Journal of Wine Economics (2025), **20**, 306–328
doi:10.1017/jwe.2025.10094

CAMBRIDGE UNIVERSITY PRESS

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

ARTICLE

Sip or smoke: The link between wine consumption and cannabis use

Sophie Ghvanidze[1], Milan Ščasný[2] and Jon H. Hanf[1]

[1]Institute of Wine and Beverage Business, Hochschule Geisenheim University, Geisenheim, Germany and [2]Institute of Economic Studies, Faculty of Social Sciences & The Environment Center, Charles University, Prague, Czech Republic
Corresponding author: Milan Ščasný, email: milan.scasny@czp.cuni.cz

Abstract
This study examines the relationship between cannabis and wine consumption, investigating whether these substances function as substitutes or complements. Using data from an online survey of 523 German wine consumers, including 215 cannabis users, we analyze consumption across four wine categories: white, red, rosé/sparkling, and sweet wines. To address potential bias from endogeneity, we employ an IV-Ordered Probit model with endogenous covariates—cannabis user/usage. The findings provide evidence of a complementary relationship: cannabis users report significantly higher wine consumption than non-users across most categories, except red wine. The effect is particularly pronounced for rosé/sparkling and sweet wines. More frequent cannabis use also correlates with increased wine consumption. Motivation-specific analyses reveal nuanced dynamics. Using cannabis for relaxation decreases wine consumption, suggesting substitution, while enhancement motives increase rosé/sparkling consumption. Social motives, however, show negative associations with these wines. Overall, results suggest that the nature of the cannabis–wine relationship depends on user motivations.

Keywords: wine; cannabis; consumer behavior; complementarity; marijuana motives measure

JEL classifications: C21; D12; I12

I. Introduction

Over the past seven years, wine consumption in Germany has declined (Davies, 2022). In contrast, cannabis use among young adults has increased notably over the last 15 years, coinciding with ongoing legalization efforts (Logan, 2023). Some proponents of legalization suggest that cannabis could serve as a substitute for alcohol and other substances, potentially resulting in public health benefits and cost savings if cannabis proves less harmful than alcohol (Guttmannova et al., 2016). Conversely, there is also concern that cannabis and alcohol may be used concurrently, which could

© The Author(s), 2025. Published by Cambridge University Press on behalf of American Association of Wine Economists. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (http://creativecommons.org/licenses/by/4.0), which permits unrestricted re-use, distribution and reproduction, provided the original article is properly cited.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

increase overall alcohol consumption and present additional public health challenges (Guttmannova et al., 2016, 2021; Hall, 2017).

The question of whether alcohol and cannabis function as substitutes or complements has been debated in the economics literature for several decades. If the substances are substitutes, restrictions on one may lead to increased use of the other. If they are complements, changes in the availability or use of one are likely to be mirrored in the other (O'Hara et al., 2016). The substitution hypothesis posits that individuals may turn to more accessible substances for purposes such as stress relief (Greeley and Oei, 1999). In contrast, the complementarity hypothesis suggests that both substances may be used together, particularly in social contexts (O'Hara et al., 2016).

To date, there is limited research specifically addressing the relationship between cannabis and wine, and it remains unclear whether these substances act as substitutes or complements. The present study aims to address this gap by examining patterns of use and the motivations underlying these behaviors. The research is guided by the following questions:

- Do cannabis users consume more wine, and if so, which type of wine, compared to cannabis non-users?
- Do people who use cannabis more frequently also consume wine frequently?
- Do people with different motives for using cannabis show different patterns of wine consumption?

Understanding the motivations for substance use may provide additional insight into the mechanisms underlying substitution and complementarity (Guttmannova et al., 2021). While prior studies have primarily focused on college populations or young adults (O'Hara et al., 2016; Stevens et al., 2021, 2022), the current research seeks to extend this work by including a broader demographic sample.

II. Literature background

The relationship between alcohol and cannabis use has been the subject of extensive research, with ongoing debate over whether these substances function primarily as substitutes or complements. Some studies report that alcohol and cannabis use can reinforce each other, while others suggest that cannabis may replace alcohol in certain contexts, potentially reducing alcohol-related harms (Gunn et al., 2022). The effects of policy interventions, such as restricting access to one substance, are also mixed: some research finds that limiting one leads to increased use of the other, while other studies observe a concurrent decline in both (O'Hara et al., 2016; Weinberger et al., 2021).

Legalization of medical cannabis has generally led to increased cannabis use among adults, but its impact on adolescent use remains uncertain (Bae and Kerr, 2020). In contrast, recreational cannabis legalization is more consistently linked to higher cannabis use among adolescents and young adults (Paschall et al., 2021). Age restrictions also shape consumption patterns: Crost and Guerrero (2012) found that reaching the legal drinking age of 21 was associated with increased alcohol use and decreased marijuana use, suggesting that legal access to alcohol may prompt some young adults to substitute alcohol for cannabis.

The evidence for substitution or complementarity is nuanced and often context-dependent. Some studies indicate that liberal cannabis policies are associated with reduced alcohol use among young adults (Subbaraman, 2016), whereas others report increased co-use following legalization (García-Ramírez et al., 2021). Cannabis and alcohol use are positively correlated, especially among adolescents and adults (Guttmannova et al., 2016). Daily cannabis users tend to consume more alcohol (Gunn et al., 2018), and frequent cannabis use is linked to more frequent drinking (Guttmannova et al., 2021). However, longitudinal research suggests that cannabis users may experience a more rapid decline in alcohol consumption over time, pointing toward a substitution effect (Weinberger et al., 2021).

The interplay between alcohol and cannabis use is further shaped by economic and policy factors, such as substance pricing and taxation. Some studies have found that higher taxes on beer and other alcoholic beverages reduce the consumption of both alcohol and cannabis, indicating a complementary relationship in certain populations (Williams et al., 2004; Miller & Seo, 2021). For example, among college students, increased beer taxes were associated with reduced use of both substances (Williams et al., 2004). Conversely, other research reports that the introduction of medical marijuana laws is associated with reduced beer consumption among young adults and fewer alcohol-related traffic fatalities, supporting a substitution effect (Anderson et al., 2013). After recreational cannabis legalization in Washington State, both binge drinking and overall alcohol intake declined while marijuana use increased, again suggesting substitution (Subbaraman, 2016).

Recent evidence underscores the importance of distinguishing between user types. Zhu et al. (2025) demonstrated that, after recreational cannabis legalization in Washington State, recreational cannabis users tended to use alcohol and cannabis together—displaying a complementary pattern—while medical cannabis users showed a substitution pattern, consuming less alcohol on days they used cannabis. This distinction highlights the need to consider user motives and contexts in understanding co-use behaviors, which have significant public health implications for legal cannabis markets.

The physiological and social underpinnings of alcohol and cannabis use also contribute to their complex relationship. Both substances activate similar brain reward pathways, potentially increasing sensitivity to other addictive substances and promoting complementary use (Hall and Lynskey, 2005; O'Hara et al., 2016). Social and psychological motives further influence co-use patterns. Stevens et al. (2021) found that motives related to enhancement, socializing, and responding to offers were linked to adverse outcomes through alcohol use, while coping motives were more strongly associated with cannabis use. Planned simultaneous use of both substances is often driven by social and enhancement motives, whereas unplanned co-use is more likely in response to offers or stress relief (Stevens et al., 2022).

Coping motives are particularly relevant among college students. Those who use alcohol and cannabis to manage negative emotions may be more likely to substitute one substance for the other (O'Hara et al., 2016). Conversely, students who use these substances for social reasons may be more likely to increase use of both (Cooper et al., 1995; O'Hara et al., 2016; Simons et al., 2005).

