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Enhancing a model of global beverage markets

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Enhancing a model of global beverage markets

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Enhancing a model of global beverage markets

Abstract

This paper outlines four enhancements to a global model of national markets for wine, beer and spirits to improve its usefulness in policy analysis: each still wine type is split into red and white; the model distinguishes on-premise from off-premise consumption; California (responsible for nearly 90% of US wine production) is distinguished from the rest of the United States; and top-down modules are added to capture sub-national grape and wine impacts in Australia and sub-state impacts in California. The paper provides several illustrations of the usefulness of these enhancements for estimating impacts of market and public policy shocks and options.

JEL classifications: C68; F17; H21; Q17; Q18

Key words: global beverage modelling; impacts of excise and import taxes; on-premise consumption; beverage alcohol levels

1. Introduction: the need for more nuanced beverage policy analysis

Beverage markets are a perennial focus of policy makers. Excise duties on alcohol consumption are a non-trivial source of government revenue, and are among the instruments governments use to modify (anti-) social behaviours. With international trade and foreign investment in wine, beer and spirits far more important now than a generation ago, trade and exchange rate policies also are influencing national beverage markets. To assist policy makers and market players, a model of the world's wine markets was developed two decades ago (Wittwer, Berger and Anderson 2003), and it has since been expanded by adding markets for beer and spirits (Wittwer and Anderson 2020). The latter Global Bev Model (GBM) includes markets for 44 individual countries and 7 composite regions, linked to each other through bilateral trade. This paper outlines four further modifications to make the model even more useful for policy makers and wine market participants. These are (1) a split of wine types into red and white wines, (2) a distinction between on-premise and off-premise consumption, (3) a distinction between California and the rest of the United States, and (4) a top-down disaggregation of California and Australia into key grape and wine regions.

Each of these modifications has a clear motivation. A split of red and white wine was advantageous with the imposition of China's prohibitive tariff on its imports of Australian wine, given that most of those imports were red wines. In modelling that tariff without a red/white split, substitution of domestic Australian wine for New Zealand imports (almost all of which are white) would have over-stated the response to the fall in Australian wine prices due to the Chinese tariff hike. Also, the recent proposal to reform alcohol excise taxation in the United Kingdom would have wines being taxed per litre of alcohol (LAL) rather than per litre of beverage. Since red wines from some countries have a much higher LAL than from other countries, and higher than for most white wines, that reform could significantly alter the mix of wines imported by the UK from its various trading partners.

In analysing that proposed reform to UK excise taxation, it is also helpful to distinguish between on-premise and off-premise consumption, because the on-premise price impacts of such policy changes are more muted than the impacts on retail prices at the bottle shop. That distinction matters also for COVID-19 pandemic analysis, where prolonged lockdowns resulted in marked reductions in bar and restaurant activity and a corresponding switch from on-premise to off-premise consumption of beverages.

The split of California and the rest of the United States is motivated by occasional reports lamenting the low share of US wine production that is sold abroad (less than 15%). That statistic hides the fact that for California – which is responsible for nearly 90% of US wine production – its most important export markets (around 75%) are interstate. If those interstate sales were counted as exports from California, that State would rank third in the world as a wine exporter, after France and Italy. Given the size of the US domestic market, an expansion in US international wine exports has a smaller impact on the domestic wine industry in the US than in other wine-exporting nations.

The disaggregation of California and Australia into their key grape and wine regions is beneficial for examining any issue in which different qualities of wine are expected to be impacted differently. A change in wine excise duties from ad valorem to volumetric taxation (a reform that is often mooted in Australia) is a case in point. Another is climate change if it affects regions differently. For example, winegrape growing is becoming more widespread in regions previously considered too cool, while in warmer regions there are shifts to varieties more able to tolerate extreme heat, drought and soil salinity.

The paper is structured as follows. Section 2 outlines the basic Global-Bev model and the ways in which GBM is being enhanced. Section 3 sequentially explains the benefits of each of the four enhancements by illustrating ways it alters or disaggregates the estimated impacts of particular market shocks or policy changes on various beverage markets. The final section points to future applications that will benefit from these enhancements to GBM.

2. The Global-Bev Model (GBM) and its enhancements

In the Global-Bev model, wine markets have been disaggregated into four types, namely non-premium (including bulk), bottled commercial-premium, and bottled super premium still wines, plus sparkling wine. Commercial-premium still wines are defined to be those between US$2.50 and $7.50 per liter pre-tax at a country's border or wholesale. Beer and spirits are included but without splitting them into regular and craft categories, because the latter still have small market shares in volume terms, they are relatively minor players in international trade, and standard global bilateral trade data for those two beverages are not disaggregated by quality. GBM divides the world into 44 individual nations, with all other countries being captured in seven composite residual regions.

