AgriRisk: A brief examination of consumer preferences in relation to Nova Scotia wine

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Reflecting Society

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Risk Proofing Nova Scotia Agriculture: A Risk Assessment System Pilot (AgriRisk)
Nova Scotia Federation of Agriculture would like to recognize the collaborative relationships that exist among Agriculture and Agri-Food Canada and the Nova Scotia Departments of Agriculture and Environment.

Acknowledgements

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Introduction

In this document global Canadian and Nova Scotian trends in wine consumption per capita are described. The intent is to provide supporting documentation for the Bayesian Network (BN) model of consumption being developed for the AgriRisk project. Global values provide the backdrop or context for local (Nova Scotia) wine consumption trends. In addition annual sales data from NSLC are used to estimate Patterns of wine sales and hence consumption for Nova Scotia.

Methods

Global data on grape consumption, production and areas under vines were downloaded from Anderson, Nelgen and Pinilla, *Global wine markets, 1860 to 2016: a statistical compendium (Anderson, Nelgen and Pinilla).* These data are available for download from the Adelaide University website and were used to produce graphs and figures for the global wine production and consumption sections of the report[1].

Data from Nova Scotia Liquor Corporation annual sales were used to explore annual total and per capita consumption of various wines. All non-grape wines (e.g. wines made from fruits or berries other than grapes) were removed prior to analyses. Statistical growth models were fit to the data using the *brms* package (Burkner, 2017) within R (R Core Team, 2017). For most of the analyses presented in this document non-linear models were fit using a 5-parameter Richards curve, general form of the logistic function (Richards, 1959). Priors for the Bayesian fits were assumed to be from normal distributions with initial values derived by fitting the data with the *nplr* package (Commo & Bot, 2016) in R which also identified the best fitting form of the Richards curve.

In general models were fit using 7000 iterations with a maximum *tree depth* of 25 and an *adapt delta* of 0.99. All results were examined to see that the four chains were well mixed, that the chains had converged, that the *rhat* parameter was close to one and the effective sample size was reasonable. In addition, models were examined to ensure they made physical sense (e.g. upper or lower asymptotes did not contradict bio-physical realities).

In early February 2018, an online survey was administered to a panel managed for NSLC by Corporate Research Associates (CRA). The survey sought to understand patterns in, and factors associated with, changes in recent drinking experiences among Nova Scotians represented in the survey panel. Altogether 1601 valid responses were received. These data were analysed using self-organising maps (SOM) {Kohonen, 1982 #8671}, tree augmented naïve Bayes (TAN) modelling {Friedman, 1997 #4778;Madden, 2009 #5252} and topic modelling {Blei, 2012 #4263} for the narrative elements of the survey responses.

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[1] Anderson, K. and V. Pinilla (2017), Annual Database of Global Wine Markets, 1835 to 2016, Wine Economics Research Centre, University of Adelaide, August (freely available in Excel files at www.adelaide.edu.au/wine-econ/databases).

Results

In this section of the report we start by highlighting trends in global wine consumption and production using the data from Anderson and Pinilla. The intent is to provide comparisons and context for the follow-on section in which we examine patterns and trends in Nova Scotia.

Thereafter we examine patterns of wine sales in Nova Scotia using the NSLC annual sales data. Finally, we look at the NSLC panel survey to identify patterns in the situations people reported on as being their most recent alcohol consumption experience and patterns of change in alcohol consumption.

What is happening to global wine production and consumption?

Area under vines – global and for select countries

Global area under vines has been declining since about the late 1960's to a low point of just under 7 million hectares in 2010 ~ an almost 50% decline. Between 2010 and 2016 there was an upsurge to 7.6 million hectares (Figure 1). Worthy of note is the massive expansion of vine area in China, from zero in the early 1960's to over one quarter of the world's area by 2016. Also noteworthy is the massive decrease in Italy's vine area from the early 1950's. Canada's area under vines increased from the early 1990's; however, since 2011 this growth has flattened off (Figure 2).

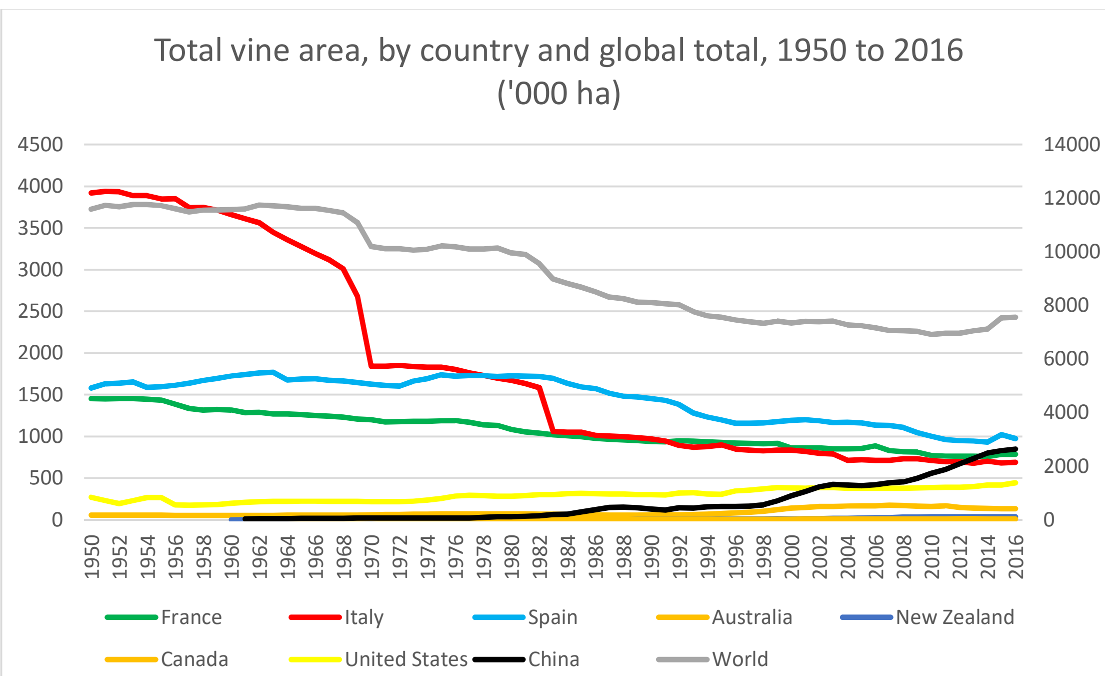

Figure 1. Total vine area, by country, 1950 to 2016 ('000 ha). Source: Anderson and Pinilla, 2017.

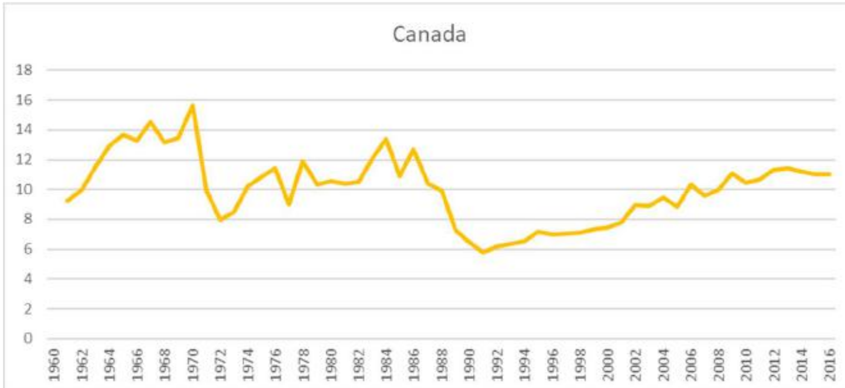

Figure 2. Total vine area, Canada, 1960 to 2016 ('000 ha). Source: Anderson and Pinilla, 2017.

Production of wine – global and for select countries

Global production of wine has stabilised since the mid to late 1980’s at about 27 million kilolitres (Figure 3). Dramatic decreases are notable for European producers France and Italy with increases for Australia, USA and Spain and to a much lesser extent China and New Zealand. Canada’s production appears to have plateaued at about 55,000 KL. These production figures translate into a global per capita average production of about 4ltrs over the last 10 years (Figure 4).