Overall, the literature highlights a multifaceted and context-dependent relationship between alcohol and cannabis use, shaped by policy, economic factors, user type,

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

and individual motives. Some studies support substitution, others complementarity, and many point to both effects depending on the circumstances (Risso et al., 2020). Brown (2019) notes that the current evidence does not allow for a definitive conclusion regarding the nature of the relationship, highlighting the need for further research, particularly studies that address user type and longitudinal patterns.

III. Materials and methods

a. Research design

Data collection followed the framework of Ghvanidze et al. (2025a, 2025b) and was carried out via an online survey administered by Trend Research. The target population consisted of German wine consumers aged 20–60 who had consumed wine at least once in the past 30 days. Quotas were applied to ensure balanced representation by age and gender, based on demographic benchmarks from Szolnoki's (2019) Wine Consumer Analysis. To align with the study's objectives, the sample was structured to include equal representation of cannabis users, defined as individuals who had used cannabis—medically or recreationally—at least once in the previous 12 months. Of the 1,546 individuals initially surveyed, the final sample included 523 wine drinkers, 215 of whom also reported cannabis use. Sample descriptive statistics are reported in Table A1 in Appendix; the correlation matrix between all covariates and the dependent variables is displayed in Table S1 in the Online Supplementary Material.

To assess motives for wine consumption, a 24-item questionnaire adapted from Cooper's Drinking Motives Questionnaire (1994) was used. For those who also used cannabis, questions from the Marijuana Motives Measure (MMM; Simons et al., 1998) were added. The MMM is a well-established tool in cannabis research (O'Hara et al., 2016; Simons et al., 2005). Participants rated their responses on a scale from 1 (never) to 5 (always).

Cannabis and alcohol use were measured based on consumption frequency and categorized into six levels ranging from several times a week to never. Wine consumption data were collected separately for five types (red, white, rosé, sparkling, and sweet/dessert wines), along with other alcoholic beverages (beer, alcopops, and spirits). For this study, we defined a dummy variable "cannabis_user" set to one if a person had used cannabis at least once in the past year, and zero otherwise. Additionally, we created a categorical variable with five levels ("cannabis_usage") to capture cannabis use frequency, defined as using cannabis several times a week (=4), several times a month (=3), several times a year (=2), once a year or less (=1), and never (=0) as the reference category.

As all survey participants consumed wine at least occasionally, we combined the six wine consumption categories into three levels: frequent drinkers who drank wine at least once a week (=3), occasional drinkers who consumed wine several times a month (=2), and the remaining respondents who seldom consumed wine (=1). This coding was applied to each wine type (with rosé and sparkling wines combined into one category) as well as to *any wine*.[1]

[1]A frequent wine drinker for *any wine* is defined as someone who drank any of the five wines (white, red, rosé, sparkling, and sweet) at least once a week or who drank two of them at least several times a month.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

b. Methodology

A factor analysis with varimax rotation was performed to simplify the variables and uncover the underlying structure of the motivation factors for wine and cannabis use. The reliability of these constructs was then evaluated using Cronbach's α.

The relationship between ordinal wine consumption (with 3 levels) and cannabis use is analyzed by the Ordered Probit (OP) model,[2] in which an underlying score is estimated as a linear function of the independent variables and a set of cut points, κ's. The probability that individual i will select outcome j corresponds to the probability that the estimated linear function plus random error is within the range of the cut points estimated for the outcome:

Outcome equation:

$$P\left(Y_i = j\right) = Pr\left(k_{j-1} < \left(\boldsymbol{x_i'\beta_1} + \beta_2\, Cannabis_i + e.y_i\right) \leq_{kj}\right) \tag{1}$$

First-stage equations:

$$P\left(Cannabis_i = n\right) = Pr\left(\vartheta_{n-1} < \left(\boldsymbol{x_i'\gamma_1} + z_i'\gamma_2 + e.c_i\right) \leq \vartheta_n\right) \tag{2a}$$

$$P\left(Cannabis_i = 1\right) = \emptyset\left(\alpha_0 + \boldsymbol{x_i'\alpha_1} + z_i'\alpha_2 + e.c_i\right) \tag{2b}$$

where $e.y_i$ is the unobserved error that is assumed to be standard normal. The coefficients β's are estimated together with the cut points $k_1, k_2, \ldots, k_{J-1}$, where J is the number of possible outcomes, $J = 3$ in our case. The term $\boldsymbol{x}$ is a vector of explanatory variables that explain wine consumption, as *cannabis* does, and β_2 is the key coefficient of our interest.

To meaningfully estimate a model, covariates must be exogenous. This assumption is violated if omitted confounders are correlated with x_i' or cannabis use, if reverse causation is present, if x_i' or cannabis use are measured with error, or if they are correlated with the error term in the outcome equation. In our case, none of these conditions can be ruled out. To address this, we employ an IV-OP model with endogenous covariates,[3] treating cannabis use as endogenous. In the first stage, cannabis use is regressed on a set of exogenous and instrumental variables.

We examine the relationship between wine consumption (the dependent variable) in two different ways. First, we regress wine use frequency on cannabis user status

[2]The working version of our paper relied on estimating the Partial Proportional Odds model – Generalised Ordered Logit, which relaxes the strict assumptions of ordered data modelling on parallel lines. This model is also more parsimonious and interpretable than non-ordinal methods such as the multinomial logistic model (Williams, 2016), which comes at the cost of less straightforward interpretation of its results. We found that the parallel lines assumption was violated in a very limited number of cases, even for quite complex model specifications. Due to likely endogenous covariates, we prefer to estimate the extended Ordered Probit with an endogenous key covariate, which is cannabis use. We are grateful to one of the referees for noting this problem.

[3]Using the instrumental variables can solve the four problems related to endogeneity of covariates. To reverse causation works with linear models if all exogenous variables predicting y in eq. (1) are also used among the instruments in the first-stage, in eq. (2). However, there is no solving the reverse-causation problem for endogenous Ordered Probit model (see StataCorp, 2025).

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

(binary). Since the endogenous variable *cannabis_user* is binary, we estimate a Probit model (eq. 2a) using age cohorts (Generation Z, Millennials) and gender (female) as instruments, zs. Since other studies find these controls correlate with cannabis use (Ghvanidze et al., 2024, 2025b), while they are not correlated with wine consumption (see Table S3, Online Supplementary Material), we consider them valid instruments in this model.

Second, we regress the frequency of wine consumption on cannabis use, measured in five ordered categories, with non-use as the reference group. Because the endogenous variable *cannabis_usage* is ordinal, we estimate an OP model in the first stage (eq. 2b). Differences in cannabis use among users allow us to draw on respondents' assessments of cannabis's healthiness and taste. These variables are correlated with cannabis use (see Table S3 in the Online Supplementary Material), apply only to cannabis users, and are unlikely to have a direct effect on wine consumption. We therefore use two binary instruments: *C_healthy* (equal to one if the respondent believes cannabis is healthy) and *C_taste* (equal to one if the respondent likes the taste of cannabis).

In both specifications of the first-stage model, the unobserved error term $e.c_i$ is assumed to follow a standard normal distribution. The presence of endogenous covariates is reflected in a nonzero correlation between the error terms of the outcome equation (eq. 1) and the first-stage equations (eq. 2a or eq. 2b). Formally, this is expressed as $\rho = corr\,(e.y_i, e.c_i)$.

IV. Results

a. Sample description

The sample of wine drinkers includes slightly more females (54.3%) than males. It represented young adults aged 20–60, with a mean age of 38.3 years; 17% belong to Generation Z (younger than 27), 45% and 32% are members of Generation M (27–41 years old), and Generation X (42–56 years old). More than half had vocational or upper secondary education (54.5%) and were employed (83%). About 9% did not provide information about their income, 2% did not have any income, and the median is €39,000 per year; see details in Table A1 in the Appendix.