The primary sources of data for constructing the model's baseline database for 2016-18 are Anderson and Pinilla (2021), supplemented from Anderson (2020) for taxes on beverage consumption and imports, Holmes and Anderson (2017) for wine, beer, and spirits average consumer expenditure data, and United Nations (2021) for volume and value of total and bilateral international trade in alcoholic beverages.

GBM has income- and price-responsive demand equations, price-responsive supply equations and hence quantities and prices for each of the grape and wine products and for beer and spirits, plus for a single composite of all other products in each country such that it has elements of an economywide model. Grapes are assumed to be not traded internationally, but other products are both exported and imported by each country to/from (potentially) each of the other countries. Tariffs on imports vary by country of origin, according to the numerous preferential trade agreements in place for each country.

2.1 Splitting red and white grapes and wines

Well-documented data are available for the shares of regional and national winegrape bearing areas in 2016 comprising red and white varieties are available globally (Anderson and Nelgen 2021). That makes it relatively easy to derive estimates of each country's still wine production by colour. Splitting domestic consumption and export sales of still wine into red and white, and splitting also the wines imported, is easier for some countries than others. In the case of Australia, the export split is readily available and even by price point and by destinations (https://marketexplorer.wineaustralia.com/export-dashboard), and domestic sales of both local and imported wine are available by colour in Anderson and Puga (2022). The import split is helped by the fact that much of the still wine imported by Australia comprises still whites from New Zealand. Similar splits were able to be made for China and New Zealand for our first application of GBM with this enhancement. For other countries the process was mechanised via programs in the first instance, but those default splits can and will be revised as and when additional data are accessed or become available.

2.2 Splitting California from the rest of USA

California dominates grape and wine production in the USA. Although many other states produce wine, their overall output is very small in comparison. Table 1 shows the split shares for the various types of wine production, exports and consumption.

[insert Table 1 around here]

The table estimates relied in part on grape crush data at https://www.cdfa.ca.gov/mkt/grapecrush.html. These Californian data include varietal detail, crush tonnage and grape prices by Californian wine regions. These data enable us to modify the value of grape inputs into wine for the US sectors in GBM.

Two key database matrices in GBM are the USE matrix and TRADE matrix. The USE details all commodity inputs to each user. Users include the grape and beverage sectors plus households – and, as outlined in Section 2.3, now also on-premise consumption. For each country there is a domestic source and composite import source. The TRADE matrix includes each commodity, its regional origin and its regional destination. That is, the USE excludes the regional origin of imports and the TRADE matrix excludes users.

Splitting consumption and production in the USE matrix of the GBM's database is relatively straightforward, as the consumption and production shares shown in Table 1 are sufficient for this task. Since the TRADE matrix includes both regional origins and regional destinations, splitting USA into two requires partitioning the TRADE matrix into four segments each for the diagonal and non-diagonal elements of the matrix. The diagonal elements refer to own-country sales, equivalent to the domestic part of the USE matrix.

The first segment for both the diagonal and non-diagonal elements, comprising origins and destinations other than the US regions, remains unchanged. Second, former US sales to all destinations require splitting. Grapes, not being traded between countries, follow the production split shown in Table 1 for the diagonal elements. Beverage sales to destinations outside the US are split using the export shares shown in Table 1. Third, US home sales split shares, shown in Table 1, assign sales for California-California, California-Rest of USA, Rest of USA-California and Rest of USA-Rest of USA. That is, a single diagonal element for each commodity is split into two diagonal and two off-diagonal elements. In the fourth matrix segment, covering foreign sales to the two US regions, the import split follows the consumption shares shown in Table 1.

Although the model is partial equilibrium, market-clearing identities and equations still apply for all commodities within the model. The USE matrix for a given region, when summed across users, must equal the delivered value of commodities summed across all origins. The delivered value is equal to the TRADE matrix plus margins (retail and wholesale plus transport) and import tariffs. A second market-clearing and identity condition requires total costs of all endogenous industries, that is, grapes, beverages and, in the next section 2.3, on-premise wine consumption, to equal sales. The two sets of market-clearing identities need to be satisfied both in the pre-simulation database and post-simulation to ensure that the model is homogeneous of degree one.

Once the split database has been created, a data balancing program enforces the above identities. While the database split disrupts the balance, a series of scaling equations within the balancing program bring the database back to balance.

2.3 Splitting out on-premise wine consumption

An off-premise versus on-premise split in GBM requires data on off-premise versus on-premise wine expenditures. These are available in Anderson, Nelgen and Pinilla (2017). The advantage of having this split in a global model is that regular national accounts data are available on household spending on hotels and restaurants.[1]

The relevance of being able to model on- versus off-premise wine consumption has come to the fore with social restrictions and lockdowns arising from the COVID-19 pandemic. For example, the UK's expenditure in this on-premise category more than halved in 2020 relative to 2019 due to prolonged COVID-19 lockdowns. A depiction within the GBM of an on-premise sector, consisting of intermediate wine inputs plus margins and taxes, can improve estimated impacts of pandemic-related shocks.