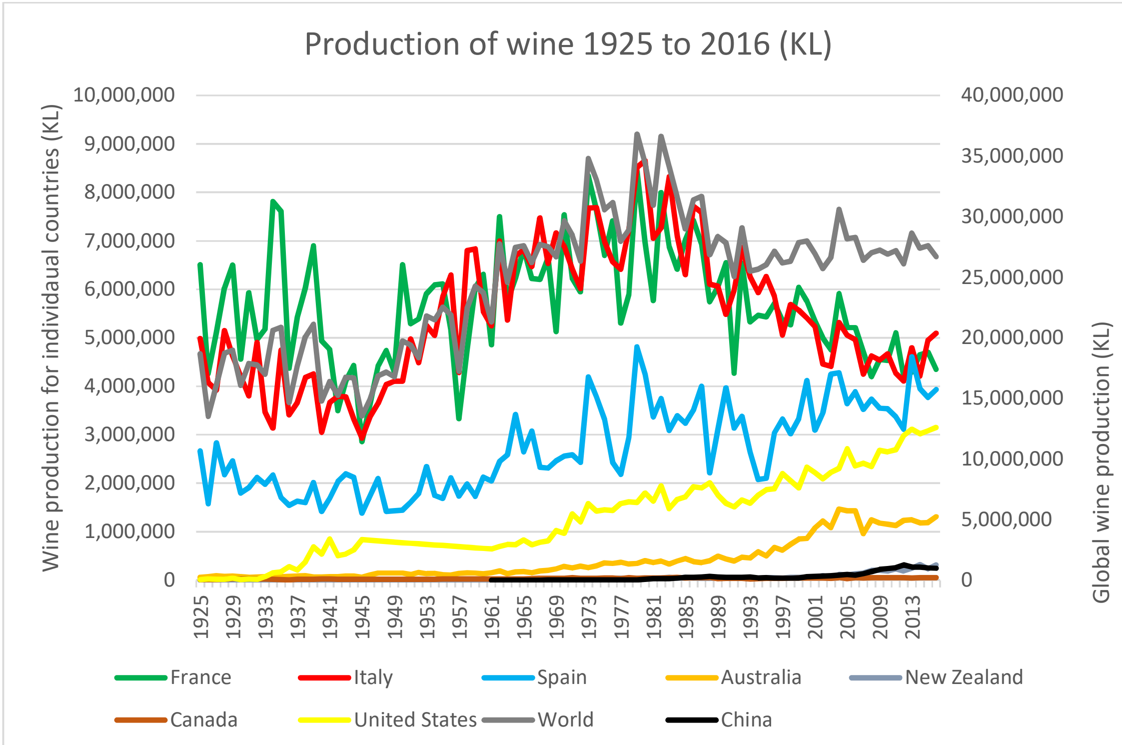

Figure 3. Wine production (KL) for select countries and global production 1925 to 2016. Source: Anderson and Pinilla, 2017.

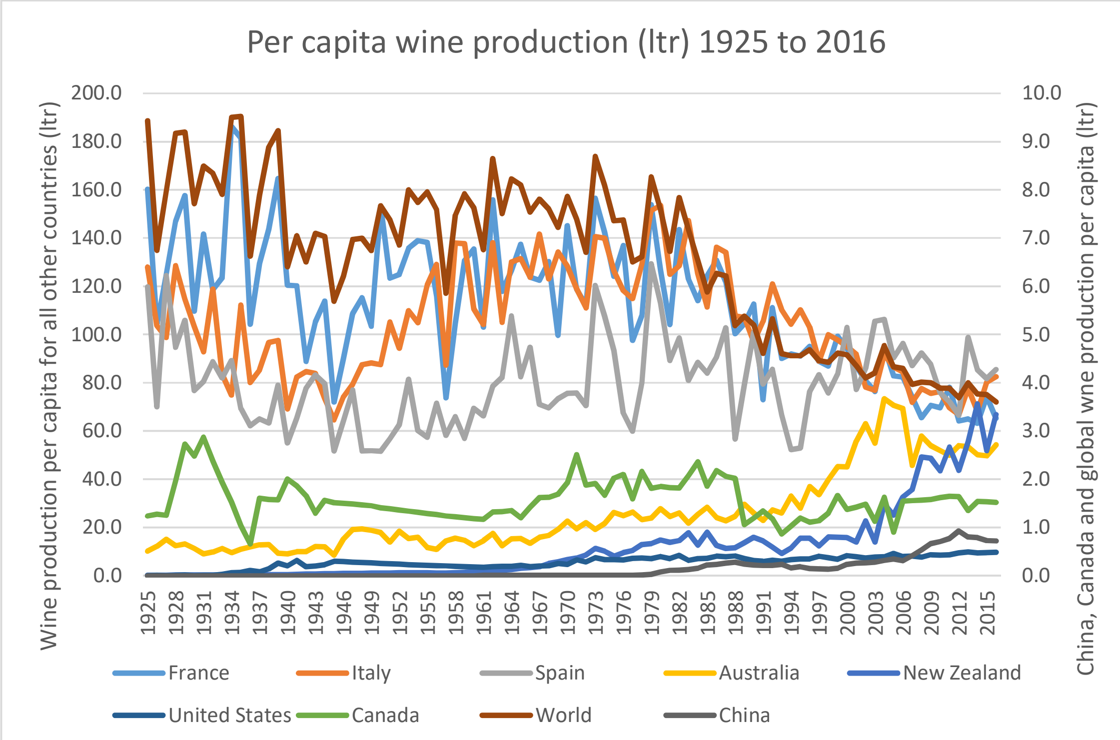

Figure 4. Per capita wine production (KL) for select countries and global production 1925 to 2016. Source: Anderson and Pinilla, 2017.

Consumption per capita for our select countries

Per capita wine consumption for major European wine producing countries has steadily and dramatically declined since after the second World War (Figure 5). In contrast, per capita consumption for Canada, USA, Australia and New Zealand has been steadily increasing since the early to mid-1960's, although this increase seems to have flattened out since about 2010 (Figure 6).

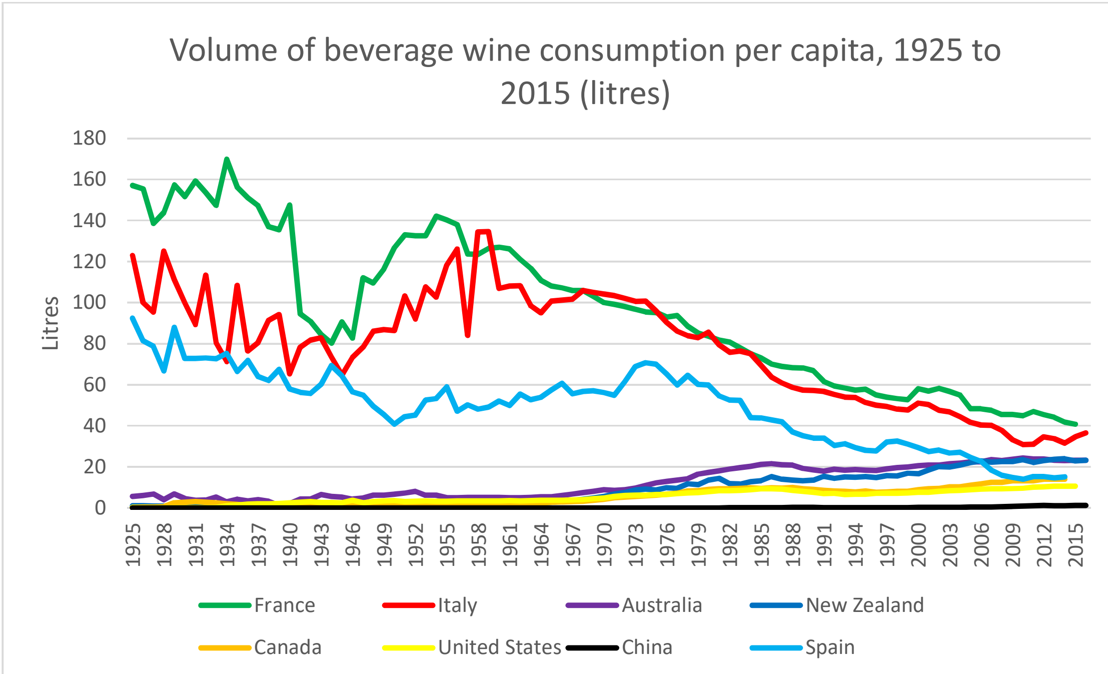

Figure 5. Volume of beverage wine consumption per capita, 1925 to 2015 (litres). Source: Anderson and Pinilla, 2017.

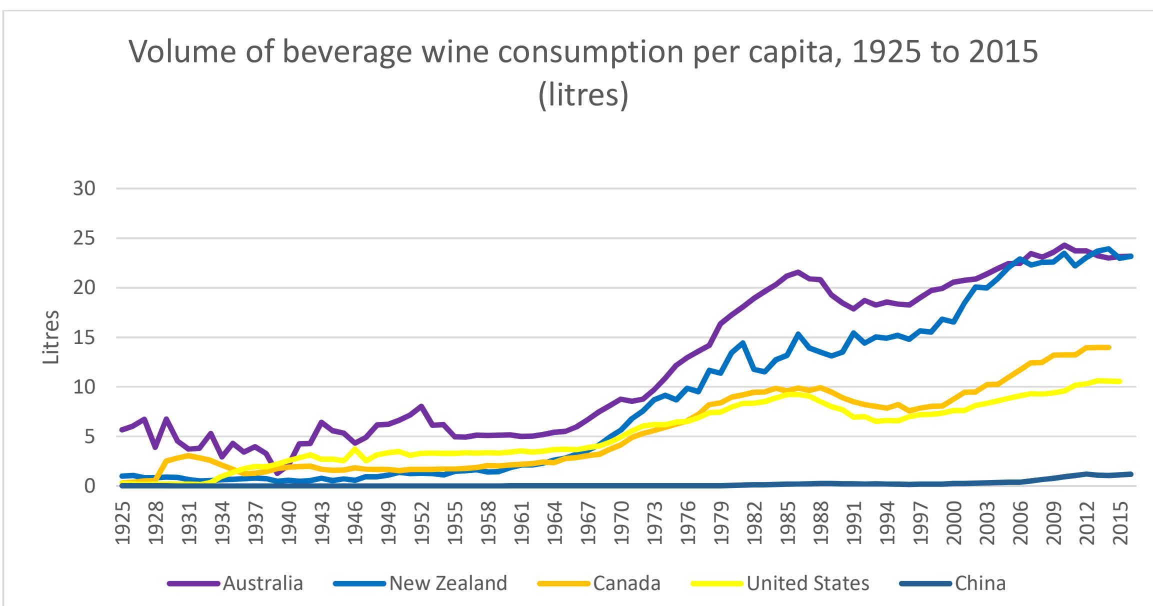

Figure 6. Volume of beverage wine consumption per capita, 1925 to 2015 (litres) for Australia, New Zealand, Canada, the USA and China. Source: Anderson and Pinilla, 2017.