Cannabis was used at least once in the last year by 41% of respondents. About 11% were using cannabis at least once a week, 14% several times a month, 7% several times a year, and 9% used cannabis once a year or less often. From those who used cannabis at least once, 52% believe it is healthy for them and 39% like its taste.

About 47% drank wine frequently (at least once a week), 16% occasionally (several times a month), and 37% seldom (several times a year and less often). Among wine types, there are 15%, 16%, 12%, and 5% of frequent drinkers of white, red, rosé & sparkling, and sweet wine, respectively. These wines were drunk seldom by 57%, 59%, 62%, and 82%, respectively (see Figure A1 in the Appendix).

b. Factor analysis

Following the MMM scales by Simons et al. (1998), we tested five- and four-factor models to explore the motives behind cannabis use (see the details in the Appendix), resulting in the following four factors: socializing & expansion, enhancement, coping

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 1. Percentage of wine and cannabis users by their frequency of use, $N = 523$

	Wine consumption				
Cannabis use	*Less often*	*x/year*	*x/month*	*x/week*	*Total*
Never	4.4%	19.3%	9.6%	25.6%	58.9%
Less often	0.4%	3.8%	1.3%	5.0%	10.5%
x/year	0.8%	3.1%	4.0%	6.5%	14.3%
x/month	0.0%	1.9%	0.6%	4.8%	7.3%
x/week	0.6%	2.3%	1.0%	5.2%	9.0%
Total	6.1%	30.4%	16.4%	47.0%	100.0%

& creativity, and conformity. The differences from previous studies are likely due to variations in sample composition and high correlations between social and expansion, and between coping and expansion items (Simons et al., 1998).

The high Cronbach's alphas for the cannabis use motives demonstrate solid internal consistency across all factors (Table S1 in the Online Supplementary Material). The Kaiser–Meyer–Olkin measure of 0.94, coupled with a significant Bartlett's sphericity test, validates the soundness of the factor structures. This culminates in a four-factor solution for cannabis, with all factor loadings above 0.5, indicating robust correlations. The factor loadings and internal consistency (α) range from 0.86 to 0.94, ensuring dependable composite measures. The factors account for 71.22% of the variance, underlining the substantial distinctions among the factors (Table A2).

In summary, enhancement is the top motive for cannabis use ($\overline{x} = 3.52$). Cannabis is also used for coping & creativity ($\overline{x} = 2.85$) and socializing & expansion ($\overline{x} = 2.73$). Conformity is not a significant factor (Table A2).

c. Estimation results

i. How often are cannabis and wine consumed?

In our analysis, we examined how often cannabis and wine are consumed. Table 1 shows the percentage of respondents for each combination of cannabis and wine usage. The only visible trend is an increasing percentage of more frequent wine drinkers among cannabis users, while there is no such tendency among cannabis non-users (i.e., looking at rows). The largest segment comprises frequent wine drinkers who do not use cannabis, accounting for 26% of the sample. Interestingly, about 12% of respondents used both cannabis and wine at least several times a month, and 5% consumed them several times a week. However, there is no clear trend between the frequency of wine and cannabis consumption among cannabis users.

ii. Do cannabis users drink more wine?

Yes, they do, but it matters which type of wine. First, we explored the relationship between wine (regardless of wine type) and cannabis by correlation tests. The polychoric correlation coefficients are 0.100 for cannabis users and 0.149 for the entire sample, indicating a weak positive correlation between cannabis use and wine use. Kendall's τ-b is 0.086 and 0.099, respectively, further supporting the weak positive

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

correlation.[4] However, the independence of the consumption of these two products is rejected for the entire sample ($N = 523$, $P = 0.009$), suggesting a relationship between the two products. However, this cannot be confirmed for cannabis users only ($N = 215$, $P = 0.148$). These preliminary findings indicate a complementarity, which we will further investigate.

Subsequently, we estimate OP with an endogenous covariate ("cannabis_user") to examine whether cannabis users consumed more wine, regardless of how often cannabis was used (see Table 2). We use age cohorts (Generation Z, Millennials) and gender (female) as the instruments in the first-stage (cannabis user) model; in fact, we confirm that age cohorts and gender are not correlated with wine consumption in the OP model (see Table S3 in the Online Supplementary Material). The estimated correlation between the errors from the wine consumption OP and the errors from the cannabis user Probit model is significant for red wines ($\rho = 0.375$, $P = 0.073$) and sweet wines ($\rho = -0.808$, $P = 0.000$), indicating cannabis usage and wine consumption are endogenous at least for these two types of wine.

In the second stage, cannabis use is not correlated with the frequency of red wine consumption, while it is positively correlated with sweet wine consumption. Compared to cannabis non-users, the positive coefficient for "cannabis_user" (1.562) implies the probability (marginal effect) of 32% and 17% to drink sweet wine frequently, and occasionally, respectively. We find a similar pattern for rosé and sparkling wines—the probability of cannabis users to drink these wines frequently (occasionally) is 17% (12%). This result is also confirmed by the OP model, although yielding smaller marginal effects (7% and 6%). Cannabis users also consume more white wines; however, the message differs between the two models. Controlling for endogeneity results in a higher probability of drinking white wine occasionally (9.3%), while the positive marginal effect (15.4%) is not significant at any conventional level for drinking white wine frequently. We find a much stronger association in the OP model without controlling for endogeneity, with implied probabilities of 5.6% and 7.8%. Since endogeneity of "cannabis_user" is rejected in the OP model with an endogenous covariate for white wine, we tend to support the positive correlation between cannabis users and white wines, although it is weaker than in the case of rosé and sparkling and sweet and dessert wines.

Controlling for endogeneity, we find no association between cannabis users and the consumption frequency of any type of wine. The insignificant correlation between the error terms provides no evidence of endogeneity for any wine type. When relying on the OP model under the assumption of no endogeneity, we find a positive association between any type of wine and cannabis users: cannabis users have a 9.8% higher probability of drinking wine frequently compared to non-users (see Table 2, first column).

iii. Do people who used cannabis more frequently also consume wine frequently?

Our instruments (*C_healthy* = 1 if they believe cannabis is healthy, *C_taste* = 1 if they like the taste of cannabis) work very well in all specifications and for all wine

[4] $|\tau b| = 0.07$ indicates a weak association, $|\tau b| = 0.21$ indicates a medium association, and $|\tau b| = 0.35$ indicates a strong association (https://www.spss-tutorials.com/kendalls-tau/).

