at understanding the future research agenda related to crises in the wine industry.

Figure 4 presents a thematic map with two axes: X represents theme significance, and Y represents development level [44]. Clusters form based on keyword co-occurrence or density, creating motor, basic, niche, and emerging/declining themes [45].

The dotted lines divide the thematic map into four quadrants based on the density and centrality [46]:

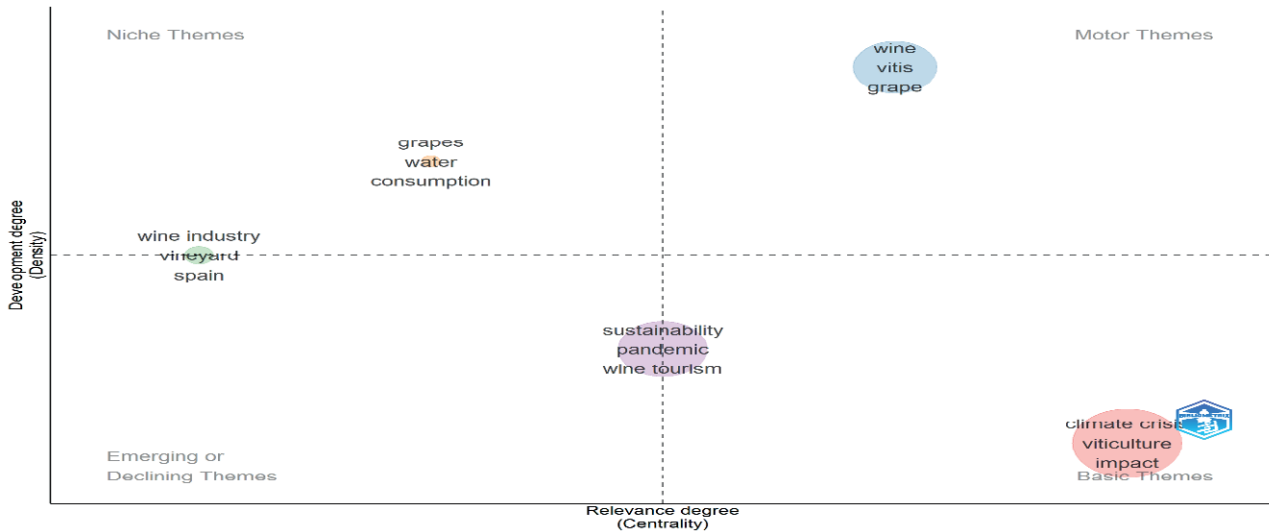


Figure 4. Crisis-focused thematic map in the wine industry. Source: Author.

- Motor Themes (High Density, High Centrality);
- The Niche Themes (High Density, Low Centrality);
- Emerging or Declining Themes (Low Density, Low Centrality);
- The Basic Themes (Low Density, High Centrality).

Motor themes such as wine, vitis, and grapes are highly developed and central, serving as the foundational pillars of the field. In contrast, themes related to the climate crisis, viticulture, and its impact were classified as basic themes. These are central but relatively underdeveloped, indicating a critical area that requires deeper analytical engagement in the future. Niche themes, such as grapes, water, and consumption, represent specialized topics. They exhibit strong internal coherence but are poorly integrated into the broader research network. Emerging or declining themes, such as the wine industry, vineyards, and Spain, reflect areas in transition, gaining attention or losing prominence.

Topics such as pandemics, sustainability, and wine tourism are positioned on the thematic map at the intersection of basic themes and emerging or declining themes along the point where the X and Y axes meet. This placement indicates that these areas are both central and not fully developed. In other words, these themes are gaining importance in the literature while simultaneously requiring more in-depth analyses.

This distribution reveals a literature landscape in which fundamental concepts are well-established. This approach would provide a more comprehensive and cross-cutting understanding of crises in the wine industry. It would also help address existing gaps and support more effective risk management and policy development.