Total alcohol consumption per capita

Since the 1950's per capita alcohol consumption has declined for France, Italy and Spain, increased dramatically for China and remained relatively constant since the early 1990's for Australia, New Zealand, Canada and the USA (Figure 7). The average per capita alcohol consumption across these eight countries between 2010 and 2014 is just over 7 litres per capita.

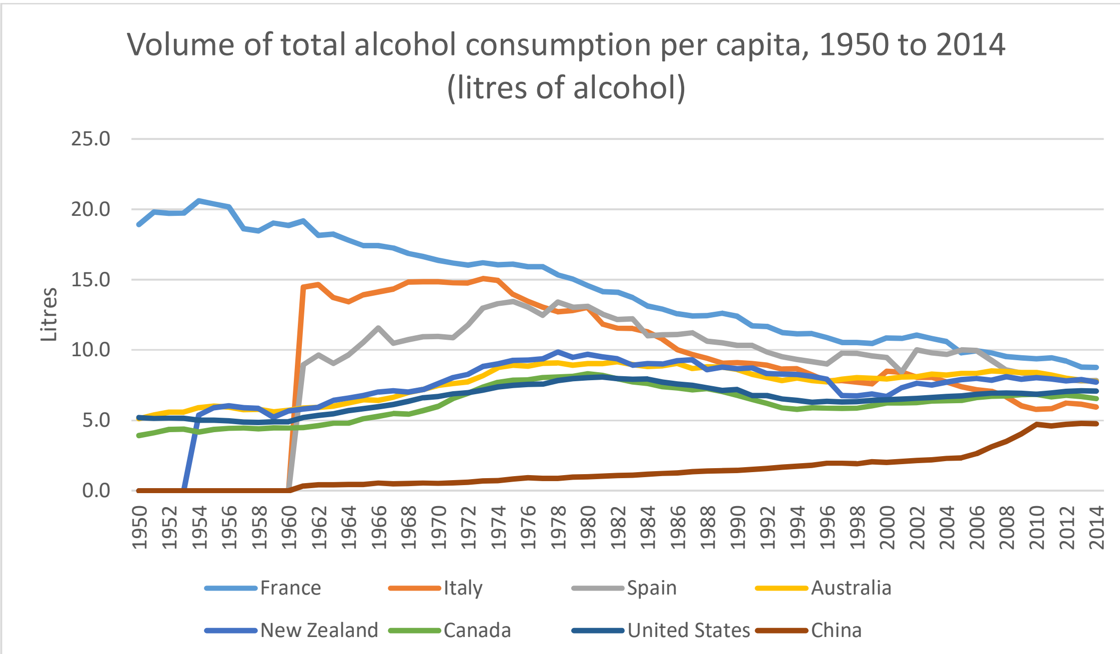

Figure 7. Volume of total alcohol consumption per capita, 1925 to 2015 (litres of alcohol) for select countries. Source: Anderson and Pinilla, 2017.

Percent wine, beer, spirits for our select countries

Wine's share of total alcohol consumption has seen steady increases for Canada, Australia and the USA but has declined in France (Figure 8). For Canada the share was about 25% in 2014 (the most recent data). For Canada, wine appears to be replacing beer and spirits (Figure 9, Figure 10).

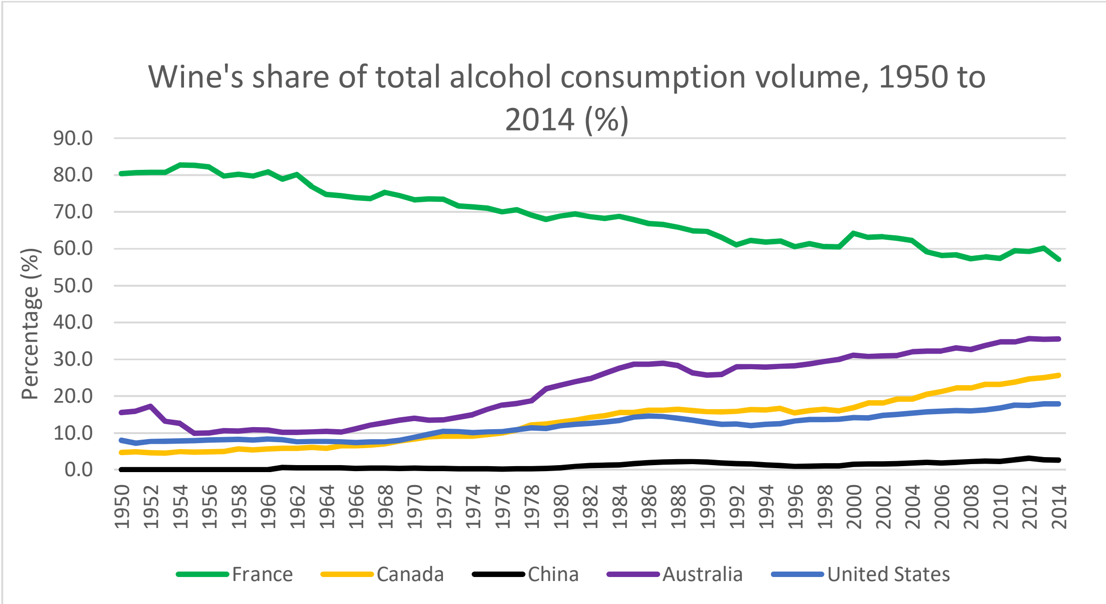

Figure 8. Wine's share of total alcohol consumption volume, 1950 to 2014 (%). Source: Anderson and Pinilla, 2017.

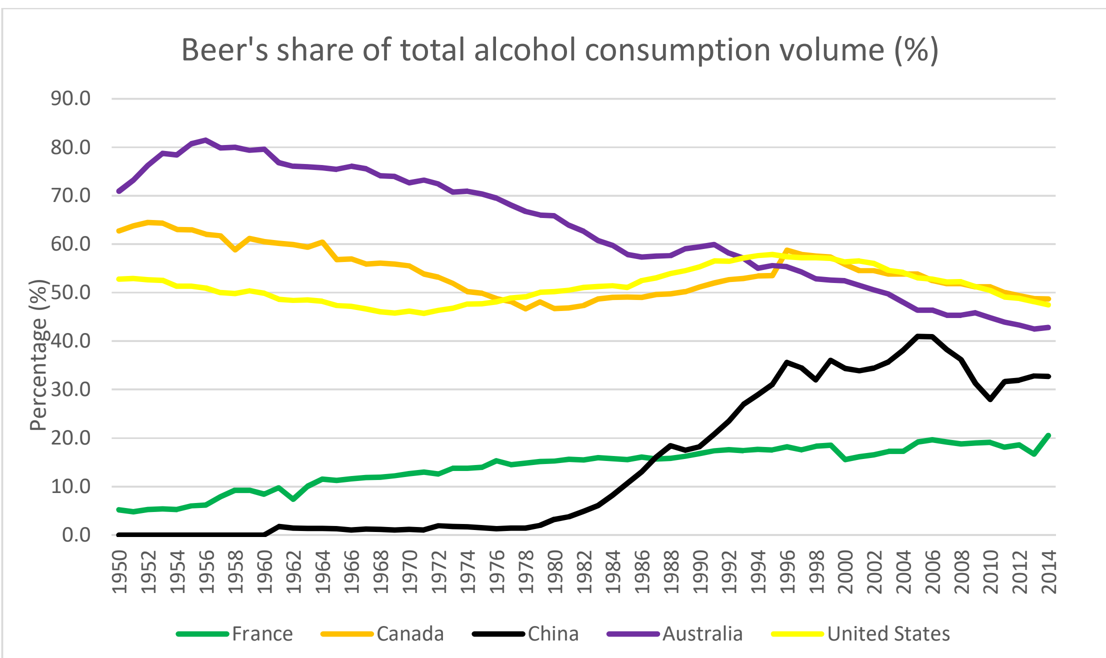

Figure 9. Beer's share of total alcohol consumption volume (%). Source: Anderson and Pinilla, 2017.