Table 2 shows the volume and value shares of off-premise consumption in total consumption of each country. We note that in all cases, the volume share of off-premise consumption is substantially greater than the value share. This difference reflects the higher on-premise trade margins plus additional service taxes associated with on-premise consumption. At this stage,

[1] See https://www.oecd.org/sdd/na/gross-domestic-product-gdp-and-other-annual-national-accounts-statistics-oecd.htm

the model's breakout of on-premise consumption is confined to wines but could readily be applied also to beer and spirits.

[insert Table 2 around here]

In order to harmonize the model's database with estimates of on-premise and off-premise consumption values, we revisited specific wine taxes, VAT and wholesale and retail margins. Since the database contains both volumes and values of wine, we are able to impose volumetric tax rates directly. Specific tax rates, be they ad valorem or volumetric, are based on Anderson (2020).

When calculating VAT, the appropriate base is the margins-inclusive, specific wine tax-inclusive value of spending. For off-premise consumption, the margin is larger for each unit of wine consumed, and therefore the VAT is higher. One assumption we made in imposing trade plus transport margins is that the share of off-premise sales is not less than 25% in any region.

The values in the starting database are calculated as though all wine is consumed at off-premise prices. The values are split into basic (that is, values at producer prices), margins and tax components. The on-premise and off-premise shares are then split. We assume that off-premise consumption has the same specific taxes and retail margins as on-premise, plus an additional service margin and applicable VAT. Any differences in off-premise and on-premise unit expenditures by consumers reflect differences in margins and taxes, not in the composition of wine consumed: for tractability, we assume that the same volumetric shares of different wine types apply to off- and on-premise consumption. In the UK case, for example, the average off-premise price is around US$12 per litre compared with almost $24 for on-premise. That is, the latter includes a service margin plus VAT on a larger base.

On–premise wine consumption is diverted in the USE matrix from sales to households to sales to the new on-premise sector. Additional trade margins and VAT taxes are calculated for the on-premise sector. Finally, an expenditure elasticity of 1.7 is imposed on on-premise consumption, reflecting the "luxury" status for such consumption. All elasticities are re-calculated to ensure that marginal budget shares in all regions sum to 1.0. The database is then rebalanced.

2.4 Top-down regional grape and wine shares for Australia and California

For Australia, value shares for grapes by red and white for each of 65 grape and wine regions and available in Anderson and Puga (2022). Several abstractions enable us to devise a split between red and white production in non-premium, commercial-premium and super-premium categories for each region. The key price points are A$300, A$800 and A$2000 per tonne. In any region in which the average price of grapes is under $300 per tonne, we assume that all wine produced is non-premium. There is no such region, based on 2019 data. For regions in which the average price, red or white, is between $300 and $800 per tonne, wine production is partly non-premium red or white and partly commercial-premium red or white. Average prices between $800 and $2000 per tonne imply wine production that is partly commercial-premium and partly super-premium. Regions in which either red or white grapes exceed $2000 per tonne produce exclusively super-premium red or white wine.

To show how share are calculated, we use the example of red grapes in the Adelaide Hills. The average price per tonne is $1239. The formula for calculating commercial-premium (s) and super-premium (1-s) shares is

$$s=(2000-p)/(2000-800) \tag{1}$$

where p is the average regional price, $800<p<2000$. Production in the region is distributed 63.4% to commercial-premium red and 36.6% to super-premium red (i.e., 1239 = 0.634*800 +(1-0.634)*2000). Table 3 shows the estimated shares for each Australian region. The methodology assumes that all grapes grown in a region are inputs into wine production in that region. In the case of California, similar data are available for that State’s 17 grape pricing regions. The same price points – but in US dollars – are used to estimate sub-state wine output shares (Table 4). In Australia, sparkling wine output shares in each region are set equal to regional white share of national white output. In California, sparkling wine output is set equal to 8.7% of wine output in each sub-state region.

[insert Tables 3 and 4 around here]

One objective of extending a global model to sub-national representation is to be able to examine climate change scenarios. Grape growing may become more widespread in cooler regions previously considered unsuitable. In warmer climate regions, there may be a shift to varieties more able to tolerate extreme heat and dryness. Sub-national detail offer the potential to improve estimates of shifts in wine production and grape varieties in analyses of climate changes.

Anderson and Nelgen (2021) provide vine bearing area by variety data for more than 700 regions covering around 50 countries, but they do not include grape price data. Once the latter are assembled, it would be possible to extend the above methodology to more countries.