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 2. IV-Ordered Probit estimates of wine consumption and cannabis use

	All wines	All wines		White		Red		Rosé & sparkling		Sweet & dessert	
	Ordered Probit	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
Cannabis user	0.248**	0.255		0.647*		−0.429		0.785**		1.562***	
	(0.110)	(0.363)		(0.367)		(0.328)		(0.347)		(0.162)	
Income	0.007***	0.008***	−0.002	0.008***	−0.002	0.006***	−0.0015	0.008***	−0.002	0.003	−0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.0025)	(0.002)	(0.003)	(0.002)	(0.003)
Income missing	0.176	0.197	−0.399*	0.414*	−0.404*	0.072	−0.4020*	0.280	−0.411*	0.176	−0.397*
	(0.205)	(0.212)	(0.233)	(0.212)	(0.233)	(0.218)	(0.2316)	(0.220)	(0.233)	(0.239)	(0.226)
Generation Z	−0.128		0.860***		0.873***		0.8713***		0.836***		0.808***
	(0.158)		(0.171)		(0.168)		(0.1669)		(0.172)		(0.153)
Millennials	0.051		0.651***		0.667***		0.6775***		0.688***		0.688***
	(0.116)		(0.129)		(0.128)		(0.1242)		(0.127)		(0.116)
Female	−0.025		−0.395***		−0.361***		−0.3535***		−0.367***		−0.433***
	(0.108)		(0.118)		(0.128)		(0.1205)		(0.120)		(0.104)
Constant			−0.411**		−0.440***		−0.4449***		−0.435***		−0.377**
			(0.161)		(0.164)		(0.1585)		(0.160)		(0.152)
\cut 1	0.015	0.057		0.788		0.267		0.939		1.518	
	(0.153)	(0.196)		(0.192)		(0.201)		(0.178)		(0.133)	
\cut 2	0.445***	0.485		1.681		1.017		1.808		2.088	
	(0.154)	(0.196)		(0.181)		(0.236)		(0.165)		(0.146)	

(*Continued*)

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 2. (*Continued.*)

	All wines	All wines		White		Red		Rosé & sparkling		Sweet & dessert	
	Ordered Probit	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
Corr (e.cannabis, e.wine)	NA	−0.007		−0.192		0.375*		−0.285		−0.808***	
		(0.232)		(0.241)		(0.209)		(0.229)		(0.083)	
Marginal effect											
Wine = 1 (infrequent)	−0.092**	−0.093		−0.247*		0.163		−0.293**		−0.481***	
	(0.040)	(0.131)		(0.136)		(0.106)		(0.126)		(0.056)	
Wine = 2 (occasionally)	−0.007*	−0.006		0.093**		−0.059		0.122***		0.166***	
	(0.004)	(0.010)		(0.042)		(0.042)		(0.039)		(0.023)	
Wine = 3 (frequent)	0.098**	0.010		0.154		−0.104		0.171*		0.316***	
	(0.044)	(0.141)		(0.096)		(0.081)		(0.089)		(0.063)	
LL	−523.642	−853.008		−818.121		−821.765		−789.123		−618.725	
AIC	1063.284	1730.016		1660.242		1667.530		1602.245		1261.450	
BIC	1097.361	1781.131		1711.357		1718.645		1653.360		1312.565	

Note: The dependent variable is wine consumption, where 3 = frequent, 2 = occasional, 1 = infrequent (seldom, rarely, or none). Covariate *cannabis_user* is a binary measure that equals one if the respondent used cannabis less than once a year or more often, zero otherwise. Significance *** < 1%, ** < 5%, * < 10%, standard errors are in the parentheses. No. obs. = 523.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

types; believing cannabis is healthy or tasty increases the likelihood of using cannabis more frequently. Being younger and less educated also increase the likelihood of using cannabis more (see the first-stage estimates in Model 2, 3a, 3b). Using cannabis for coping and relaxation decreases the frequency of its usage (see Model 3a and 3b).

We also find that cannabis usage and wine consumption, both measured on an ordinal scale, are endogenous, which is confirmed by significant correlations between the errors from wine consumption (OP) and the errors from cannabis use (OP), except for red wine ($\rho = -0.128$, $P = 0.141$) (see Table 3). These correlations also support estimating the OP model with the endogenous *cannabis_usage* covariate. In all cases, the correlation *ρ (cannabis_usage, Wine)* is positive, indicating that unobserved factors that increase the probability of consuming wine tend to also decrease the probability of using cannabis.

Age cohorts and gender are significantly correlated with *cann_user*, and perceptions of cannabis's healthiness and taste are strongly correlated with *CANNuser* (Table S1), satisfying the relevance condition. Our choice of instruments is guided by both statistical relevance and theoretical considerations. Age cohorts and gender are established predictors of cannabis use (Cuttler et al., 2016; Hamilton et al., 2019), yet once other socio-demographic factors are controlled for, there is no clear mechanism through which they would directly influence wine consumption. Perceptions of cannabis's healthiness and taste are also strong predictors of cannabis use, but these perceptions are product-specific and shaped by personal experience, cultural factors, and knowledge of cannabis, which are distinct from how individuals evaluate wine. Although consumers sometimes describe cannabis in ways that parallel the complexity of wine, such evaluations do not imply equivalence in judgments about the two products. Hence, these instruments are unlikely to be correlated with wine consumption except through their effect on cannabis use, supporting their validity.

The answer to our key question, *"Do people who use cannabis more frequently also consume wine frequently?"* is yes, they do. This is confirmed by positive and significant coefficients for the ordinal variable *cannabis_usage*, whose magnitude increases with increasing frequency of cannabis use (see Table 3). Moreover, since all coefficients for *cannabis_usage* are positive, we also conclude that not using cannabis (the reference category) is associated with a lower frequency of wine usage—a fact we have already observed in the OP model with an endogenous binary covariate. Marginal effects from Model 2 on the likelihood to consume wine frequently are 18% (*cannabis_usage* = 1), 26% (*cannabis_usage* = 2), 42% (*cannabis_usage* = 3), and 41% (*cannabis_usage* = 4). This can be transformed into predictive probabilities. The share of frequent wine drinkers is significantly increasing with the frequency of cannabis use (see Figure 1).

The negative and significant coefficient for the interaction between *cannabis_usage* and *Copying* (−0.2165) in Model 3b (Table 3) indicates that more frequent cannabis use for relaxation is associated with lower wine consumption frequency. Other motives for cannabis use, as mediated through cannabis use, show no effect on wine consumption, which may partly reflect the small sample size.

Among the socio-demographic variables, income is positively associated with increased wine consumption, while higher secondary education is negatively correlated with it. Neither age, gender (female), nor employment status correlates with wine

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 3. IV-Ordered Probit estimates of wine consumption with endogenous cannabis use

	Model 1		Model 2		Model 3a		Model 3b	
	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)
cannabis_usage = 1	0.212		0.481**		0.482*		0.401	
	(0.181)		(0.233)		(0.249)		(0.260)	
cannabis_usage = 2	0.351**		0.691***		0.658***		0.674***	
	(0.159)		(0.223)		(0.238)		(0.255)	
cannabis_usage = 3	0.714***		1.168***		1.121***		0.788**	
	(0.225)		(0.296)		(0.309)		(0.389)	
cannabis_usage = 4	0.654***		1.144***		1.062***		1.222***	
	(0.231)		(0.323)		(0.346)		(0.470)	
Income			0.007***		0.007***		0.007***	
			(0.002)		(0.002)		(0.002)	
Income missing			0.195		0.190		0.205	
			(0.203)		(0.204)		(0.208)	
Female			0.011	−0.134	0.008	−0.141	0.025	−0.141
			(0.108)	(0.120)	(0.108)	(0.120)	(0.111)	(0.120)
Education 1			−0.365	1.552***	−0.327	1.537***	−0.182	1.537***
			(0.341)	(0.288)	(0.350)	(0.289)	(0.381)	(0.289)
Education 2			−0.528**	1.304***	−0.500**	1.285***	−0.369	1.285***
			(0.213)	(0.148)	(0.225)	(0.148)	(0.262)	(0.148)

(*Continued*)

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 3. (*Continued.*)

	Model 1		Model 2		Model 3a		Model 3b	
	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)
Age			0.005		0.005		0.007	
			(0.005)		(0.005)		(0.005)	
Generation Z		1.213***		1.293***		1.312***		1.311***
		(0.337)		(0.399)		(0.398)		(0.398)
Millennials		0.886***		1.149***		1.141***		1.134***
		(0.325)		(0.388)		(0.388)		(0.387)
Generation X		0.637*		0.807**		0.803**		0.790**
		(0.332)		(0.393)		(0.393)		(0.392)
Retired			−0.415		−0.406		−0.339	
			(0.345)		(0.346)		(0.351)	
C_Mot_Social						0.095	−0.004	0.097
						(0.077)	(0.036)	(0.079)
C_Mot_Enhance						−0.093	0.068*	−0.116
						(0.076)	(0.041)	(0.077)
C_Mot_Confirm						0.006	−0.217***	0.091
						(0.088)	(0.041)	(0.081)
C_Mot_Coping						−0.196**	0.019	−0.207***
						(0.078)	(0.045)	(0.079)
Cannabis_taste		1.530***		1.135***		1.097***		1.116***
		(0.144)		(0.150)		(0.160)		(0.161)