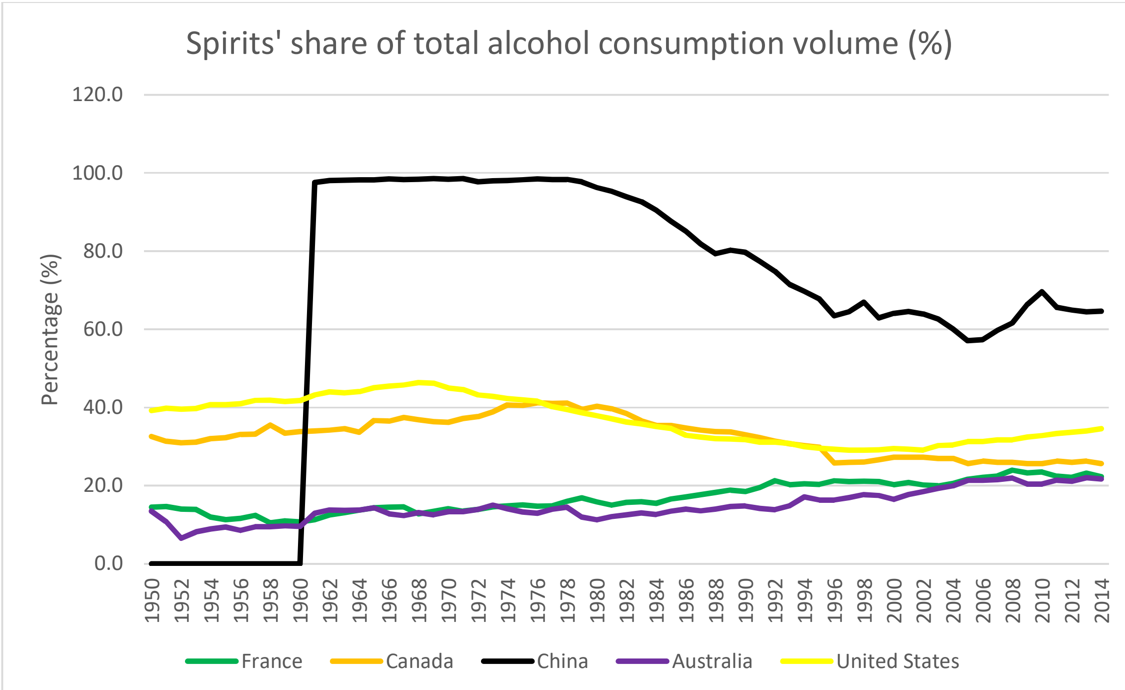

Figure 10. Spirits' share of total alcohol consumption volume (%). Source: Anderson and Pinilla, 2017.

Summary of global patterns

Although there has been a slight upturn in the global area under vines the total area has remained relatively stable at about 7.5 million hectares. Since about 2011 Canada's area under vines has been stable at about 11,000 ha.

What is happening in Canada?

Canada production, imports, consumption, exports

Canadian wine production per capita has remained relatively static for the past 20 odd years at between 1.5 and 1.6 litres per capita per year (Figure 11). So, per capita wine consumption in Canada (at around 13 to 14 litres per capita per year over the period 2010 to 2014) is largely being satisfied through imports. Since about 2012, per capita exports from Canada increased quite dramatically to exceed production.

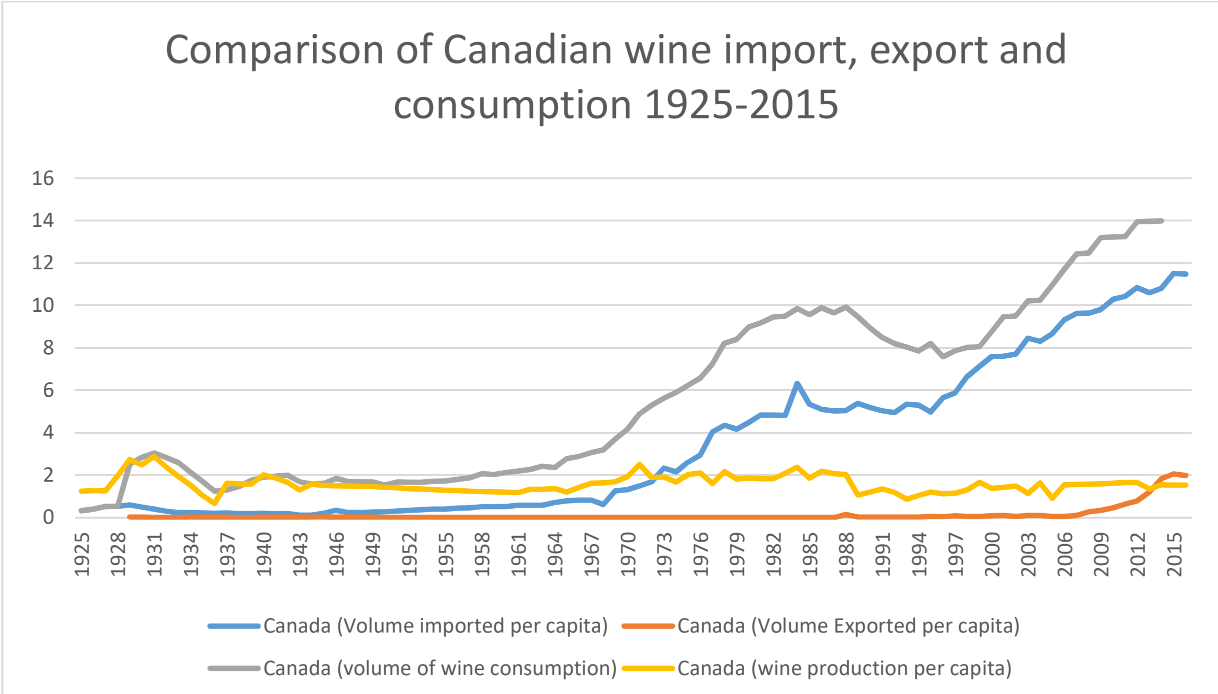

Figure 11. Comparison of Canadian wine import, export and consumption 1925-2015. Source: Anderson and Pinilla, 2017.

What is happening in Nova Scotia?

In this section we focus on wine sales data from NSLC to explore patterns in wine sales through time. Good data was available for the 2008 / 09 to 2016 / 17 financial years. The data that were used were for purely grape wines. No non-grape fruit or other non-grape wine data were used.

We start by exploring total consumption (per capita) of wine and then examine trends in wine consumption for imported wine, Nova Scotia wine (i.e. with a minimum of 85% Nova Scotia grapes) and Nova Scotia bottled wines.

Total wine sales through NSLC

Analysis of per capita sales data identified a slow decline in the per capita volumes and dollar values of wine sales in Nova Scotia through NSLC outlets (retail and wholesale). The best fitting statistical model suggests a plateau in per capita volume sales of about 11 litres per capita and a sales value of almost $150 per capita per year (Figure 12, Table 1). Year on year changes in per capita sales (volume and value) have shown steady declines since 2012_13 financial year although 2015_16 financial year went against that trend (Figure 13, Figure 14).

Whilst farm gate sales are not included in these total sales they are unlikely to change the overall picture as they comprised only 4 to 5% of the total value of NSLC sales included in this analysis[2].

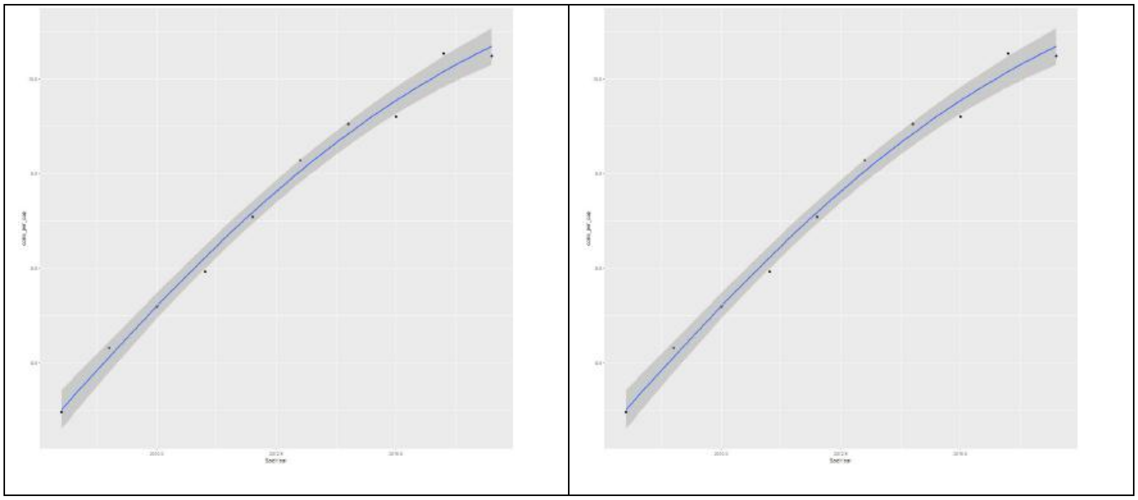

Figure 12. Per capita sales of all grape wines through NSLC outlets: left is volume in litres per capita and right is value in CAD per capita. The dots identify the data, the trend lines and 95% confidence bands were derived from fitting non-linear statistical models.

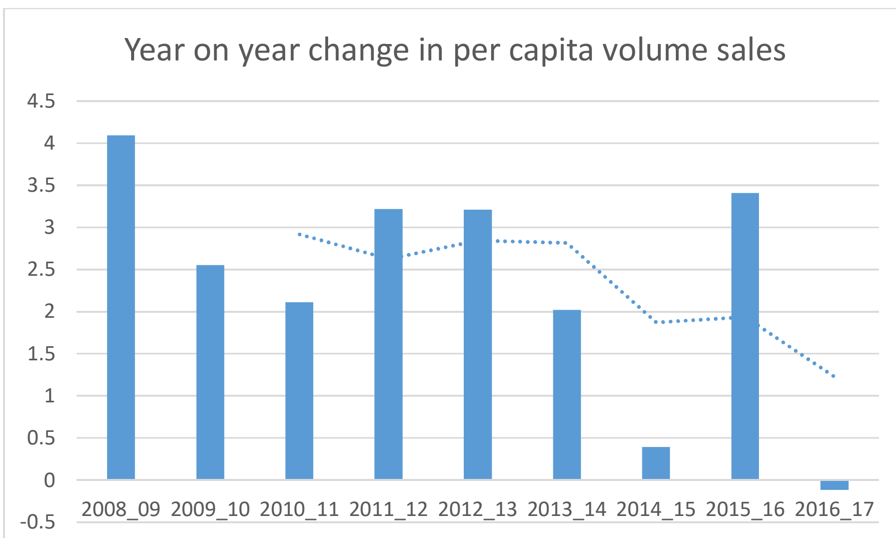

Figure 13. Year on year change in per capita sales (volume) as a percent with 3-period moving average trendline for comparision.