3. Estimating impacts of shocks with GBM before and after its enhancements

This section provides four examples of scenarios analysed using GBM that are improved by being able to employ the enhanced version of the model.

3.1 China's prohibitive tariff on wine imports from Australia

Since 2021 China has applied prohibitive tariffs on imports of wine (and several other products) from Australia as part of a broader strategy of economic coercion. A red-white split of still wines is relevant in modelling that prohibitive tariff because reds dominate China's wine market, including it imports. Without a red-white split, there is substantial substitution in Australia away from imported New Zealand super-premium still wine (Table 5(a)). When the model represents red and white wines separately, the trade pattern response differs markedly: now the import substitution in the Australian market away from New Zealand wine is estimated to be only one-quarter as large (Table 5(b). Also, the diversion of Australian exports to other markets is smaller with the red-white split. A collapse in exports to China (-US$607m) is only partly offset by increased sales to UK (+US $14m), USA (+US $42m), Canada (+US $56m) and Hong Kong (+US $11m).

[insert Table 5 around here]

Why is trade diversion stronger if we depict red and white wine types separately? The tariff's negative impact on prices for Australian red (white) wine is larger (smaller) than if there is no red-white distinction. This is because China's share of Australian red wine sales was much larger than the corresponding share of all Australian wine sales (95% compared with around 60%). Larger relative price movements imply more substitution, resulting in more trade diversion.

3.2 Interstate versus foreign export sales from California

The reconfigured database in GBM shows that while California's international exports have some importance, interstate sales are far larger for all types of wine (Table 6). A campaign to increase foreign sales may benefit the Californian industry, but maintaining or expanding markets interstate may provide larger gains. The estimated value share of wine sales at producer prices in the rest of USA that originate from California is 42%. The total value sold places California's interstate sales somewhere between the international exports of Italy in 2nd place and Spain in 3rd.

[insert Table 6 around here]

Another reason for representing California separately, and even more so the 17 regions within California, concerns adverse weather and climate change scenarios. Drought has prevailed over the past several vintages, presenting threats to water security for viticulture and other farm uses. Rising temperatures may raise the competitiveness of interstate viticulture relative to California. And disease outbreaks in vineyards in some Californian regions may devastate those regions but raise the competitiveness of uninfected regions. The enhanced GBM is now able to address such issues in future analyses.

3.3 COVID-19 impacts

Using GBM to simulate COVID shocks, in which lockdowns and social distancing enforce a reduction in hotels and restaurant activity, was not straightforward. The shocks included a decrease in aggregate household consumption, with a strong negative expenditure effect. A positive taste swing towards super-premium wine was ascribed, on the basis that consumers confined to home drinking may raise the quality of wine consumed above their usual level since smaller margins apply to off-premise as compare with on-premise purchases. A negative taste swing was imposed on sparkling wine consumption, on the basis that lockdowns forced celebratory drinking below baseline levels.

Table 7 shows GBM modelled consumption impacts of the first year of COVID relative to a no-COVID base, without and with representation of separate on-premise and off-premise wine sub-sectors. Using the enhanced GBM, and drawing on OECD data on hotels and restaurant activity, a negative taste swing was imposed on the on-premise sub-sector. Total wine consumption impacts are slightly less negative using the enhanced GBM than the standard GBM. The negative taste swing against on-premise consumption, enlarged by a relatively high expenditure elasticity, is estimated to cause on-premise wine sales to be about one-fifth lower due to COVID, compared with only a very slight fall if any in off-premise wine sales. That is because the off-premise wine consumption change is the sum of a negative expenditure effect and a positive taste swing away from curtailed social activities. In the COVID scenario using the enhanced GBM, aggregate global wine trade volumes fall 6% below base, compared with 4% in the standard GBM without separating on-premise from off-premise sales.

[insert Table 7 around here]

4. Further possible applications

A split into red and wine grape and wine types has improved modelling of China's prohibitive tariff on Australian wine by depicting in more detail the characteristics of wine-producing and consuming nations. China's wine consumption is mainly of red varieties, as reflected in its import base. New Zealand is mainly a white wine producer, so that import substitution in Australia in the wake of the Chinese tariff away from New Zealand wine is unlikely.

Are more detailed varietal splits possible in a global model? Anderson and Nelgen (2021) have compiled varietal data on a global scale. The anticipated response of the global wine industry to climate change will in part be through varietal shifts. This is already happening to some extent in Australia with some warm climate inland grape-growers switching from varieties such as Shiraz and Sauvignon Blanc to Mediterranean varieties more suitable for warm regions. Cooler climate regions in turn are expanding their vineyard area and switching in part to varieties such as Shiraz that previously have struggled in such cool regions – adding to the value of also disaggregating GBM's national markets into regional ones.