(*Continued*)

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Table 3. (*Continued.*)

	Model 1		Model 2		Model 3a		Model 3b	
	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)	Second-stage (wine use)	First-stage (cannabis use)
Cannabis_healthy		1.273***		1.174***		1.180***		1.194***
		(0.158)		(0.159)		(0.174)		(0.175)
\cut 1	−0.166	1.523	0.306	1.934	0.287	1.897	0.372	1.887
	(0.078)	(0.316)	(0.239)	(0.385)	(0.243)	(0.384)	(0.248)	(0.383)
\cut 2	0.254	2.012	0.731	2.547	0.713	2.518	0.827	2.511
	(0.076)	(0.321)	(0.238)	(0.391)	(0.242)	(0.391)	(0.247)	(0.390)
\cut 3		2.863		3.506		3.530		3.520
		(0.332)		(0.404)		(0.4051)		(0.404)
\cut 4		3.431		4.084		4.139		4.128
		(0.339)		(0.410)		(0.412)		(0.411)
ρ(e.1,e.2)	−0.219***		−0.304***		−0.273**		−0.215*	
	(0.084)		(0.010)		(0.113)		(0.123)	
LL	−1005.533		−948.432		−943.503		−921.137	
AIC	2043.067		1948.864		1947.007		1910.273	
BIC	2111.220		2059.61		2074.794		2055.099	

Note: The dependent variable is wine consumption, described by three levels: frequent (=3), occasional (=2), and seldom, rarely, or none (=1). Cannabis_usage describes use of cannabis several times a week (=4), several times a month (=3), several times a year (=2), and once a year and less (=1); the reference category (=0) is no use of cannabis. The term ρ (e.1, e.2) is the correlation between the errors from wine consumption and the errors from cannabis use, and it indicates endogeneity between cannabis usage and wine consumption. Motivations to use cannabis (*C_Mot_Social, C_Mot_Enhance, C_Mot_Confirm, C_Mot_Coping*) are interacted with Cannabis_usage in the second stage in Model 3b, while they enter directly in the first stage in Model 3a and 3b. Significance *** $<$ 1%, ** $<$ 5%, * $<$ 10%, standard errors are in the parentheses. No. obs. = 523 in all models.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

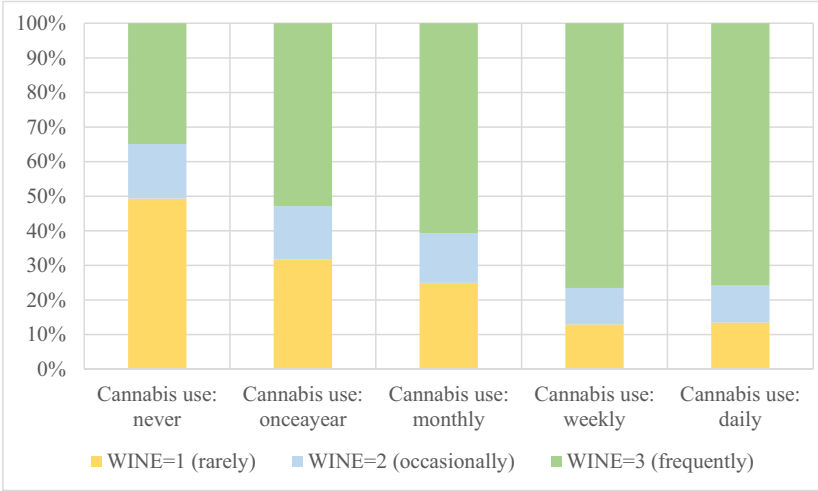


Figure 1. Predictive probability to consume (any type) wine by frequency of cannabis usage, based on Model 2 in Table 3, N = 523.

consumption. In contrast, when explaining cannabis use, most of these associations go in the opposite direction: both age (or age cohorts) and education are strong negative predictors of cannabis use. By contrast, income and employment status are not correlated with cannabis use (results available upon request).

Our findings for any wine hold qualitatively for all four wine types, see Tables S2-1 to S2-4 in the Online Supplementary Material. At first, using more cannabis is correlated with consuming white, red, rosé and sparkling, and sweet and dessert wines; see the marginal effect (probability) on frequent wine consumption. As shown in Figure 2, the probability of consuming wine frequently increases with the frequency of cannabis use. We also confirm endogeneity of cannabis use and wine consumption for each of the four wine types, indicated by a negative and strongly significant correlation between the two errors.

Second, covariates in the first stage (OP on cannabis use) have the same direction and similar significance. Similarly, this is true for most of the covariates in the second-stage model (OP on wine consumption). However, there are still some differences; income does not correlate with consumption of sweet wines, while females drink less sweet wine (and this is not significant for all other wines). Lower education is strongly and negatively correlated with consuming more rosé and sparkling, and sweet wines, while it does not correlate with consuming more white and red wines. Older people drink more red wines and less sweet wines, while pensioners drink less rosé and sparkling. Third, using cannabis to cope and relax decreases the frequency of cannabis use. Using more cannabis for relaxation also reduces consumption of each of the four wine types. Interestingly enough, using more cannabis to enhance mood is associated positively with consumption of rosé and sparkling wine, while using more cannabis for socializing with friends acts opposite, see Table S2–4 in the Online Supplementary Material.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

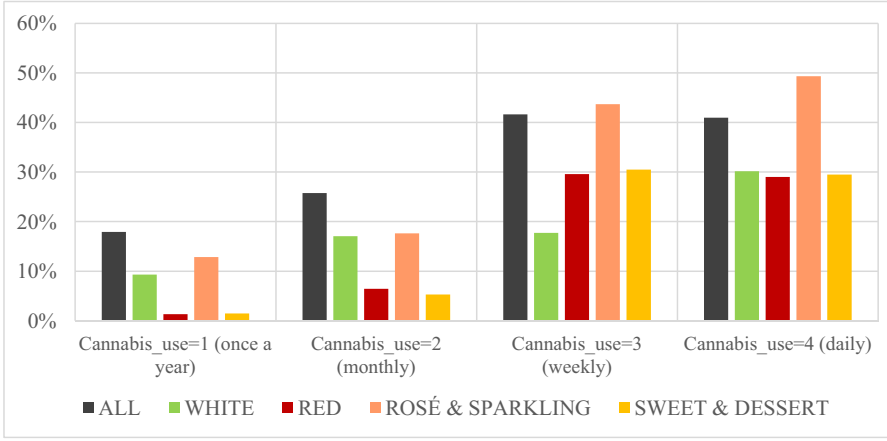


Figure 2. Marginal effects on frequent wine consumption, by wine types and cannabis use frequency, $N = 523$.

iv. Are motives to consume cannabis and wine correlated?

We further explored the correlation between wine and cannabis use across four different motivations for each product (detailed results are available upon request from the authors). Our analysis reveals that wine and cannabis usage tend to increase together for certain motivations. Specifically, when individuals consume wine to socialize (Kendall's τ-b = 0.14, $\rho = 0.21$), or to enhance their mood (Kendall's τ-b = 0.099, $\rho = 0.14$), as well as when they use cannabis to improve their mood (Kendall's τ-b = 0.16, $\rho = 0.27$), there is a positive correlation between consumption of the two products. The opposite is true when drinking wine is motivated by conformity (Kendall's $\tau = -0.03$, $\rho = -0.05$), although this association is not significant ($P = 0.017$, $P = 0.085$, and $P = 0.07$, respectively).