[2] Farm gate sales make up a more important proportion when looking at NS Wine sales and will be considered more fully when those analyses are presented.

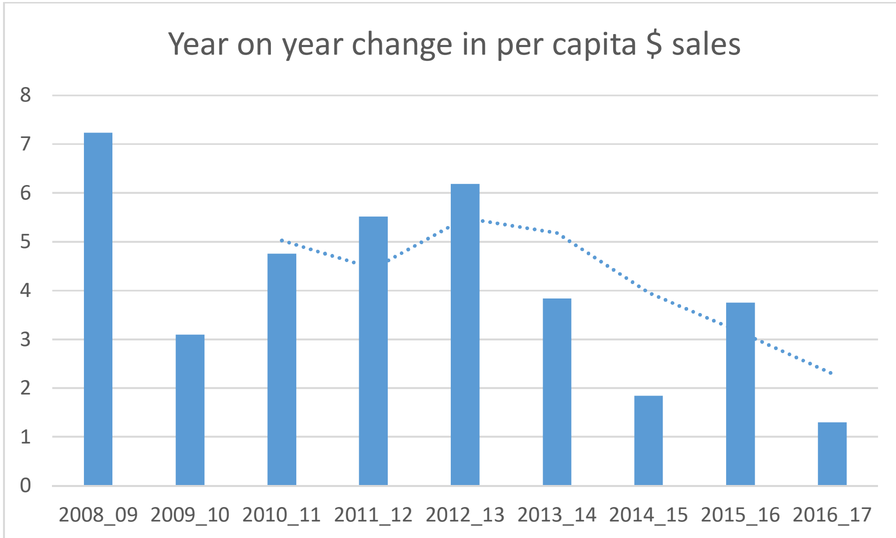

Figure 14. Year on year change in per capita sales ($ value) as a percent with 3-period moving average trendline for comparision.

Table 1. Results of Bayesian non-linear modelling of total per capita sales of wine (top volume and bottom value). Best model was a four-parameter model and hence the scale parameter is set to 1.

VOLUME

```
Inference for Stan model: gaussian(identity) brms-model.
4 chains, each with iter=7000; warmup=3500; thin=1;
post-warmup draws per chain=3500, total post-warmup draws=14000.
```

parameter	**mean**	**sd**	**2.50%**	**25%**	**50%**	**75%**	**97.50%**	**n_eff**	**Rhat**
lower asymptote	5.38	0.34	4.68	5.15	5.38	5.62	6.03	4895	1
upper asymptote	10.87	0.17	10.56	10.75	10.86	10.98	11.25	4658	1
max growth rate	0.09	0.01	0.07	0.08	0.09	0.09	0.11	5264	1
when max growth	2007.57	0.58	2006.46	2007.17	2007.56	2007.96	2008.74	5258	1
scale	1	0	1	1	1	1	1	14000	1
sigma	0.08	0.02	0.05	0.06	0.07	0.09	0.14	4483	1

VALUE

Inference for Stan model: gaussian(identity) brms-model.

4 chains, each with iter=7000; warmup=3500; thin=1;

post-warmup draws per chain=3500, total post-warmup draws=14000.

parameter	mean	sd	2.50%	25%	50%	75%	97.50%	n_eff	Rhat
lower asymptote	88.44	3.4	80.99	86.38	88.71	90.8	94.35	3863	1
upper asymptote	149.46	2.12	145.56	148.04	149.33	150.72	153.95	4851	1
max growth rate	0.18	0.02	0.15	0.17	0.18	0.19	0.21	4662	1
when max growth	2011.45	0.34	2010.73	2011.24	2011.46	2011.68	2012.1	3889	1
scale	1	0	1	1	1	1	1	14000	1
sigma	1.34	0.45	0.77	1.04	1.25	1.53	2.48	4130	1

Nova Scotia wine sold through NSLC as well as estimates of farm gate sales

Sales of Nova Scotia wines show a similar pattern of declining per capita sales both in terms of volume and value (Figure 15). Although farm gate sales increase the per capita value[3] of sales by an average of about 43% each year, over the period 2014_15 to 2016_17 the overall pattern of sales was still best described by a non-linear model with an upper asymptote of almost $19 per year per capita (

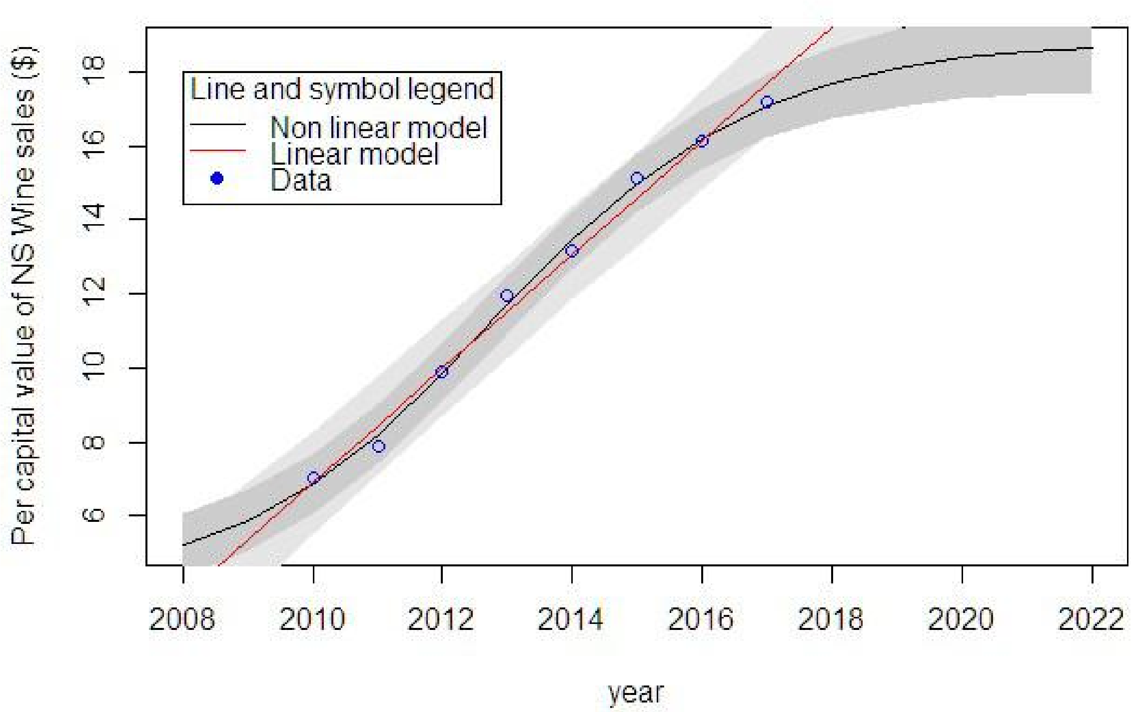

Figure 16). If volumes followed a similar trend (i.e. farm gate sales volume added 43% to the per capita totals) then the asymptote of per capita volume of NS Wine sales (including farm gate) would be about 750ml per capita per year.

[3] At the time of this analysis we did not have farm gate volumes that we could use for this analysis.

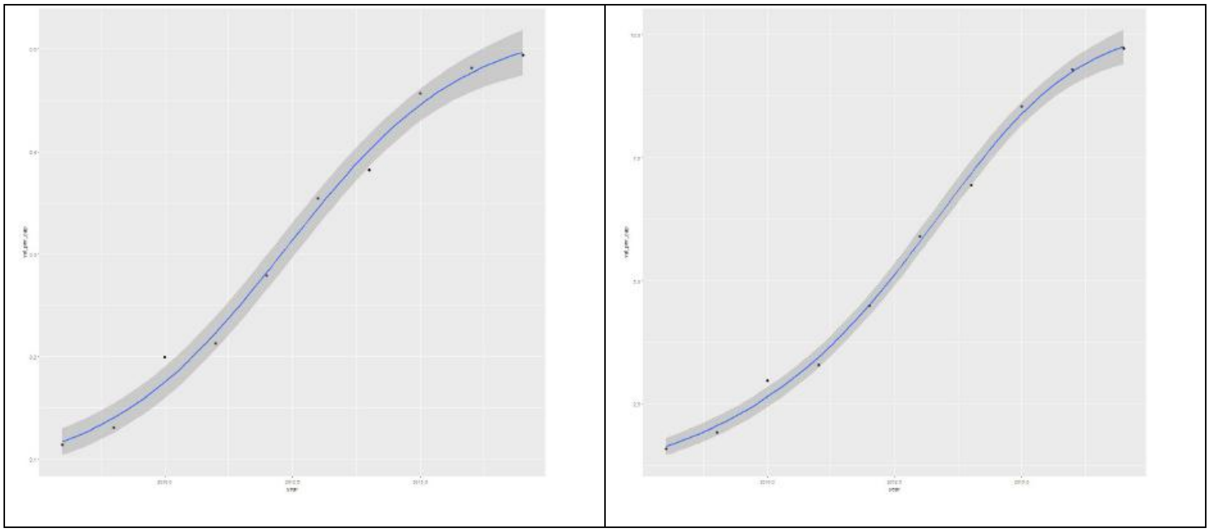

Figure 15. Per capita sales of Nova Scotia wines (with a minimum of 85% Nova Scotia grapes) through NSLC outlets: left is volume in litres per capita and right is value in $ per capita. The dots identify the data points, the trend lines and 95% confidence bands were derived from fitting a non-linear statistical model.