5. DISCUSSION, IMPLICATIONS, AND LIMITATIONS

Overall, this study identifies the most influential scientific output outlets through performance evaluation and scientific mapping. Bibliometric analyses generally construct a framework of the existing literature using quantitative methods [47]. In contrast, this study develops a map of the current literature through qualitative and interpretive analyses, while also providing a thematic framework for future research. Furthermore, a comparative and holistic literature framework is established by evaluating the types of crises addressed and their impact domains in these publications through content analysis.

Wine scholarship reflects the evolution of the industry. Research in this domain has progressed from the foundational inquiries of the 1990s to more complex and multidimensional themes, including the rise of e-commerce and wine tourism, an increasing focus on sustainability, and recent global crises [48]. The findings of the present study also indicate that, by its nature, the wine industry is exposed to multiple interacting crises, including climate change, market fluctuations, pandemics, and terrorism. However, despite this progression, the relevant literature appears to focus on specific types of crises, particularly more prominent ones, such as climate crises and pandemics. Indeed, previous research on crises in the wine industry has focused primarily on adaptive responses to climate crises [49]. This suggests that the multiple and interacting crisis structures faced by the industry have not been sufficiently addressed.

When these findings are evaluated theoretically, it is observed that the literature does not display a balanced

distribution. This study reveals this imbalance by comparatively examining which types of crises are addressed by crisis-focused publications in the wine industry and in which impact domains these crises are concentrated in. This imbalance may result from sudden and highly visible crises attracting academic attention more rapidly or from certain impact domains that are more difficult to measure. Future research should address different types of crises and impact domains using more integrated theoretical approaches. Additionally, studies should be conducted in this direction to establish a more explanatory and in-depth theoretical foundation.

The findings also have important implications for practitioners. In the present study, it is shown that the crises in the publications included in the analysis focus on their effects on production and organization/management. Therefore, when evaluated in terms of publications within the sample, these publications do not sufficiently address the impact domains of processing and supply, marketing and sales, wine tourism and hospitality, and policy and regulation. Moreover, there is a distinct concentration on certain impact domains for some types of crises. For example, studies addressing the climate crisis clearly focus on its effects on production. These findings reveal that crises produce structural effects specific to the sectoral context while indicating that the comprehensive and multidimensional nature of crises is neglected. Therefore, wine businesses must develop multi-layered and integrated crisis management models that consider crisis type–impact domain matches.

Future research should develop a comparative and integrated perspective that examines the interactive effects of different types of crises. The current literature emphasizes that organizational resilience should be considered a multistage and interactive process involving learning before, during, and after a crisis [50]. Therefore, resilience to crises is fueled by the interaction between the internal and external environments. This perspective supports the view that crisis management research remains fragmented and requires a more integrated theoretical approach that connects the different phases of crisis response.

Second, it should be taken into account that digital technologies such as artificial intelligence, augmented reality, and virtual reality create not only opportunities but also new areas of vulnerability. Indeed, the potential of these technologies to generate crises or deepen existing crises should be examined. Finally, it was observed that more structural and systemic themes, such as the viticulture ecosystem, water resource constraints, and consumption dynamics, are relatively neglected in the crisis literature of the wine industry.

Although this study included a detailed and comprehensive analysis, it had some limitations. First, the inclusion of different databases, such as PubMed or Google Scholar, in addition to WoS and Scopus, would allow for a more comprehensive literature review. Second, examining only English-language publications and excluding non-article publications led to the omission of studies of different types. This study not only maps the existing literature but also provides a basis for deeper and more multidimensional research by making the current limitations of the field visible.

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APPENDIX

Table A. Publications included in the sample.