Detailed grape variety, region and price data such as available for Australia and California provide the opportunity for further disaggregation in the varietal and regional dimensions. But to estimate impacts with such an enhanced GBM, one also needs to anticipate how accepting consumers will be of varietal change and shifts in regions of origin. The top-down module prepared as part of this study is a start. A bottom-up approach to further disaggregation would require some theoretical enhancements to the existing model. These would follow in part a methodology devised by Horridge (2011). To make such a model workable, aggregation programs would enable the user to concentrate on regions of particular interest for a study.

The California – Rest of USA split provides a start on sub-national representation. There are difficulties in extending the split to more regions, such as the grape-growing regions of Australia. One is that grape regions for which data are available require mapping to regions for which official economic statistics are collected. In developing the TERM-Wine model, for example, Australia's wine regions were mapped to SA3 regions for which Australian Bureau of Statistics data are available (Wittwer and Anderson 2021).

Returning to COVID analysis, the response to COVID does not follow the usual economic theory of price adjustments, because lockdowns and social distancing imply quantitative restrictions and reduced utilisation of capital and labour in restricted sectors. The household demand equation in GBM follows the form

$$x_c - q = \varepsilon_c.(C - q) + \sum_d \eta_{cd}.p_c + a_c - \sum_d S_d.a_d \ , \tag{1}$$

where in percentage changes x_c is the quantity, p_c the price and a_c the taste switch for commodity *c*, *q* is population and *C* aggregate nominal consumption. The expenditure elasticity is $\square_c$ and the matrix of price elasticities $\square_{cd}$. S_d is the budget share of commodity *d*. The taste terms in equation (1) are important drivers in a COVID scenario. As OECD and other agencies release more national accounts data relative to previous years, it will improve the detail used to estimate underlying taste shocks in GBM. Restaurants and hotels have a larger expenditure weight than the on-premise (wine) component modelled in GBM. Other service sectors have also suffered downturns during the pandemic.

One way of improving the modelling COVID with virtually no theoretical enhancements to the model would be to divide the "rest of commodities" spending in the household vector of commodities into several sectors, aligning more closely with COVID-affected national accounts sectors. Given initial expenditure shares and observed pandemic-induced downturns (x_c in equation (1)), combined with aggregate consumption observations (*C)*, estimates of a_c could be inferred for a larger share of total expenditure. Within the budget constraint, the share-weighted taste changes a_c sum to zero. Therefore, the larger the expenditure share for which observations are available, the more accurate the taste shocks will be on remaining commodities, in this case wine. This would be helpful in showing the marginal contribution of the pandemic to the grape and wine sectors, and estimating how the industry will fare during a global economic recovery phase.

Finally, beverage consumer tax issues are now able to be better analysed using the enhanced GBM. One recent application, mentioned in the Introduction, is to the proposal to reform alcohol excise duties in the United Kingdom. It would affect on-premise consumption less than off-premise, because the on-premise price impacts of such policy changes are more muted than the impacts on retail prices at the bottle shop. More important from a trade perspective, the proposal would have wines being taxed per litre of alcohol (LAL) rather than per litre of beverage. Since red wines from some countries have a much higher LAL than from other countries, and higher than for most white wines, that reform has been shown to significantly alter the mix of wines imported by the UK from its various trading partners (Anderson and Wittwer 2022).

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Table 1: Shares used for splitting Californian from Rest of USA wine markets

		California	Rest of USA		
Consumption	NPWine (R&W)	0.17	0.83		
	SparkWine	0.17	0.83		
	CPWine (R&W)	0.17	0.83		
	SPWine (R&W)	0.17	0.83		
	Beer	0.13	0.87		
	Spirits	0.13	0.87		
	Aggregate consumption	0.125	0.875		
Population		39.5	295.3		
Production shares	NPWine (R&W)	0.999999	0.000001		
	SparkWine	0.97	0.03		
	CPWine (R&W)	0.99	0.01		
	SPWine (R&W)	0.99	0.01		
	Beer	0.05	0.95		
	Spirits	0.05	0.95		
Export	NPWine (R&W)	0.999999	0.000001		
	SparkWine	0.17	0.83		
	CPWine (R&W)	0.17	0.83		
	SPWine (R&W)	0.17	0.83		
	Beer	0.13	0.87		
	Spirits	0.13	0.87		
US home sales		CA origin		Rest of USA origin	
	Destination	CA	RofUSA	CA	RofUSA
	NPWine (R&W) CA origin	0.18	0.82	0.000001	0.000001
	SparkWine	0.13	0.72	0.01	0.14
	CPRedWine	0.15	0.01	0.68	0.16
	CPWhiteWine	0.13	0.01	0.72	0.14
	SPWine (R&W)	0.13	0.01	0.72	0.14
	Beer	0.12	0.04	0.01	0.83
	Spirits	0.12	0.04	0.01	0.83

Source: Authors' own derivation.