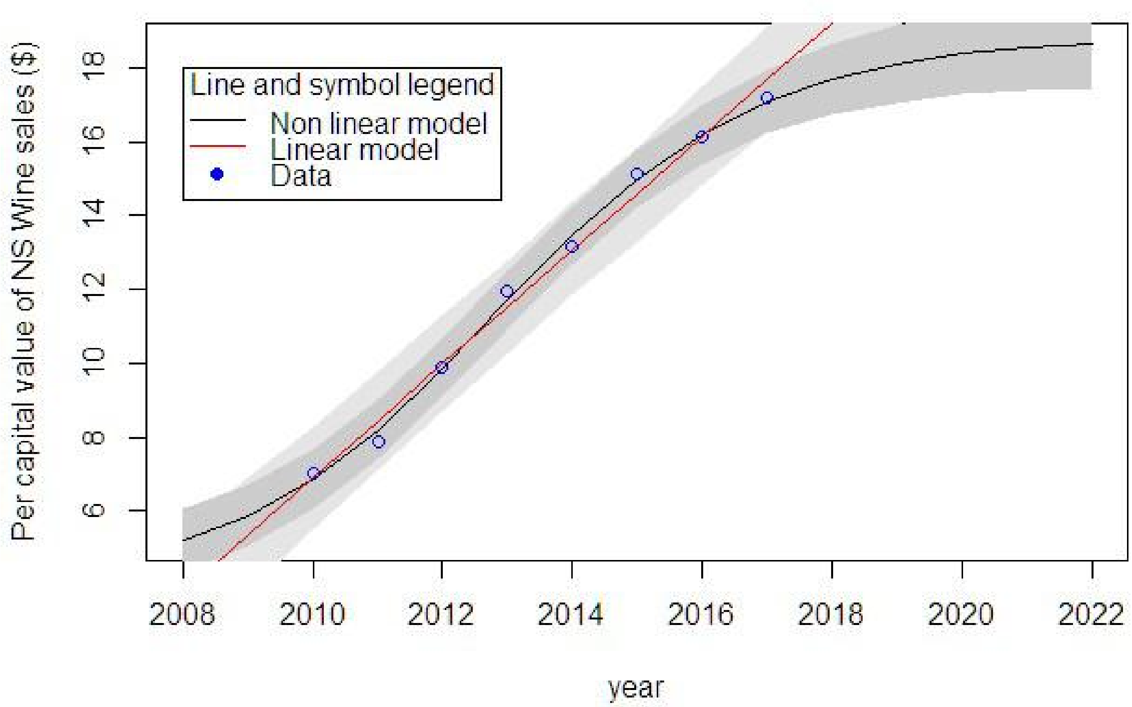

Figure 16. Per capita sales of Nova Scotia wine inclusive of farm gate sales estimate projected from 2008 to 2022. Plot shows best fitting non-linear model, linear model and data. Data was

only available for 2000_10 to 2016_17 financial years. Background shading indicates 95% confidence intervals for linear model (lightest grey at back of plot) and non-linear model (darker grey towards front of plot).

Nova Scotia bottled wine sold through NSLC

The trends on per capita sales of Nova Scotia bottled wine are highly uncertain. The notable drop in per capita sales in the 2013_14 and 2014_15 financial years followed by a resurgence in sales in the last two years of the series means these results are uncertain and should be treated with caution (Figure 17). Given the available data, Presently, the best fitting (non-linear) model suggests an upper asymptote of just about 2.4 litres per capita per year with sales value having an upper asymptote of almost $23 per capita per year.

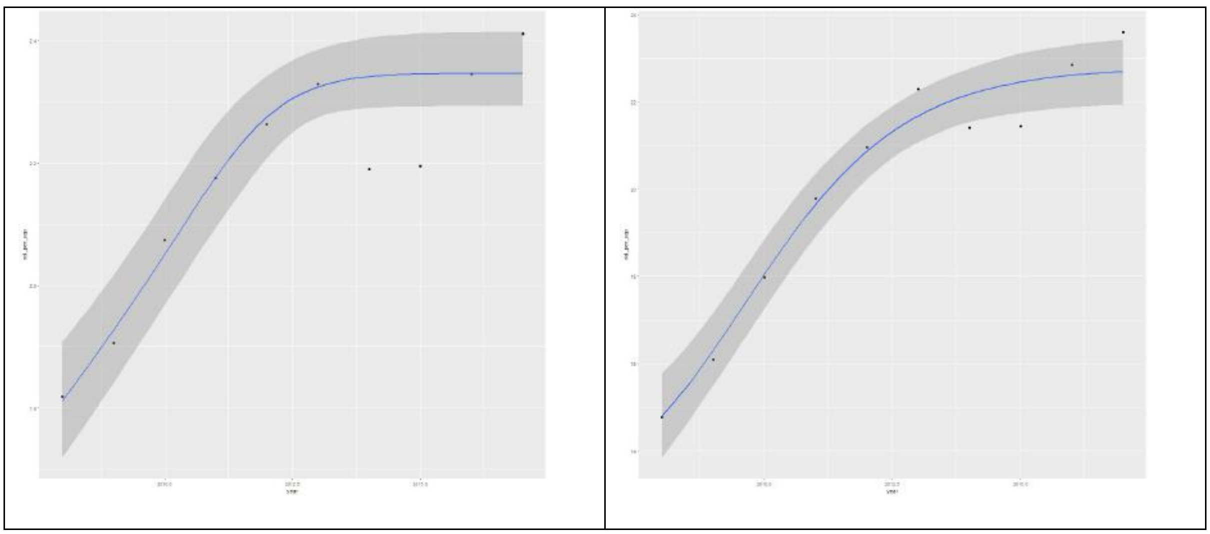

Figure 17. Per capita sales of Nova Scotia bottled wines (with less than 85% Nova Scotia grapes) through NSLC outlets: left is volume in litres per capita and right is value in $ per capita. The dots identify the data points, the trend lines and 95% confidence bands were derived from fitting a non-linear statistical model.

Sales of imported wine through NSLC

The pattern in per capita volume sales (as indicated by the non-linear model fit) suggests a strong upper asymptote on volume sales but a much more gradual decline in the dollar value of sales (Figure 18). The upper asymptote for volume was estimated to be just over 7 litres per capita whilst the value upper asymptote was estimated to be a little over $112 per capita per year.

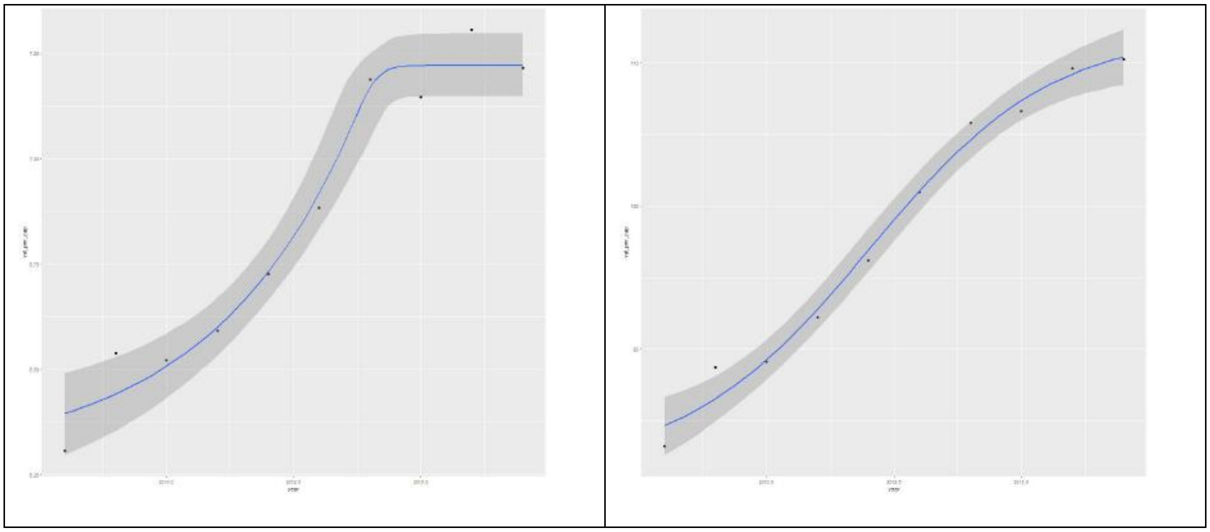

Figure 18. Per capita sales of imported wines through NSLC outlets: left is volume in litres per capita and right is value in $ per capita. The dots identify the data points, the trend lines and 95% confidence bands were derived from fitting a non-linear statistical model.

Summary

Across each of the wine categories examined (as well as total wine sales volumes and value) per capita volume and dollar value sales were found to be declining through time. Best fitting non-linear models suggest upper asymptotes on sales. There is of course considerable uncertainty in the models and new data may find these models wanting. They are however the best fitting models for the available data. Total wine sales, Nova Scotia wine sales and imported wine sales were all well described by the best fitting models. Models fit to sales of wines made from less than 85% Nova Scotia grapes and bottled in Nova Scotia were more uncertain and their values should be treated with caution.