V. Discussion and conclusion

Understanding the relationship between alcohol and cannabis use is vital for developing effective strategies to manage substance use (O'Hara et al., 2016). This study takes an innovative approach by examining whether cannabis and wine act as substitutes or complements to one another. The motivations and patterns behind the consumption of these substances can differ significantly. Initially, the research delved into the motives for consuming wine and cannabis. It also investigated the potential substitution or complementarity between the two by analyzing the correlation between their consumption frequencies. In our study, a complementary relationship would mean that frequent use of one substance is associated with higher use of the other, while a substitution relationship would indicate that higher use of one is associated with lower consumption of the other.

Our factor analysis indicates that the main motivation for using cannabis is enhancement. Cannabis is also frequently associated with coping and boosting creativity. These findings align with previous research, which suggests that cannabis is

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

commonly used to amplify positive experiences, foster social connections, and enhance overall enjoyment, mood, and well-being (Fleming et al., 2022).

The findings from the correlation tests and OP models indicate a complementary relationship between wine and cannabis. This pattern suggests that more frequent cannabis use is associated with more frequent wine consumption, indicating a complementary relationship specifically among cannabis users. Moreover, we find that individuals identified as cannabis users tend to consume wine more frequently, regardless of how often they use cannabis.

However, it is crucial to remember that this relationship is correlational and does not establish a causal link between the two behaviors. This finding is consistent with previous research showing that frequent recreational cannabis users tend to drink more alcohol overall (Gunn et al., 2018) and that higher cannabis use correlates with increased alcohol intake on days when cannabis is used (Gunn et al., 2019). Such users may face greater risks related to the combined use of these substances (Gunn et al., 2019) or might experience enhanced dopaminergic effects from using both together (Hall and Lynskey, 2005).

Our analysis confirms that wine consumption and cannabis use are endogenous behaviors, implying that unobserved factors influencing one are likely to influence the other. Since the estimated correlations are mostly negative, our data suggest that these unobserved factors tend to drive wine and cannabis consumption in opposite directions.

In fact, we identify opposite associations (or correlations with only one product) for several observed socio-demographic covariates in our study, such as education, income, and age. We also find that taste preferences and perceived healthiness regarding cannabis, together with age and education, serve as very good instruments. Future research should explore which omitted factors, not captured in our survey, may contribute to more accurate modelling of this relationship.

An interesting finding is that the complementary relationship observed between cannabis user and almost all types of wine does not extend to red wine. This could be due to two main reasons: Firstly, red wine is often enjoyed with heavy meals in traditional, familiar settings, either at home or outside. Consumers who favor this type of food and setting might be less inclined to use cannabis. Moreover, red wines are generally more expensive. Secondly, drinking red wine is sometimes seen as a coping mechanism or a way to relax. If this need is already met through cannabis use, there may be less desire to drink red wine for the same purpose (O'Hara et al., 2016; Stone and Kennedy-Moore, 1992). However, this relationship is not apparent when cannabis use is considered as a binary choice; the complementary relationship emerges only when analyzing the frequency of both cannabis and red wine use.

Additionally, our findings reveal that increased consumption of rosé and sparkling, and red wines is associated with more frequent cannabis use when cannabis is used for mood enhancement. This is consistent with research by Fleming et al. (2022), Hamilton et al. (2019), O'Hara et al. (2016), and Stevens et al. (2021), which suggests that individuals who use alcohol for enhancement purposes tend to consume both substances more frequently and concurrently. Moreover, drinking rosé, sparkling, and white wines is often linked to socializing in pleasant and relaxed environments.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Furthermore, the results indicate a substitution relationship, as wines are consumed less frequently, whereas cannabis is used more frequently for conformity, to fit in with a group. Although this finding holds for all wines, the negative association is stronger for rosé & sparkling, and sweet wines. This aligns with the findings of O'Hara et al. (2016), which suggest that when both alcohol and cannabis are used to fit in with a group and to cope with stress, higher alcohol consumption reduces the likelihood of cannabis use. Moreover, cannabis and sweet wines are substitutes when cannabis is used for socializing.

Our study's findings are also consistent with previous research, which suggests that alcohol consumption is frequently associated with social activities, whereas cannabis use is often related to coping with stress, anxiety, and negative emotions, as well as managing social isolation (Fleming et al., 2022; O'Hara et al., 2016).

Alcohol and cannabis use share physiological and social factors that reinforce their complementary nature (Hall and Lynskey, 2005). Research on animals suggests these substances activate similar brain reward pathways, which may increase sensitivity to other addictive substances and promote complementary use (O'Hara et al., 2016).

The findings of this study underscore the complexities involved in addressing substance use among wine consumers. Although infrequent cannabis use poses less risk than frequent use, the complementary use of wine and cannabis significantly increases the chances of accidents, alcohol-related consequences, and health problems (Lee et al., 2022). Policies or interventions designed to curb alcohol and cannabis use may have varying effects on different groups of consumers. Notably, reducing cannabis use among frequent users could decrease the concurrent use of both substances; the same could be the case for heavy wine drinkers. Therefore, strategies to reduce complementary use should focus on frequent users of cannabis and frequent wine drinkers.

VI. Limitations and future research

This study underscores the need for further research in determining whether wine and cannabis function as substitutes or complements. The lack of detailed data on consumption patterns, including timing and quantity, necessitates further investigation to clarify the circumstances under which (and for whom) these substances may act as substitutes or complements. For example, individuals might use them alternately or together depending on context and motivation. Investigating these relationships in various social settings is not just important but essential for a comprehensive understanding (Weinberger et al., 2021).

The results of this study may be influenced by self-selection, as participants voluntarily opted into the online survey. To improve the reliability and generalizability of future research, it is recommended that participants be recruited using randomized sampling drawn from the broader population of wine consumers. This approach would help reduce potential biases associated with self-selection. It is also important to note that our sample includes only individuals who reported wine consumption within the past 30 days. As such, the findings pertain exclusively to active wine consumers. The study cannot therefore speak to whether cannabis use influences the binary decision to consume wine at all.

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

With Germany on the verge of major regulatory changes related to cannabis legalization, future research should include longitudinal studies to track changes in consumption patterns, motivations, and the interaction between wine and cannabis, whether as substitutes or complements. Investigating shifts in attitudes and perceived benefits of cannabis and wine post-legalization may shed light on behavioral changes and associated health impacts. These insights could help shape public health strategies aimed at minimizing harm in a post-legalization context (Turna et al., 2022).

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/jwe.2025.10094.

Acknowledgements. We thank the reviewers for their valuable feedback, which has helped to strengthen this manuscript. Open Access funding enabled and organized by Projekt DEAL and institutional open access agreement between Charles University and Cambridge.

Funding statement. This study was funded by the Internal Research Grant of Geisenheim University and by Technology Agency of the Czech Republic under grant no. TL03000329.

