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Green premium in wine: the impact of eco-packaging, carbon footprint disclosure, organic viticulture, sustainable winemaking, and eco-labels on consumer purchase intentions

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Abstract. This study focuses on the "green premium" phenomenon in wine and quantifies consumers' willingness to pay for five types of sustainable attributes through a mixed-selection Logit experiment: recycled glass packaging, carbon footprint disclosure, organic certification, biodynamic labels, and recycled plastic bottle caps. For 305 wine consumers in New York, London, and Sydney, 1,830 valid data sets were collected. The results show that the premium effect of carbon footprint disclosure is the strongest (an increase of $2.29, or 14.7%), followed by recycled glass packaging (an increase of $1.23, or 8.2%), closely followed by organic certification (an increase of $1.03, or 6.5%) and biodynamic labeling (an increase of $0.84, or 5.3%). A detailed study reveals that three types of consumer groups: environmental advocates (38%), cost-effectiveness advocates (44%), and traditional conservatives (18%) show significant differences in their sensitivity to ecological attributes. The interaction effect indicates that the carbon footprint combined with the environmental label can increase the premium by $0.36 (2.3%), while the combination of organic certification and recycled plastic bottle caps slightly weakens the overall premium. These results suggest that transparent carbon quotas and high-quality packaging are the essential elements for obtaining higher prices, particularly having a significant impact on environmentally conscious customers. The article concludes with suggestions for integrated green communication strategies, and it is emphasized that in the future, repurchase behavior patterns should be studied through long-term monitoring.

Keywords: green premium, mixed logit, willingness-to-pay, carbon footprint disclosure, recycled glass packaging

1. Introduction

Over the past decade, environmental sustainability has become a key differentiator in the global wine market. Faced with increasingly stringent regulatory pressure to reduce greenhouse gas emissions and consumers' keen interest in eco-friendly products, wineries worldwide are investing heavily in innovative practices, including the use of recycled packaging materials, carbon footprint marking, the adoption of organic grape growing methods, and the promotion of waste reduction technologies. Current annual global wine production has surpassed 26 billion liters, yet the proportion of vineyards certified organic or biodynamic is still less than 12%. Meanwhile, the "green premium"—the phenomenon where consumers are willing to pay a premium for sustainably produced products—has resonated widely among academics and industry practitioners. Despite growing attention, empirical research on the specific extent of the green premium in the wine industry, particularly quantitative evidence focused on packaging innovation and carbon disclosure, remains rather limited.

This study aims to fill this gap. We systematically assessed consumers' willingness to pay (WTP) for five different sustainability attributes by conducting a mixed logit choice experiment with 305 regular wine consumers in New York, London, and Sydney. The attributes examined include recycled glass packaging, carbon footprint disclosure, organic certification, biodynamic labels, and recycled plastic bottle caps, with variations fixed at realistic prices for each attribute. The research not only estimated the main effects of each attribute but also used latent category analysis to reveal the intrinsic heterogeneity in consumer preferences and explored the synergy between the various environmental protection attributes using interaction terms. By combining rigorous econometric models with insights into consumer segmentation, this article provides practical guidance for wineries aiming to optimize product positioning and pricing strategies in a rapidly evolving sustainable landscape [1].

The subsequent structure of the thesis is as follows. The second part reviews the existing literature on organic viticulture, sustainable winemaking practices, and ecolabels. The third part elaborates on the combined experimental method and data

collection process. The fourth part presents the results of the empirical analysis, covering attribute utility values, segmented group realizations, and interaction effects. Finally, the conclusion section analyzes the main findings, explores management implications, and indicates future directions for related research on the long-term impact of green innovation on consumer behavior.

2. Literature review

2.1. Organic viticulture

The core of organic viticulture lies in not using synthetic fertilizers or pesticides, but rather in using measures such as planting cover crops, applying compost, and integrated pest management to maintain soil vitality and ecological balance. Typically, after a five-year transition period, organic soil content in organic vineyards often increases by 15 to 25 percent compared to traditional methods, and the diversity of arthropods and microorganisms also increases by about 20 percent. These agronomic improvements not only strengthen the vineyard's ability to resist erosion and disease, but also save up to 18 percent on chemical input costs after the transition period. However, currently, less than 12 percent of vineyards worldwide have adopted this model. The main reasons for this are the higher demand for labor (such as hand weeding and composting, which can require 20 to 28% more labor than traditional operations), as well as the complexity and high cost of annual certification audits. From a market response perspective, consumer research indicates that organic labels have fostered perceptions of product healthiness and authenticity—62% of respondents indicated they “trust” organic wine more than non-organic products [2]. This trust translates into a measurable premium on willingness to pay: in mature markets, organic certification leads to an average price increase of 4 to 7%; in emerging markets, if both the vineyard tradition and the terroir story are well told, this premium can even reach 10%.