Given the available data, our best estimate of per capita wine sales (volume and value) is summarised in Table 2 below.

Table 2. Summary of estimates of asymptotic wine sales (volume and dollar value) by category. Both volume and value include farm-gate sales, but the volume estimate is crude and requires revision once the data becomes available.

Wine category	Volume per capita (ltrs) Asymptote estimate[4]	Volume 95% CI	Value per capita ($) Asymptote estimate	Value 95% CI
Nova Scotia wines (85% Nova Scotia grapes) including farm gate sales	0.76	0.71 – 0.80	18.84	17.79 – 20.09
Nova Scotia wines – bottled	2.35	2.29 – 2.41	22.80	22.00 – 23.61
Imported wines	7.22	7.15 – 7.30	112.22	109.59 – 115.14
Total	10.33	10.15 – 10.51	153.86	149.38 – 158.84

[4] Estimated assuming NS Wine volume sold through farm gates sales was the same proportion as the value (i.e 43%).

Drinking situations and changes in drinking patterns in Nova Scotia

Situations in which people consume alcohol

As part of the survey to NSLC panellists, respondents were asked to identify situational factors (what they drank, how much they drank, where, with whom, how many people were there and what the event or situation was) associated with a specific, recent experience in which they consumed alcohol. The majority (76%) of drinking experiences were relatively recent (within the last month, Figure 19). Most of these experiences were associated with mild drinking (1 to 3 drinks), at home and with family members (Figure 20). However, this simple description masks considerable diversity in the patterns of drinking situations. Although every person's drinking experiences are personal and unique we sought to identify broad patterns in alcohol consumption.

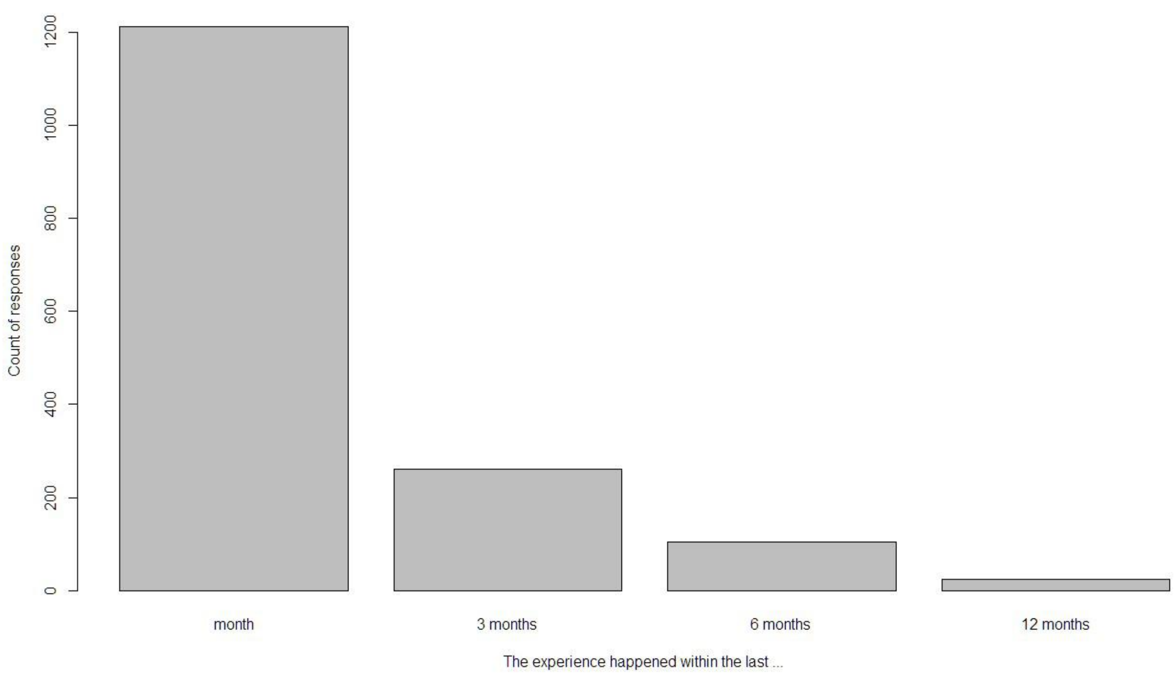

Figure 19. Frequency of reported drinking experiences (n=1601). Source: NSLC panel survey.

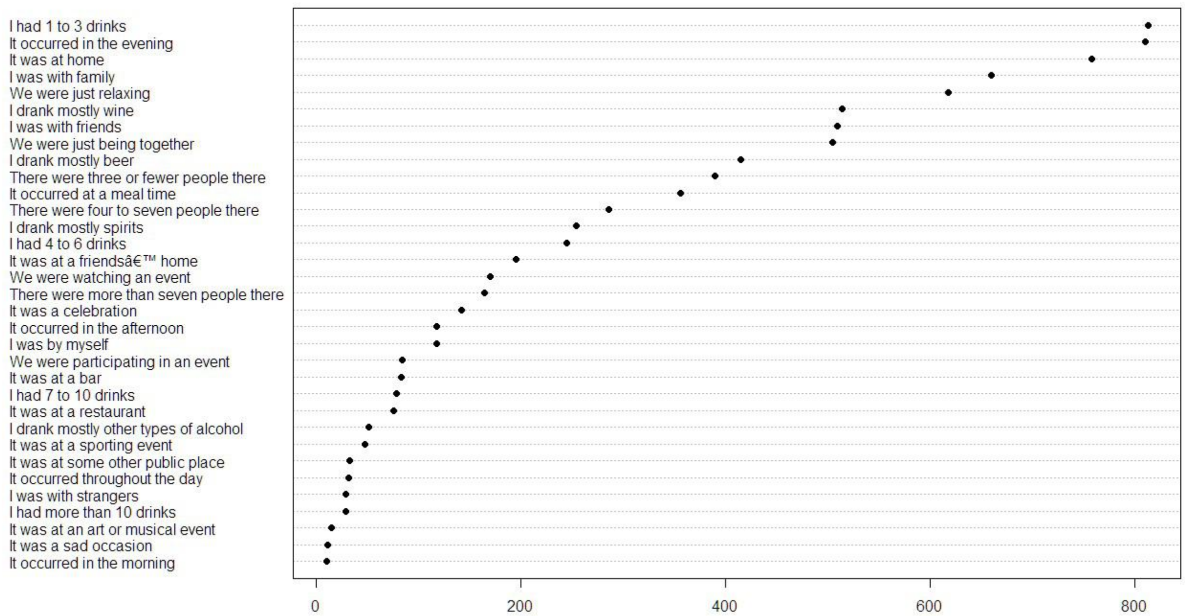

Figure 20. Dot chart of frequency of drinking situation attributes across survey question 5. Source: NSLC panel survey.

We sought to identify predictable patterns in the reported experiences of alcohol consumption in a twostep process: firstly, responses to Question 5[5] of the survey instrument were used to develop a self-organising map (SOM) as a classifier of responses. SOMs are a class of artificial neural network (Kohonen, 1982) that have been shown to be very accurate in market

[5] The following question was presented to respondents: “By moving items from the left-hand side to the right-hand side, please provide more detail of the experience you just described. Move only those elements that were true for the experience you just described.” Respondents were presented with a column of 33 options and asked to move each option to an empty right-hand column. The first 4 items they were presented with related to type of alcohol (beer, wine, spirits, other); the next 4 related to how much they drank (1 to 3, 4 to 6, 7 to 10 and more than 10 drinks); the next 4 related to who they were with (by myself, friends, family, strangers); the next 3 related to how many people were there (less than 4, 4 to 7, more than 7); the next 7 options related to where the event took place (at home, at a bar, at a friends home, at a sports or art / music event, restaurant, some other public place), there were then 5 timing options (morning, afternoon, evening, meal time, throughout the day) and finally a set related to what the situation was (celebration, relaxing, sad occasion, being together, watching an event, participating in an event). Responses to Q5 were divided into 8 sub-questions in the data set each approximately relating to one of the 7 categories of response options and an 8th which was not-applicable or other. Thus for example Q5.1 largely dealt with what was drunk; Q5.2 with how much was drunk, etc.

This question related to an experience that respondents had just described, using an open-ended text format:

“Recall the most recent experience you had of drinking alcohol. Using the text box below please tell us about it.”

segmentation and classification of high dimensional data (Bigné, Aldas-Manzano, Küster, & Vila, 2010; Boone & Roehm, 2002; Li, Law, & Wang, 2010).

A 5 by 5 grid was used which yielded the 25 categories (Figure 21). The SOM analysis resulted in individual responses being assigned to one of 25 SOM categories. The category assignment provided the basis for a tree augmented Naïve Bayes (TAN) classification {Jiang, 2012 #5254;Friedman, 1997 #4778} of results. The TAN model used the category as target and the same data used in the SOM (i.e. responses to Q5) as inputs. The TAN model was tested using 10-fold cross validation and was found to predict SOM category correctly (overall) 79% of the time. Overall 1227 (76%) of the responses were assigned to groups that were accurately predicted by the TAN model where accurately predicted was taken to mean group membership was predicted with >60% accuracy and with low variance. Categories 1, 15, 19, 21, 22, 23 and 24 were included in this reliable set[6]. In general, these were the groups with larger numbers of responses (Table 3). Although the overall prediction accuracy was very high, most of the categories were not predicted well. However, these categories accounted for a minority (24%) of responses. For the most part this is likely to be due to insufficient numbers of responses in these groups to adequately train the TAN model.