References

Anderson, D. M., Hansen, B., and Rees, D. I. (2013). Medical marijuana laws, traffic fatalities, and alcohol consumption. *The Journal of Law and Economics*, 56(2), 333–369. https://doi.org/10.1086/668812

Bae, H., and Kerr, D. C. R. (2020). Marijuana use trends among college students in states with and without legalization of recreational use: Initial and longer-term changes from 2008 to 2018. *Addiction*, 115(6), 1115–1124. https://doi.org/10.1111/add.14939

Brown, N. A. (2019). Alcohol and marijuana: Substitutes or complements and a deeper evaluation of marijuana prohibition. *Honors Program Theses*. 403, University of Northern Iowa. UNI ScholarWorks. https://scholarworks.uni.edu/hpt/403

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, 6(2), 117–128. https://doi.org/10.1037/1040-3590.6.2.117

Cooper, M. L., Frone, M. R., Russell, M., and Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, 69, 990–1005. https://doi.org/10.1037/0022-3514.69.5.990

Crost, B., and Guerrero, S. (2012). The effect of alcohol availability on marijuana use: Evidence from the minimum legal drinking age. *Journal of Health Economics*, 31(1), 112–121. https://doi.org/10.1016/j.jhealeco.2011.12.005

Cuttler, C., Mischley, L. K., and Sexton, M. (2016). Sex differences in Cannabis use and effects: A cross-sectional survey of Cannabis users. *Cannabis and Cannabinoid Research*, 1(1), 166–175. https://doi.org/10.1089/can.2016.0010

Davies, K. (2022). Cannabis use among young adults in Germany from 1993 to 2021, by gender. Statista GmbH. Retrieved from: https://www.statista.com/statistics/1334488/cannabis-use-young-adults-germany/, accessed on January 15, 2024.

Fleming, C. B., Graupensperger, S., Calhoun, B. H., and Lee, C. M. (2022). Alcohol use motives and cannabis use among young adults: Between- and within-person associations based on monthly data from a community sample. *Substance Use & Misuse*, 57(11), 1673–1680. https://doi.org/10.1080/10826084.2022.2107672

García-Ramírez, G., Paschall, M. J., and Grube, J. W. (2021). Retail availability of recreational marijuana and alcohol in Oregon counties and co-use of alcohol and marijuana and related beliefs among adolescents. *Substance Use & Misuse*, 56(3), 345–352. https://doi.org/10.1080/10826084.2020.1858104

Ghvanidze, S., Kang, S. K., Ščasný, M., and Hanf, J. (2025b). Profiling cannabis consumption motivation and situations as casual leisure: Evidence from German consumers. *World Leisure Journal*, 1–22. https://doi.org/10.1080/16078055.2025.2540336

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Ghvanidze, S., Lucas, B. F., Brunner, T. A., and Hanf, J. H. (2025a). Unveiling wine and cannabis consumption motivations: A segmentation study of wine consumers in Germany. *International Journal of Wine Business Research*, 37(3), 354–374. https://doi.org/10.1108/ijwbr-07-2024-0036

Greeley, J., and Oei, T. (1999). Alcohol and tension reduction. In: Leonard KE, Blane HT (eds.), *Psychological Theories of Drinking and Alcoholism* (2nd ed., 14–53). Guilford Press.

Gunn, R., Jackson, K., Borsari, B., and Metrik, J. (2019). A longitudinal examination of daily patterns of cannabis and alcohol co-use among medicinal and recreational veteran cannabis users. *Drug and Alcohol Dependence*, 205, 107661. https://doi.org/10.1016/j.drugalcdep.2019.107661

Gunn, R. L., Aston, E. R., and Metrik, J. (2022). Patterns of cannabis and alcohol co-use: Substitution versus complementary effects. *Alcohol Research: Current Reviews*, 42, 04. doi:10.35946/arcr.v42.1.04

Gunn, R. L., Norris, A. L., Sokolovsky, A., Micalizzi, L., Merrill, J. E., and Barnett, N. P. (2018). Marijuana use is associated with alcohol use and consequences across the first 2 years of college. *Psychology of Addictive Behaviors*, 32(8), 885–894. https://doi.org/10.1037/adb0000416

Guttmannova, K., Fleming, C. B., Rhew, I. C., Abdallah, D. A., Patrick, M. E., Duckworth, J. C., and Lee, C. M. (2021). Dual trajectories of cannabis and alcohol use among young adults in a state with legal nonmedical cannabis. *Alcohol Clinical and Experimental Research*, 45(7), 1458–1467. https://doi.org/10.1111/acer.14629

Guttmannova, K., Lee, C. M., Kilmer, J. R., Fleming, C. B., Rhew, I. C., Kosterman, R., Larimer, ME. (2016). Impacts of changing marijuana policies on alcohol use in the United States. *Alcoholism: Clinical and Experimental Research*, 40(1), 33–46. https://doi.org/10.1111/acer.12942

Hall, W. (2017). Alcohol and cannabis: Comparing their adverse health effects and regulatory regimes. *International Journal of Drug Policy*, 42, 57–62. https://doi.org/10.1016/j.drugpo.2016.10.021

Hall, W. D., and Lynskey, M. (2005). Is cannabis a gateway drug? Testing hypotheses about the relationship between cannabis use and the use of other illicit drugs. *Drug and Alcohol Review*, 24, 39–48. https://doi.org/10.1080/09595230500126698

Hamilton, A. D., Jang, J. B., Patrick, M. E., Schulenberg, J. E., and Keyes, K. M. (2019). Age, period and cohort effects in frequent cannabis use among US students: 1991–2018. *Addiction*, 114(10), 1763–1772. https://doi.org/10.1111/add.14665

Lee, C. M., Calhoun, B. H., Abdallah, D. A., Blayney, J. A., Schultz, N. R., Brunner, M., and Patrick, M. E. (2022). Simultaneous alcohol and marijuana use among young adults: A scoping review of prevalence, patterns, psychological correlates, and consequences. *Alcohol Research: Current Reviews*, 42(1), 8. https://doi.org/10.35946/arcr.v42.1.08

Logan, O. (2023). Cannabis to be legalized in Germany in 2023: What you need to know. *IamExpat*. https://www.iamexpat.de/expat-info/german-expat-news/cannabis-to-be-legalised-in-germany-in-2023-what-you-need-to-know, accessed on May 15, 2024.

Miller, K., and Seo, B. (2021). The effect of cannabis legalization on substance demand and tax revenues. *national tax Journal*, 74(1), 109–145. https://doi.org/10.1086/712915

O'Hara, R. E., Armeli, S., and Tennen, H. (2016). Alcohol and cannabis use among college students: substitutes or complements? *Addictive Behaviors*, 58, 1–6. https://doi.org/10.1016/j.addbeh.2016.02.004

Paschall, M. J., García-Ramírez, G., and Grube, J. W. (2021). Recreational marijuana legalization and use among California adolescents: Findings from a statewide survey. *Journal of Studies on Alcohol and Drugs*, 82(1), 103–111. https://doi.org/10.15288/jsad.2021.82.103

Risso, C., Boniface, S., Subbaraman, M. S., and Englund, A. (2020). Does cannabis complement or substitute alcohol consumption? A systematic review of human and animal studies. *Journal of Psychopharmacology*, 34(9), 938–954. https://doi.org/10.1177/0269881120919970

Simons, J., Correia, C. J., Carey, K. B., and Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, 45(3), 265–273. https://doi.org/10.1037/0022-0167.45.3.265

Simons, J. S., Gaher, R. M., Correia, C. J., Hansen, C. L., and Christopher, M. S. (2005). An affective-motivational model of marijuana and alcohol problems among college students. *Psychology of Addictive Behaviors*, 19, 326–334. http://dx.doi.org/10.1037/0893-164X.19.3.326

StataCorp. (2025). *Stata 19 Extended Regression Models Reference Manual*. Stata Press.