Author(s)	Year	Title
Eisinger	1991	Early consumer-protection legislation - a 17th-century law prohibiting lead adulteration of Wines
Beverland and Bretherton	1998	The evolution of strategy in medium and large Auckland (New Zealand)-based wineries
Landsteiner	1999	The crisis of wine production in late sixteenth-century Central Europe: Climatic causes and economic consequences
Pinilla and Ayuda	2002	The political economy of the wine trade: Spanish exports and the international market, 1890-1935
Jones	2005	Climate change in the Western United States grape growing regions
Pérez-Torrado et al.	2005	Monitoring stress-related genes during the process of biomass propagation of <i>Saccharomyces cerevisiae</i> strains used for wine making
Kingsbury and Hayter	2006	Business associations and local development: The Okanagan wine industry's response to NAFTA
White et al.	2006	Extreme heat reduces and shifts United States premium wine production in the 21st century
Belliveau et al.	2006	Multiple exposures and dynamic vulnerability: Evidence from the grape industry in the Okanagan Valley, Canada
Beer and Thomas	2007	The politics and policy of economic restructuring in Australia: Understanding government responses to the closure of an automotive plant
Strachan	2007	The colonial identity of wine: The Leakey Affair" and the Franco-Algerian order of things"
Webb et al.	2008	Modelling the relationship between climate, winegrape price and winegrape quality in Australia
Webb et al.	2008	Climate change and winegrape quality in Australia
Cardebat and Figuet	2009	Estimation of a hedonic price equation for Alsace, Beaujolais and Provence wines
Costa-Font et al.	2009	Explaining low farm-gate prices in the Catalan wine sector
Duquesnois et al.	2010	Wine producers' strategic response to a crisis situation
Holland and Smit	2010	Climate change and the wine industry: Current research themes and new directions
Cavicchi and Santini	2011	Brunellopoli: A wine scandal under the tuscan sun
Săseanu et al.	2011	Benchmark models for the wine industry. Recommendations for Republic of Moldova
Neacșu and Bobeică	2011	Sustainable development of the wine industry on climate changes
Duarte Alonso and Liu	2012	Coping with changes in a sector in crisis: The case of small Spanish wineries
Castillo and García	2013	Analysis of international competitive positioning of quality wine from Spain
Viers et al.	2013	Vinecology: pairing wine with nature
Bellia and Pilato	2014	Competitiveness of wine business within green economy: Sicilian case
Pickering et al.	2014	Determining adaptive capacity to climate change in the grape and wine industry
Mozell and Thachn	2014	The impact of climate change on the global wine industry: Challenges & solutions
Holland and Smit	2014	Recent climate change in the Prince Edward County winegrowing region, Ontario, Canada: implications for adaptation in a fledgling wine industry
Duarte Alonso	2015	Resilience in the context of two traditional Spanish rural sectors: an exploratory study
De Salvo et al.	2015	A spatial micro-econometric approach to estimating climate change impacts on wine firm performance: A case study from Moldavia region, Romania
Sánchez-Monedero et al.	2015	Strategies to transform organic residues from olive and wine industries: Greenhouse gas emissions and climate change
Longbottom and Petrie	2015	Role of vineyard practices in generating and mitigating greenhouse gas emissions
Fabrizzi et al.	2015	Coping with the economic crisis in agriculture: an analysis of the Tuscany (Italy) premium quality wine area and strategies for impact mitigation
Castex et al.	2015	Water availability, use and governance in the wine producing region of Mendoza, Argentina
Ferrise et al.	2016	Climate change and grapevines: A simulation study for the Mediterranean basin
Röcker et al.	2016	The use of glucose oxidase and catalase for the enzymatic reduction of the potential ethanol content in wine
Mosedale et al.	2016	Climate change impacts and adaptive strategies: lessons from the grapevine
Ashenfelter and Storchmann	2016	The economics of wine, weather, and climate change
Schultz	2016	Global climate change, sustainability, and some challenges for grape and wine production
Tissot et al.	2017	Modeling environmental impacts on viticultural ecosystems: A first case study in a regulated wine producing area