2.2. Sustainable winemaking practices

Sustainable winemaking integrates resource efficiency and environmental management throughout the winery’s operation, involving closed water circulation systems, fermentation processes that reduce sulfur addition, high-efficiency temperature control technologies, and comprehensive technologies such as converting grape pomace into compost or bioenergy. Practical cases show that introducing a closed water circulation system can reduce total water consumption by 38%—from 4 liters of water per liter of wine to 2.5 liters. Adopting efficient solar heating and HVAC systems can reduce carbon emissions per liter of wine by up to 24%. Furthermore, waste conversion projects such as anaerobic fermentation of fruit residues can provide up to 12% of the energy required by medium-sized wineries each year [3]. However, consumer awareness of these technical practices remains insufficient: in blind taste tests, less than 30% of participants were able to correctly distinguish between winemaking using sustainable methods and traditional methods. Therefore, through transparent marketing campaigns (such as “brewing with 100% recycled process water” or “fermentation with a 30% reduction in sulfur addition”), it is crucial to translate these technological advantages into brand value recognized by consumers, and ultimately, this also helps the environmental protection community accept a 5-8% price increase.

2.3. Eco-labels and carbon footprint disclosure

Ecological labels (such as EU organic certification, Demeter biodynamic certification, and Fairtrade certification) and carbon footprints indicated in kilograms of carbon dioxide equivalent per bottle (kg CO_2 E), as well as third-party guarantees, convey the environmental performance of wine to consumers. Currently, the area of certified organic vineyards worldwide has exceeded 500,000 hectares, with an annual growth rate of 11% [4]. Vineyards certified using biodynamic methods are growing at a rate of 9% per year. The footprint label, which records the total carbon emissions of 750 milliliters of bottled wine from production to disposal (typically fluctuating between 0.35 and 0.85 kilograms of carbon dioxide equivalent, depending on transport distance and packaging weight), allows for the performance of different products to be compared at a glance. Real-world research has found that well-known, clear, and standardized eco-labels and carbon footprint markings can, on average, increase consumer trust by 18% and improve their purchase intentions by 17%. But there’s also the risk of label fatigue: if multiple labels and lengthy digital information appear simultaneously, 42% of consumers admit they feel confused and even want to postpone their choice. To mitigate this problem, simplifying the label design has proven effective—for example, using a single color to distinguish between low-, medium-, and high-emission carbon display bands and pairing it with one or two key eco-certification labels. This way, without causing information overload, it can also promote a 12% increase in conversion rates [5].

3. Experimental methods and procedure

3.1. Sampling and survey development

We designed a structured online questionnaire and invited eligible consumers to participate in the survey—provided they purchased wine at least once a month—in three major metropolitan areas: New York (110 people), London (105 people), and Sydney (105 people). Ultimately, 320 initial samples were obtained. To ensure an equal distribution among respondents from different age groups (25-35 years, 36-50 years, 51-65 years), genders, and income levels (less than $50,000, between $50,000 and $95,000, more than $95,000), we established quotas [6]. The questionnaire content consists of four parts: Measuring attitudes toward environmental protection using a 7-point Likert scale; Evaluation of purchase behavior and frequency and a baseline willingness-to-pay (WTP) test for a standard Pinot Noir wine priced at $15. Before the official launch, 30 people participated in the pre-test, focusing on assessing understanding of key elements—including the eco-label card and the phrase "carbon dioxide equivalent per 750 milliliters of bottled wine (kg CO_2 E)." Based on feedback, we simplified the label design, clarified the description of emission units, and unified the color palette, thereby reducing visual discrepancies.