Stevens, A. K., Aston, E. R., Gunn, R. L., Sokolovsky, A. W., Treloar Padovano, H., White, H. R., and Jackson, K. M. (2021). Does the combination matter? Examining the influence of alcohol and cannabis product

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

combinations on simultaneous use and consequences in daily life. *Alcohol Clin Exp Res*, 45(1), 181–193. https://doi.org/10.1111/acer.14494

Stevens, A. K., Boyle, H. K., Sokolovsky, A. W., White, H. R., and Jackson, K. M. (2022). Nuanced relations between simultaneous alcohol and cannabis use motives and negative consequences among college students: The role of multiple product use. *Experimental and Clinical Psychopharmacology*, 30(5), 593–608. https://doi.org/10.1037/pha0000454

Stone, A. A., and Kennedy-Moore, E. (1992). Commentary to part three: Assessing situational coping: Conceptual and methodological considerations. In: Friedman HS (ed.), *Hostility, Coping, and Health* (203–214). American Psychological Association.

Subbaraman, M. S. (2016). Substitution and complementarity of alcohol and cannabis: A review of the literature. *Substance Use & Misuse*, 51, 1399–1414. https://doi.org/10.3109/10826084.2016.1170145

Szolnoki, G. (2019). Geisenheimer Weinkundenanalyse 2018. Geisenheim University. Retrieved from https://www.hs-geisenheim.de/fileadmin/redaktion/FORSCHUNG/Institut_fuer_Wein-_und_Getraenkewirtschaft/Professur_fuer_Marktforschung/Projekte/Segmentierung/Geisenheimer_Weinkundenanalyse_2018_2019_03_08.pdf, accessed on May 20, 2020.

Turna, J., Balodis, I., Van Ameringen, M., Busse, J. W., and MacKillop, J. (2022). Attitudes and beliefs toward cannabis before recreational legalization: A cross-sectional study of community adults in Ontario. https://doi.org/10.1089/can.2019.0088

Weinberger, A. H., Zhu, J., Levin, J., Moeller, S. J., McKee, S. A., and Goodwin, R. D. (2021). Changes in alcohol use by cannabis use status among adolescents and young adults in the United States: Emerging evidence for both substitution and complementarity. *Alcoholism: Clinical and Experimental Research*, 45(12), 2536–2545. https://doi.org/10.1111/acer.14737

Williams, J., Pacula, R. L., Chaloupka, F. J., and Wechsler, H. (2004). Alcohol and marijuana use among college students: Economic complements or substitutes? *Health Economics*, 13(9), 825–843. https://doi.org/10.1002/hec.859

Williams, R. (2016). Understanding and interpreting generalized ordered logit models. *The Journal of Mathematical Sociology*, 40(1), 7–20. https://doi.org/10.1080/0022250X.2015.1112384

Zhu, Y., Trangenstein, P. J., and Kerr, W. C. (2025). Does cannabis substitute or complement alcohol after recreational cannabis legalization in the Washington State? A three-level mixed-effects modeling. *Addictive Behaviors*, 162, 108218. https://doi.org/10.1016/j.addbeh.2024.108218

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press

Appendix

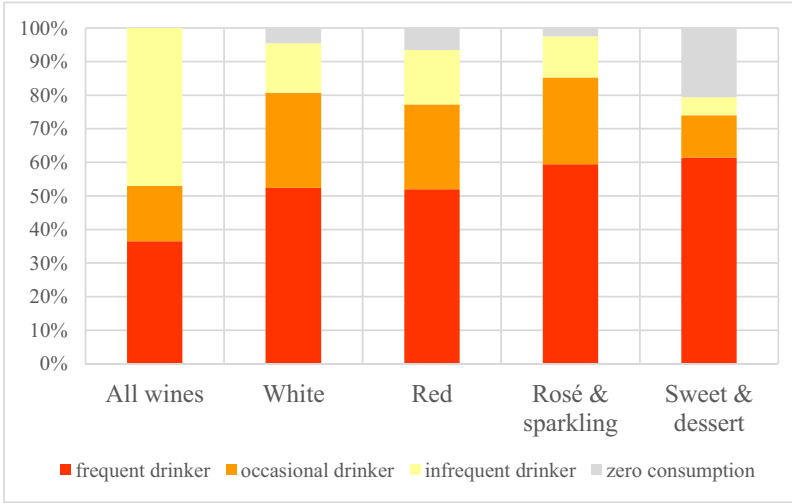


Figure A1. Frequency of drinking wine, $N = 523$.
Note: Red, orange, and the sum of yellow and grey define level 3, 2, and 1, respectively, of the dependent variable.

Table A1. Sample descriptive statistics, by wine user segment

	All, $n = 523$	Wine infrequent user (=1), $n = 191$	Wine occasional user (=2), $n = 86$	Wine frequent user (=1), $n = 246$
Socio-demographics				
Female	0.457	0.476	0.535	0.415
Income (ths. EUR)	36.936	32.377	35.791	40.876
Income not reported	0.086	0.099	0.081	0.077
Education 1 (lower secondary | less)	0.034	0.021	0.058	0.037
Education 2 (higher secondary)	0.231	0.215	0.267	0.232
Education 3 (tertiary)	0.734	0.764	0.674	0.732
Age [years]	38.258	37.649	40.314	38.012
Generation Z (younger than 27 years)	0.174	0.215	0.140	0.154
Millennials (27–41 years old)	0.446	0.414	0.419	0.480
Generation X (42–56 years old)	0.317	0.309	0.349	0.313

(*Continued*)

Table A1. (*Continued.*)

	All, $n = 523$	Wine infrequent user (=1), $n = 191$	Wine occasional user (=2), $n = 86$	Wine frequent user (=1), $n = 246$
Employed	0.836	0.801	0.791	0.878
Retired	0.025	0.037	0.023	0.016
Cannabis user	0.411	0.351	0.419	0.455
cannabis_usage [0,.,4]				
never	0.589	0.649	0.581	0.545
1 [once a year and less]	0.105	0.115	0.081	0.106
2 [monthly]	0.143	0.105	0.244	0.138
3 [weekly]	0.073	0.052	0.035	0.102
4 [daily]	0.090	0.079	0.058	0.110
C_taste	0.214	0.147	0.209	0.268
C_healthy	0.161	0.105	0.093	0.228

Note: All measures are a binary variable, except income (in thousands EUR a year), age (in years), and cannabis usage (5 categories, with 0 = never and 5 = several times a day).

Table A2. Factor analysis results based on cannabis consumption motives

Consumption motives	Mean	Variance explained %	α
Socializing & expansion	2.73	49.49	0.93
Enhancement	3.52	4.27	0.86
Coping & creativity	2.85	11.55	0.90
Conformity	2.01	5.93	0.94
Total variance			71.22

Note: Both five- and four-factor models were tested, including and excluding the new item "I consume cannabis because I believe it is healthy for me." The fifth factor explained less than 4% of the variance in both models. Additionally, the items related to expansion – "It helps me be more creative and original" and "to understand things differently" – loaded onto two factors, simultaneously. To confirm the four-factor model's suitability, a factor analysis with the new item was conducted. The items concerning "expansion," which pertain to broadening awareness, self-confidence, and openness to new experiences, are loaded onto the factor labeled "social." Consequently, we designate the factor as "Social and Expansion." However, unlike J. Simons et al. (1998), items related to creativity, originally part of the enhancement factor, loaded onto coping scales, leading to the "Coping and Creativity" label.
All factor loadings are significant at $P < 0.001$: How often do you drink wine for the following reasons? 1 = "never" 5 = "always," $N = 215$, based on authors' estimations. We recoded each motive to zero for non-users of cannabis in the regression models.

Cite this article: Ghvanidze, S., Ščasný, M., and Hanf, J. H. (2025). Sip or smoke: The link between wine consumption and cannabis use. *Journal of Wine Economics*, 20(4), 306–328. https://doi.org/10.1017/jwe.2025.10094

https://doi.org/10.1017/jwe.2025.10094 Published online by Cambridge University Press