Author(s)	Year	Title
Sacchelli et al.	2017	A mix-method model for adaptation to climate change in the agricultural sector: A case study for Italian wine farms
Li and Bardaji	2017	A new wine superpower? An analysis of the Chinese wine industry
Zabaniotou et al.	2018	Sustainable bioeconomy transitions: Targeting value capture by integrating pyrolysis in a winery waste biorefinery
Chen and Juvenal	2018	Quality and the Great Trade Collapse
Escobar et al.	2018	Consumers' wine preferences in a changing scenario
Kool et al.	2018	The influence of institutions on the climate change adaptive capacity of winegrowers in Utiel-Requena
Lazoglou et al.	2018	Climate change projections for Greek viticulture as simulated by a regional climate model
Kwon and Constantinides	2018	Ideology and moral reasoning: How wine was saved from the 19th century phylloxera epidemic
Moreno et al.	2018	Climate reconstruction for the Entre-Douro-e-Minho region (NW Portugal) between AD 1626 and AD 1820: synthesis of viticulture data and foraminiferal evidence
Garcia-Casarejos et al.	2018	Introduction of renewable energy in the Spanish wine sector
Valette et al.	2018	Cooperatives versus corporations: Survival in the French wine industry
Bacenetti	2019	Heat and cold production for winemaking using pruning residues: Environmental impact assessment
Leitao	2019	Branding Port: Crisis, transformation and the advent of modern brands in the Port Wine Trade (1945-1975)
Brandano et al.	2019	Comparative efficiency of agricultural cooperatives and conventional firms in a sample of quasi-twin companies
Cradock-Henry and Fountain	2019	Characterising resilience in the wine industry: Insights and evidence from Marlborough, New Zealand
Song et al.	2019	Effects of terrorist attacks on tourist flows to France: Is wine tourism a substitute for urban tourism?
Tello et al.	2019	Major outbreaks in the nineteenth century shaped grape phylloxera contemporary genetic structure in Europe
Di Giuseppe et al.	2020	A natural organic coating to control and minimize late frost damages on wine shoots
Gilinsky et al.	2020	US wine industry preparedness for unforeseen crises and disasters: An empirical test
Saraiva et al.	2020	Water footprint sustainability as a tool to address climate change in the wine sector: A methodological approach applied to a Portuguese case study
Ben Ameer and Le Fur	2020	Volatility transmission to the fine wine market
Calle et al.	2020	Social economy, environmental proactivity, eco-innovation and performance in the Spanish wine sector
Ferrer-Alos	2020	Commercial structures and the globalisation of viticulture in Catalonia: From brandy to wine and cava (eighteenth-twentieth centuries)
Migliaccio and Tucci	2020	Economic assets and financial performance of Italian wine companies
Ruiz Estrada et al.	2020	Measuring wine industry efficiency with wine industry network evaluation model (Wine-model)
Králíková et al.	2021	Visitors' happiness and loyalty in the moravian wine region
Kudryashova and Casetti	2021	The Internet of Things - the nearest future of viticulture
Bunting et al.	2021	Vitis vinifera production in Michigan: Factors and trends driving cultivation Patterns
Szolnoki et al.	2021	A cross-cultural analysis of the motivation factors and profitability of online wine tastings during Covid-19 pandemic
Pickering et al.	2021	Prevalence and management of alkyl-methoxypyrazines in a changing climate: Viticultural and oenological considerations
Carrasco Monteagudo et al.	2021	Greening wine exports? Changes in the carbon footprint of spanish wine exports
Hewer and Gough	2021	Climate change impact assessment on grape growth and wine production in the Okanagan Valley (Canada)
Zhang and Carboni	2021	The sustainable project management utilization in French wineries while adapting to climate change
Sottini et al.	2021	Impact of climate change on wine tourism: An approach through social media data
Cameron et al.	2021	Is advancement of grapevine maturity explained by an increase in the rate of ripening or advancement of veraison?
Wittwer and Anderson	2021	COVID-19 and global beverage markets: Implications for wine
Mirabelli-Montan et al.	2021	Techniques for mitigating the effects of smoke taint while maintaining quality in wine production: A review
Bressan et al.	2021	Confronting the unprecedented: micro and small businesses in the age of coronavirus disease 2019
Agnoli and Charters	2022	The alcohol consumption of wine drinkers with the onset of Covid-19
Monteiro et al.	2022	The role of biostimulants as alleviators of biotic and abiotic stresses in grapevine: A review