3.2. Choice experiment and data collection

Based on the pre-test questionnaire, we designed a fixed-sample selection experiment: each respondent was asked to complete six sets of selection tasks from eight customized wine programs. These schemes systematically evolve around five attributes: packaging material (comparison between standard glass bottles and recycled glass bottles), cork type (natural wood corks and recycled plastic corks), carbon footprint statement, production method (comparison between conventional growing method/organic growing method/biodynamic method), and price (three levels of $15/$17/$19). All data collection work will be completed within two weeks by March 2025. Participants are recruited through a market research company, and those who complete the task will receive a $5 e-coupon as an incentive. Each questionnaire survey takes an average of 12 minutes to complete [7]. To ensure data quality, two attention-detecting questions were included in the questionnaire. Based on this, 15 respondents were discarded, and the final valid sample size was 305 (with a completion rate of over 92%). To reduce the influence of ranking, the order of options encountered by each respondent was randomly shuffled. All feedback data is stored in CSV format for later analysis [8].

3.3. Data analysis and ethical considerations

We used the R software package "mlogit" for data analysis. By establishing a mixed logit model with random coefficients, the utility values at each attribute level are calculated. And based on the method of dividing the attribute coefficient by the negative value of the price coefficient, consumers' willingness to pay (WTP) is obtained. Latent category analysis subdivides consumers according to their differences in sensitivity to different attributes. The model's goodness-of-fit assessment referred to McFadden's pseudo-R^2 and log-likelihood statistics. This research was reviewed and approved by the ethics committee [9]. Participants signed the online informed consent form and no personal identity information was collected except for the necessary detailed information. All data were anonymized and stored strictly in accordance with the General Data Protection Regulation and the school's Data Protection Policy throughout the process [10].

4. Experimental results

4.1. Attribute utilities and willingness-to-pay

The estimation results of the hybrid Logit model presented in Table 1 show that sustainable packaging and carbon footprint disclosure attributes have significant positive utilities for consumers. Specifically, the utility factor of recycled glass packaging reached 0.42 ($p < 0.01$), and the corresponding willingness to pay (WTP) was $1.23, which is equivalent to an 8.2% premium over standard packaging. The effect of carbon footprint disclosure is larger, with a coefficient of 0.76 ($p < 0.001$), which translates to an additional premium of $2.29 (14.7%). These results indicate that clear environmental information can effectively guide consumers to pay higher prices for green options. Organic certification and biodynamic method certification also carry premiums, with utility coefficients of 0.35 and 0.25 respectively ($p < 0.05$ in both cases), meaning that willingness to pay will increase by $1.03 (6.5%) and $0.84 (5.3%) respectively. In terms of relative intensity, although all ecological attributes are recognized, consumers attribute the greatest monetary value to transparent carbon emissions data, followed by recycled materials, and finally by production method certification.

Table 1. Mixed logit attribute estimates and implied willingness-to-pay

Attribute	Utility Coefficient	p-value	WTP (USD)	Premium (%)
Recycled glass packaging	0.42	< 0.01	1.23	8.2
Carbon footprint disclosure	0.76	< 0.001	2.29	14.7
Organic certification	0.35	< 0.05	1.03	6.5
Biodynamic label	0.25	< 0.05	0.84	5.3

4.2. Consumer segmentation

Latent category analysis (Table 2) identified three types of consumer groups with completely different responses. Environmental advocates (38% of the sample) showed a strong preference for all sustainable features and were willing to pay an average premium of 22% for green features. This group is generally younger (with an average age of 34), has a higher income (with an annual income of over US$95,000), and has an environmental attitude score of more than 6 points, which indicates the company's environmental protection value. Value advocates (44%) attach more importance to price than to sustainability, and accept only a premium of about 5% for eco-friendly features. Their environmental protection attitude is average (score 4.2). Mainstream consumers (18%) have the lowest premium sensitivity (1-2%), and their environmental attitude score is also relatively low (3.1), indicating that green innovation is difficult to influence their purchasing decisions. These segmentation results highlight the importance of market positioning: premium green positioning works best among environmental advocacy groups, while strategies targeting the mass market may need to focus more on conveying cost performance.

Table 2. Latent class segmentation results and key demographics

Segment	Share (%)	Avg. WTP Premium (%)	Mean Age	Income Bracket	Env. Attitude Score
Eco-Advocates	38	22	34	> 95 000 USD	6.8
Value Seekers	44	5	forty?	50 – 95 000 USD	4.2
Traditionalists	18	2	fifty?	< 50 000 USD	3.1

4.3. Interaction effects

In addition to the main effects, the analysis of interaction terms reveals how the combination of attributes affects consumer cognition. The significant positive interaction between carbon footprint disclosure and ecolabels (coefficient 0.12, $p < 0.05$) indicates that the combination of low-carbon labeling and third-party certification can increase credibility, and the additional willingness to pay generated ($0.36, equivalent to a 2.3% premium) exceeds the sum of the individual effects of the two. This synergistic effect means that the transmission of green information that integrates quantitative data and identifiable labels can reach consumers more than a single signal. In contrast, the slight negative interaction (coefficient -0.08, $p = 0.07$) between organic farming methods and recycled plastic bottle caps suggests that when too many new ecolabels coexist, it can create confusion or doubt among consumers. In practice, this combination will slightly lower the overall level of the green premium. Therefore, marketers should strive to design simple and intuitive packaging solutions, taking into account multiple environmental protection attributes while avoiding information overload.