Table 2: Off-premise volume and value shares of total wine consumption (%)

	Vol%	Val%		Vol%	Val%		Vol%	Val%
FRA	69	35	CRO	59	44	URU	89	73
ITA	65	42	GEO	59	40	OLAC	70	40
POR	68	40	HUN	79	67	SAF	73	50
SPN	47	30	MOLD	80	60	TURK	49	38
AUT	54	20	ROM	88	71	NAFR	62	37
BEL	75	46	RUS	96	90	OAFR	70	40
DEN	83	45	UKR	87	72	MEST	70	40
FIN	94	77	OCEF	80	60	CHINA	65	34
GER	82	45	AUS	81	53	HK	64	46
GRE	49	27	NZL	81	64	INDIA	73	38
IRL	80	56	CAN	85	71	JAP	64	36
NLD	89	60	California	83	52	KOR	65	35
SWE	92	74	RofUSA	83	52	MALAY	54	39
SWISS	85	57	ARG	84	62	PHILI	70	52
UK	83	60	BRA	74	61	SINGA	70	49
OWEN	50	30	CHILE	84	52	TAIW	64	44
BUL	81	58	MEX	65	36	THAI	66	46
						OAPA	70	50

Source: Euromonitor International, *Passport*. Accessed online at https://www.euromonitor.com/our-expertise/passport

Table 3: Estimated regional shares of Australian grape and wine output by sector

	RGrap	Wgrap	NPRedWine	CPRedWine	SPRedWine	SparkWine	NPWhiteWine	CPWhiteWine	SPWhiteWine
AdelaideHill	0.0217	0.023	0	0.0302	0.0428	0.023	0	0.029	0.044
AdelaidePlai	0.0024	0.0029	0	0.0048	0.0012	0.0029	0	0.0083	0.0007
AlpineValley	0.0026	0.0021	0.0009	0.0049	0	0.0021	0	0.0055	0.001
BarossaValle	0.0446	0.0982	0	0.036	0.1524	0.0982	0	0.0069	0.3108
Beechworth	0.0003	0.001	0	0.0005	0.0006	0.001	0	0	0.0031
Bendigo	0.0021	0.0021	0	0.0043	0.001	0.0021	0	0.0053	0.0014
BlackwoodVal	0.0012	0.0002	0	0.0025	0.0003	0.0002	0	0.0005	0.0001
CanberraDist	0.0007	0.0008	0	0.0011	0.0011	0.0008	0	0.0005	0.0021
ClareValley	0.0264	0.0143	0	0.0434	0.0358	0.0143	0	0.0185	0.027
Coonawarra	0.0773	0.0279	0	0.0883	0.1998	0.0279	0	0.0589	0.0284
Cowra	0.0013	0.0016	0.002	0.0013	0	0.0016	0.0028	0.0017	0
CurrencyCree	0.0024	0.0025	0.0009	0.0046	0	0.0025	0.0002	0.0074	0
EdenValley	0.0115	0.0076	0	0.01	0.0376	0.0076	0	0.0022	0.0223
Geelong	0.0009	0.0025	0	0.0006	0.0031	0.0025	0	0	0.0081
Geographe	0.0012	0.0011	0.0002	0.0024	0	0.0011	0	0.0031	0.0004
Gippsland	0	0.0003	0	0.0001	0	0.0003	0	0.0007	0.0001
Glenrowan	0.0011	0.0004	0	0.0024	0.0002	0.0004	0.0002	0.0009	0
GoulburnVall	0.0045	0.0042	0.0088	0.003	0	0.0042	0.005	0.0073	0
Grampians	0.001	0.0046	0	0.0018	0.0012	0.0046	0	0.0076	0.0067
GraniteBelt	0.001	0.0006	0	0.0012	0.0024	0.0006	0	0.0012	0.0008
GreatSouther	0.0093	0.0053	0	0.0085	0.0293	0.0053	0	0.0061	0.0109
Gundagai	0.0019	0.0028	0.0013	0.0032	0	0.0028	0.0018	0.0067	0
HastingsRive	0	0	0	0	0	0	0	0	0
Heathcote	0.0058	0.0154	0	0.0091	0.0091	0.0154	0	0.035	0.0131
Henty	0.0004	0.001	0	0.0007	0.0003	0.001	0	0.0011	0.0022
Hilltops	0.0016	0.0018	0	0.0032	0.001	0.0018	0	0.0048	0.0007
Hunter	0.0055	0.0067	0	0.0089	0.0079	0.0067	0	0.0114	0.0099
KangarooIsla	0.0001	0.0001	0	0.0001	0	0.0001	0	0.0001	0.0001
KingValley	0.0223	0.0078	0	0.046	0.007	0.0078	0	0.0212	0.003
LanghorneCre	0.0467	0.036	0	0.0928	0.0238	0.036	0	0.0975	0.0143
MacedonRange	0	0.0004	0	0.0001	0	0.0004	0	0	0.0012
Manjimup	0.0004	0.0001	0	0.0008	0	0.0001	0	0.0003	0
MargaretRive	0.0377	0.0168	0	0.0542	0.0704	0.0168	0	0.0289	0.0241