Author(s)	Year	Title
Sgroi and Sciancalepore	2022	Climate change and risk management policies in viticulture
Vinci et al.	2022	Environmental impact assessment of an organic wine production in central Italy: Case study from Lazio
Häfner	2022	Winegrowing and winemaking in Russia: The late nineteenth century to October 1917
Vicente et al.	2022	Biological management of acidity in wine industry: A review
Cava Jimenez et al.	2022	Enotourism in Southern Spain: The Montilla-Moriles PDO
Galbreath and Tisch	2022	Sustainable development in the wine industry: The impact of the natural environment and gender-diverse leadership
Curtis and Slocum	2022	Firm resiliency post-economic shock: A case study of rural wineries during the COVID-19 Pandemic
Simon-Elorz and Castillo-Valero	2022	Resilience and performance of wine cooperatives in Castilla La-Mancha (Spain) during a period of financial crisis
Davis and Gomez	2022	The COVID-19 pandemic, customer satisfaction and sales performance in wine tasting rooms in the Finger Lakes region of New York State
Duarte Alonso et al.	2022	COVID-19: Impacts and implications for hospitality, tourism and community. The case of Mendoza
Ducman et al.	2023	Government oversight and economic impacts: sustainability in the vineyard and the evolution of wine regulations, trade and production
Bressan et al.	2023	Exploring key factors sustaining micro and small food, wine and hospitality firms through the COVID-19 crisis
Karalis and Kanakoudis	2023	Carbon footprint of products and services: The case of a winery in Greece
Miccichè et al.	2023	Effects of artificial canopy shading on vegetative growth and ripening processes of cv. Nero d'Avola (<i>Vitis vinifera</i> L.)
Modina et al.	2023	Alpine viticulture and climate change: Environmental resources and limitations for grapevine ripening in Valtellina, Italy
Gaitan et al.	2023	Using bioclimatic indicators to assess climate change impacts on the Spanish wine sector
Synák	2023	Problems and opportunities within the wine industry in terms of the COVID-19 Pandemic
Gastaldello et al.	2023	Glass half-full? A comprehensive PLS-SEM approach to explore the pandemic's effect on wine tourism intentions
Fraga et al.	2023	Vintage Port prediction and climate change scenarios
Long et al.	2023	Australian red wines made from non-traditional, emerging red grape varieties: distinguishing sensory profiles and consumer perceptions
García et al.	2023	Feasibility of photovoltaic systems for the agrifood industry in the new energy and climate change context
Vicente et al.	2023	Microsatellite typing of <i>Lachancea thermotolerans</i> for wine fermentation monitoring
Fraboni et al.	2023	Outsourcing corporate heritage marketing in the omnichannel context: a process perspective of a small winery
Masset et al.	2023	Fine wine pricing in a small and highly competitive market
Faria et al.	2023	Fractional responses with spatial dependence of Portuguese wineries' domestic market sales to an exogenous shock (Covid-19)
Franzoni and Pelizzari	2023	Assessment of rainfall risk in a financial perspective: An application to the wine industry
Zito et al.	2023	Projected impacts of climate change on viticulture over French wine regions using downscaled CMIP6 multi-model data
Cruz-Ruiz et al.	2023	Managing digital presence in wineries practicing heroic agriculture: The cases of Ribeira Sacra and Lanzarote (Spain)
Bitakou et al.	2024	Evaluating social media marketing in the Greek winery industry
Giménez-Romero et al.	2024	Global warming significantly increases the risk of Pierce's disease epidemics in European vineyards
Hamon et al.	2024	Identification of the best viticultural areas by spatial optimisation. Application in New Zealand South Island in the context of climate change
Pascoal et al.	2024	A technical survey on practical applications and guidelines for IoT sensors in precision agriculture and viticulture
Toma et al.	2024	Grapevine plant waste utilization in nanotechnology
Micu et al.	2024	The development of a brand strategy for the romanian wine industry - a perspective from Romanian wine exporters
Tavilli et al.	2024	Effective Ethyl Carbamate Prevention in Red Wines by Treatment with Immobilized Acid Urease
Banuta et al.	2024	The effects of climate change on vines in the main growing countries in Europe