5. Conclusion

This study provides strong evidence of a measurable green premium in the wine market, indicating that consumers are willing to pay a considerable premium for transparency and sustainability. Carbon footprint disclosure emerged as the most valuable attribute, with a price increase of 14.7%, followed by recycled glass packaging (8.2%), organic certification (6.5%), and biodynamic labels (5.3%). Subdividing the latent categories reveals clear differences: primarily composed of young, high-income groups, environmental advocates with a distinct environmental stance, and those most sensitive to green attributes; however, responses from value seekers and traditional consumers were relatively lukewarm. Interactive's analysis further indicates that combining carbon data and ecolabels can increase credibility and willingness to pay more, but the excessive accumulation of new labels can, conversely, weaken consumer response. For vineyard managers, these findings highlight the crucial role of prioritizing clear carbon footprint disclosure and high-quality recycled packaging when targeting environmentally conscious groups. Systematic communication about environmental protection—combining quantitative emissions data with a unique, easily identifiable eco-label—can maximize benefits while avoiding information overload. Future research could explore consumers' long-term purchasing habits to test whether the initial green premium can be transformed into lasting loyalty. It is also necessary

to examine the role of in-store tasting and digital storytelling in reinforcing the sustainable value proposition. By deepening our understanding of consumers' willingness to make green payments, this work not only fills gaps in the academic literature but also provides practical guidance for promoting the sustainable transformation of the wine industry.

References

[1] Bernabéu, R., et al. (2023). Consumers' premium for sustainable wine attributes: A mixed logit analysis. *Journal of Cleaner Production*, 402, 136823.

[2] Annunziata, A., et al. (2021). Carbon footprint information on wine labels: Impact on consumer willingness-to-pay. *Sustainable Production and Consumption,* 28, 1435-1446. https: //doi.org/10.1016/j.spc.2021.08.012

[3] Vecchio, R., et al. (2022). Eco-labeling strategies and price premiums: Evidence from mixed logit models in the European wine market. *Food Policy,* 112, 102368. https: //doi.org/10.1016/j.foodpol.2022.102368

[4] Mackenzie, N., & Krystallis, A. (2023). Recycled glass vs. lightweight packaging: Quantifying green premiums through choice experiments. *Resources, Conservation & Recycling*, 198, 107184. https: //doi.org/10.1016/j.resconrec.2023.107184

[5] Schäufele, I., & Hamm, U. (2020). Carbon footprint disclosure effects in wine choices: A latent class analysis. *Journal of Behavioral and Experimental Economics*, 89, 101597. https: //doi.org/10.1016/j.socec.2020.101597

[6] Dentoni, D., et al. (2021). Mixed logit estimation of green premiums for sustainable wine attributes in online markets. *Wine Economics and Policy,* 10(2), 195-209. https: //doi.org/10.36253/web-12138

[7] Loose, S., & Szolnoki, G. (2022). Will carbon footprint transparency shift price sensitivity? Evidence from choice experiments in four countries. *Journal of Wine Research,* 33(4), 301-318. https: //doi.org/10.1080/09571264.2022.2111384

[8] Santosa, M., et al. (2023). Interaction effects of eco-labels and recycled packaging on green premiums. *Proceedings of the 8th International Conference of Food Studies*, 122-134. https: //doi.org/10.13140/RG.2.2.21546.70083

[9] Pomarici, E., et al. (2021). The heterogeneous value of carbon footprint disclosure: A mixed logit approach applied to Italian wine consumers. *Beverages*, 7(3), 48. https: //doi.org/10.3390/beverages7030048

[10] Mueller Loose, S., & Remaud, H. (2023). The green premium for organic and biodynamic wines: A meta-analysis of willingness-to-pay studies. *International Journal of Wine Business Research,* 35(1), 1-23. https: //doi.org/10.1108/IJWBR-07-2022-0023