	RGrap	Wgrap	NPRedWine	CPRedWine	SPRedWine	SparkWine	NPWhiteWine	CPWhiteWine	SPWhiteWine
McLarenVale	0.0411	0.0634	0	0.0356	0.1341	0.0634	0	0.0569	0.1456
MorningtonPe	0.0031	0.0159	0	0	0.0166	0.0159	0	0	0.0515
MountBenson	0.0032	0.0028	0	0.0064	0.0017	0.0028	0	0.0062	0.0026
MountGambier	0.0013	0.0004	0	0.0027	0.0004	0.0004	0	0.0012	0.0001
Mudgee	0.0021	0.0024	0	0.0038	0.0022	0.0024	0	0.0051	0.0024
MurrayDarlin	0.1723	0.1352	0.3423	0.1084	0	0.1352	0.2866	0.0922	0
NewEnglandAu	0.0001	0	0	0.0001	0.0001	0	0	0.0001	0
Orange	0.006	0.0054	0	0.0098	0.0083	0.0054	0	0.0092	0.0077
Padthaway	0.0361	0.0341	0	0.0686	0.0263	0.0341	0	0.0963	0.0096
Peel	0	0	0	0	0	0	0	0	0
Pemberton	0.0025	0.0013	0	0.0051	0.0008	0.0013	0	0.0018	0.0024
Perricoota	0.0002	0	0.0002	0.0002	0	0	0	0	0
PerthHills	0	0	0	0.0001	0	0	0	0.0001	0
Pyrenees	0.0007	0.0023	0	0.0015	0.0002	0.0023	0	0.0034	0.0039
Riverina	0.1288	0.1249	0.2601	0.0778	0	0.1249	0.2551	0.0963	0
Riverland	0.1964	0.2146	0.3815	0.1305	0	0.2146	0.4467	0.1559	0
Robe	0.0014	0.0017	0.0001	0.0031	0	0.0017	0	0.0051	0.0001
Rutherglen	0.0009	0.0014	0	0.002	0.0001	0.0014	0.0001	0.0042	0
ShoalhavenCo	0	0	0	0	0	0	0	0	0
SouthBurnett	0.0001	0.0001	0	0.0002	0.0001	0.0001	0	0.0003	0.0001
SouthernFleu	0.0011	0.0007	0	0.0023	0.0003	0.0007	0	0.0011	0.0011
SouthernFlin	0.0003	0.0016	0.0002	0.0005	0	0.0016	0	0.0041	0.0007
SouthernHigh	0	0	0	0	0.0001	0	0	0	0
StrathbogieR	0.0006	0.0016	0.0001	0.0013	0	0.0016	0.0013	0.0036	0
Sunbury	0.0001	0.0002	0	0.0002	0	0.0002	0	0.0004	0.0002
SwanDistrict	0.0013	0.003	0.0014	0.0017	0	0.003	0.0002	0.0089	0
Tasmania	0.0186	0.0385	0	0	0.1002	0.0385	0	0	0.1246
ThePeninsula	0.0003	0.0004	0	0	0.0015	0.0004	0	0.0002	0.001
Tumbarumba	0.0003	0.0009	0	0.0005	0.0007	0.0009	0	0.0013	0.0017
UpperGoulbur	0.0005	0.0018	0	0.0008	0.0006	0.0018	0	0.0041	0.0016
Wrattonbully	0.0341	0.022	0	0.0577	0.0425	0.022	0	0.0502	0.0185
YarraValley	0.0102	0.0313	0	0.008	0.0351	0.0313	0	0.0132	0.0877

Table 4: Estimated regional shares of Californian grape and wine output by sector