Author(s)	Year	Title
Praveen et al.	2024	Emergy Analysis and Life Cycle Assessment for Evaluating the Sustainability of Solar-Integrated Ecotechnologies in Winery Wastewater Treatment
Dinis et al.	2024	Canopy and soil management strategies: Insights to overcome abiotic stresses in grapevine
García-Cortijo et al.	2024	The proactive role played by sustainable wineries at times of economic crisis
Mahdi et al.	2024	Entrepreneurial marketing practices and rural wine producers' performance: The moderating role of competitive intensity in an immediate post crisis period
Sujood	2024	Uncorking the potential of wine: an empirical prediction of consumers' intention to visit wine tourism destinations (WTDs) post-COVID-19
Faria et al.	2024	Impact of an exogenous shock (COVID-19) on the performance of Portuguese wine firms: a structural break analysis
Abinandan et al.	2024	Eco-innovation minimizes the carbon footprint of wine production
Loose and Del Rey	2024	State of the International Wine Markets in 2023. The wine market at a crossroads: Temporary or structural challenges?
Gastaldello et al.	2024	Consumer behavior toward virtual wine experiences as a technology-based sustainable transformation
Martínez-Moreno et al.	2025	Medium-term impacts of saline water deficit irrigation on soil, vine nutrient status, yield and grape composition of <i>Vitis vinifera</i> L. cv. Monastrell
Honoré-Chedozeau and Valentin	2025	Back to the future: will today's new varietal and free-from" wines shape the wine experience of tomorrow?"
Sequeira and Leal	2025	Crisis and intervention: the impact of liberal legislation on portwine sector, 1870-1900
Szmania et al.	2025	Investigating abiotic stress-induced off-flavor in different white wine varieties (<i>Vitis vinifera</i> L.) using a complementary approach of sensory analysis and nontargeted gas chromatography mass spectrometry analysis
Bilen et al.	2025	Detecting new emerging viruses and phytoplasmas of grapevine in Lebanon for developing future adaptation strategies to climate change
Liles et al.	2025	Assessment of spatial and temporal trends influencing the occurrence of frost after budburst
Chitwood et al.	2025	Sí se puede: The enduring legacy of Mexico on wine and politics
Grazia et al.	2025	Too hot to profit? Climatic stress and farm-level performance in Italian viticulture
St Pierre	2025	An optimist's view on the future of wine
Tria et al.	2025	Sustainability and quality in wine pricing: Insights from the primitivo e-commerce market
Alfieri et al.	2025	Feasibility assessment of a low-cost near-infrared spectroscopy-based prototype for monitoring polyphenol extraction in fermenting musts
Balogh and Maró	2025	Impacts of climate change on the global wine sector: the case of cool-climate countries
Kingston et al.	2025	The potential of integrating biochar and stable isotope technologies for regenerative viticulture under climate change
Tymchenko	2025	The crisis phenomena of the grape and wine industry under Martial Law
Maphosa	2025	Phylloxera and the development of rural financial networks in the cape colony
Bulled	2025	Occupational syndemics in farmworkers in the Cape Winelands, South Africa
Santos et al.	2025	Crop modelling applied to Portuguese viticulture: a brief overview
Pettenuzzo et al.	2025	QTL mapping and underlying genes for heat tolerance in grapevine (Rhine Riesling x Cabernet Sauvignon) under field conditions
Brinkmann	2025	Quality regulation in the global "wine periphery": The case of late imperial Rio de Janeiro (1880–1889)
Gerbi and De Paolis	2025	The effects of climate change on wine composition and winemaking processes
Dubey et al.	2026	The role of geopolitical uncertainty on shaping carbon neutrality policy: Moderating influence of digital transformation
Bellanger et al.	2026	Biofilm of <i>Oenococcus oeni</i> on yeast derivatives: An innovation to trigger malolactic fermentation and modulate the molecular fingerprint of wines

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