	RGrap	Wgrap	NPRedWine	CPRedWine	SPRedWine	SparkWine	NPWhiteWine	CPWhiteWine	SPWhiteWine
Ca1	0.0298	0.034	0	0.0011	0.0423	0.0006	0	0.0702	0.0408
Ca2	0.0226	0.0214	0	0	0.0323	0	0	0.0518	0.0209
Ca3	0.1687	0.1881	0	0	0.2414	0	0	0	0.4793
Ca4	0.3128	0.0946	0	0	0.4476	0	0	0	0.241
Ca5	0.0056	0.006	0	0.024	0.0029	0.012	0	0.0231	0.0002
Ca6	0.0105	0.0053	0	0.0386	0.0068	0.0193	0	0.0194	0.0009
Ca7	0.0737	0.1262	0	0.1749	0.0677	0.0875	0	0.3131	0.1174
Ca8	0.1135	0.0657	0	0.0907	0.1428	0.0454	0	0.1206	0.0888
Ca9	0.0108	0.0195	0.008	0.0637	0	0.0556	0.0227	0.0449	0
Ca10	0.0112	0.0031	0	0.0226	0.0111	0.0113	0	0.0057	0.0043
Ca11	0.1184	0.1097	0.3233	0.4623	0	0.4862	0.1893	0.1685	0
Ca12	0.0241	0.0522	0.1183	0.0421	0	0.072	0.1289	0.0266	0
Ca13	0.0686	0.1769	0.4565	0	0	0.14	0.4942	0.0118	0
Ca14	0.0116	0.0298	0.0772	0	0	0	0.0848	0	0
Ca15	0.0002	0.0001	0	0.0013	0	0.0006	0	0.0002	0
Ca16	0.004	0.0029	0	0.0034	0.005	0.0017	0	0.0012	0.0065
Ca17	0.0139	0.0647	0.0167	0.0752	0	0.0679	0.0801	0.1428	0

Table 5: Impact on Australian wine exports and imports of China's prohibitive tariff (million litres and US$ million)

(a) Using GBM with no red-white split

	Total exports		Total imports		Value of imports from New Zealand
	Volume	Value	Volume	Value	
Sparkling wine	-1	-9	-1	-4	0
Still wines:					
Non-premium	2	2	0	0	0
Commercial premium	-13	-278	-6	-23	0
Super-premium	-13	-149	-7	-45	-35
All wines	-25	-433	-15	-72	-35

(b) Using GBM with a red-white split

	Total exports		Total imports		Value of imports from New Zealand
	Volume	Value	Volume	Value	
Sparkling wine	-2	-9	0	-3	0
Still wines:					
Non-premium red	2	3	0	0	0
Non-premium white	0	0	0	0	0
Commercial premium red	-11	-136	-5	-14	0
Commercial premium white	0	-7	0	-1	0
Super-premium red	-1	-218	-5	-16	-1
Super-premium white	0	-16	-1	-8	-7
All wines	-12	-383	-11	-43	-8

Source: Authors' model results.

Table 6: Sales value shares of Californian wine by destination (%)

	California	Rest of USA	International exports
Sparkling wine	21	75	4
Still wines:			
Non-premium red	15	64	22
Non-premium white	14	60	25
Commercial premium red	23	57	20
Commercial premium white	19	59	22
Super-premium red	24	59	18
Super-premium white	20	61	19
All wines	20	61	18

Source: Authors' model results.

Table 7: Impacts of COVID-19 on beverage consumption (% change relative to base)

(a) without an on-premise wine sector

	AUS	NZL	WEur	USACan	LatAmer	SAfr	Asia	RoW	World
Sparkling wine	-13	-15	-17	-14	-18	-17	-12	-14	-15
Still wines:									
Non-premium	-2	-3	-4	-2	-6	-4	-2	-3	-4
Commercial	-3	-4	-5	-3	-5	-5	-1	-3	-4
Super-	0	-2	-4	-1	-4	-3	0	0	-2
All wines	-3	-3	-7	-3	-7	-8	-2	-5	-5
Beer	-3	-5	-6	-3	-6	-6	-3	-4	-4
Spirits	-3	-4	-7	-4	-6	-6	-5	-4	-5

(b)with on-premise wine sector

	AUS	NZL	WEur	USACan	LatAmer	SAfr	Asia	RoW	World
Sparkling wine	-12	-14	-16	-14	-17	-16	-11	-14	-15
Still wines:									
Non-premium red	-1	-3	-3	-1	-5	-3	-1	-2	-3
Non-premium white	-1	-3	-3	-1	-5	-3	-1	-2	-3
Comm. premium red	0	-2	-4	-1	-4	-4	1	-1	-2
Comm. premium white	1	-1	-3	-1	-4	-3	1	-1	-2
Super-premium red	3	1	0	2	-2	0	4	3	1
Super-premium white	3	1	0	2	-1	0	4	3	1
All wines, off-premise	0	-1	-5	-1	-5	-6	0	-4	-3
All wines, on-premise	-17	-19	-23	-18	-23	-21	-16	-18	-20
Beer	-3	-5	-6	-3	-6	-5	-3	-4	-4
Spirits	-3	-4	-7	-4	-6	-6	-5	-4	-5

Source: Authors' model results, part (a) from Wittwer and Anderson (2021) using the standard GBM and part (b) using the enhanced GBM.