SOM category results were subject to a k-mean clustering using 6 clusters[7]. The clusters were used to help identify groupings within the SOMs (Figure 21, Figure 22).

None of the socio-demographic variables used in the survey (age, gender, income, employment status, living situation or marital status) meaningfully explained membership of SOM categories.

[6] Category 1 was borderline in this set given its high standard deviation of prediction accuracy.
[7] A scree plot was used to select the number of clusters.

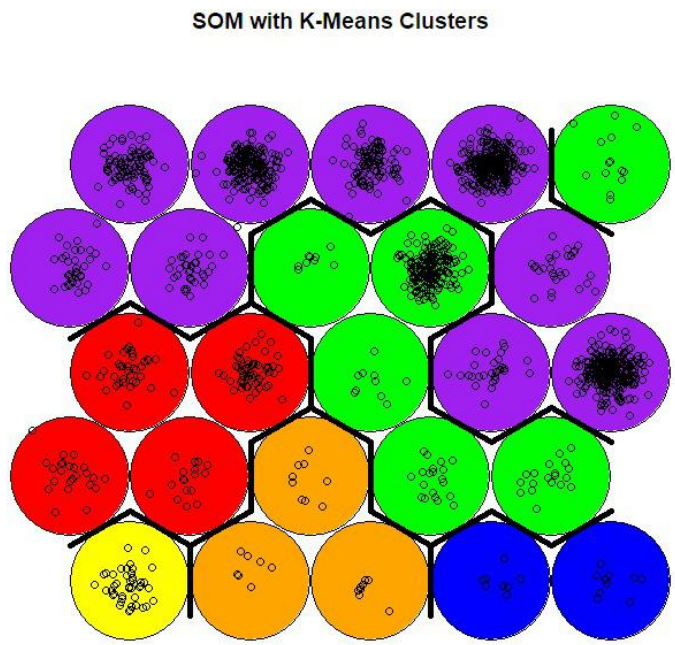

Figure 21. SOM categories with points for each response assigned to each category. Each open circle in the map represents one response in the survey results. Categories are coloured by k-means cluster (n=6). The map is read from bottom left to top right: bottom left (yellow) circle is category #1; bottom right (blue) circle is category #5; top right (green) circle is category #25. The closer together responses are on the map the more similar they are. Source: NSLC panel survey.

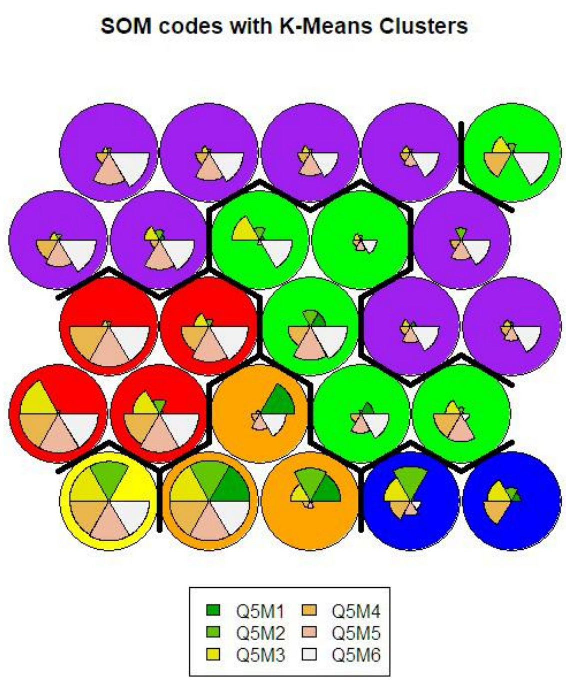

Figure 22. SOM categories with radial plots in each category to show the relative weight or contribution of each variable (question 5 with Q5M1 being the first ranked item for question 5; Qm52 being the second ranked item for question 5 and so on).

Categories are coloured by k-means cluster (n=6). The map is read from bottom left to top right: bottom left (yellow) circle is category #1; bottom right (blue) circle is category #5; top right (green) circle is category #25. The closer together responses are on the map the more similar they are. The segments in each radial plot reflect the prominence of each option set in each category. Segments are read from dark green (Q5M1) in the north east sector anti-clockwise. Category 1 for example (bottom left) is dominated by responses from question rankings 2 to 6. The red cluster categories are dominated by question rankings 3 to 6. Source: NSLC panel survey.

In Table 3, nine of the most common alcohol consumption situations are described and the accuracy with which we could predict them are presented. The largest group in the SOM, category 24, had 323 members and comprised people who were largely wine drinkers, drinking 1 to 3 drinks of wine, usually with family and usually at home in the evening.

The next largest group, category 15, had 283 responses and comprised the heavier drinkers, usually of beer and spirits, who were about equally likely to be with family or friends and tended to drink at home or a friend's home in the evening.

Category 19 comprised about 200 responses from people whose most recent drinking experiences had been with larger groups of people that were more likely to drink beer but also drank wine, at home or a friend's home, mostly with friends or family and often in groups larger than 4 people.

Respondents in category 22, with 189 responses, were almost equally likely to drink wine, beer or spirits, just a few drinks, usually at home, mostly with family but quite often by themselves in the evening to relax.

Category 23 comprised 102 respondents whose last experience had been in a larger gathering, often at a restaurant or other public place, roughly half drank wine, one third beer and a few spirits and usually with friends or family.

Category 21 respondents (86) were slightly more likely to drink wine than beer but also a few drank spirits, often drank alone or with friends and sometimes drank more than 4 drinks.

Category 1 (44 responses, bottom left, yellow circle in Figure 22) represents predominantly beer drinkers, (with some wine drinkers mixed in) who did not identify other factors associated with their drinking experience.

Table 3. Self-organising map (SOM) categories and 10-fold cross validation testing of tree augmented Naive Bayes (TAN) model that was fit to the situation data with SOM categories as the target variable. Brief descriptions of select categories and probabilities of responses for those categories (taken from TAN model) are shown. Source: NSLC panel survey.

SOM Category	10-fold CV samples completed	mean % correct	sd	number of responses in category	Simple description of category	Category description with item probabilities from TAN model
1	10	0.69	0.2	44	**Simple beer and wine drinkers**	Predominantly beer drinkers (0.5) with some wine (0.3) and spirits (0.1); otherwise know little about them
2	7	0.48	0.41	7	**Not described**	
3	4	0.75	0.5	8	**Not described**	
4	3	0.33	0.58	8	**Not described**	
5	7	0.26	0.38	10	**Not described**	
6	10	0.45	0.33	24	**Not described**	
7	8	0.23	0.39	17	**Not described**	
8	5	0.2	0.27	9	**Not described**	
9	5	0.3	0.45	20	**Not described**	
10	5	0.1	0.22	19	**Not described**	
11	10	0.62	0.19	38	**Not described**	
12	10	0.6	0.23	55	**Relax at home with friends and family**	Wine (0.24), Beer (0.18) or spirits (0.12) drinkers; 1 to 3 (0.2), 4 to 6 (0.13) drinks; with family (0.27) or friends (0.13); at home (0.66); in the evening (0.67); just relaxing (0.35)
13	8	0.19	0.37	10	**Not described**	
14	10	0.46	0.35	28	**Not described**	
15	10	0.87	0.09	283	**Beer and spirit drinkers, tendency to heavier drinking**	Beer (0.5) and spirit (0.41) drinkers, 1 to 3 (0.5), 4 to 6 (0.33) drinks; with friends (0.51) and family (0.46); 3 or fewer (0.45) or 4 to 7 (0.3) people; at home (0.6) or friends home (0.23); in the evening (0.78)

16	10	0.65	0.38	34	**Beer, wine at restaurant**	Beer (0.35), wine (0.32) drinkers; 1 to 3 (0.5) drinks; with family (0.29) or friends (0.21); 4 to 7 (0.18) people; at restaurant (0.5); in the evening (0.38) or meal time (0.24); just being together (0.24).
17	10	0.37	0.4	35	**Not described**	
18	9	0	0	9	**Not described**	
19	10	0.9	0.03	200	**Heavier social drinkers, large groups**	Beer (0.41) and wine (0.33) drinkers; 1 to 3 (0.45) or 4 to 6 (0.24) drinks; with friends (0.69) or family (0.49); 4 to 7 (0.27) or more than 7 (0.22) people; at home (0.32) or friends home (0.21)
20	9	0.47	0.35	29	**Not described**	
21	10	0.79	0.18	86	**Drinking quite a lot, often alone**	Wine (0.44), beer (0.3) or spirits (0.20) drinkers; 1 to 3 (0.65) or 4 to 6 (0.17) drinks; by myself (0.36), with friends (0.29) or with family (0.24); at home (0.65); in the evening (0.42) or meal time (0.20).
22	10	0.88	0.07	189	**Mixed but light drinkers at home to relax**	Beer (0.33), wine (0.33) and spirits (0.29) drinkers; 1 to 3 (0.75) drinks; with family (0.49) or by myself (0.25); at home (0.78); in the evening (0.64); just relaxing (0.73)
23	10	0.83	0.09	102	**Bigger gathering, restaurant, public places**	Wine (0.53), beer (0.31) and spirits (0.13) drinkers; 1 to 3 drinks (0.78); with friends (0.45) or family (0.39); 3 or fewer (0.29), more than 7 (0.21) or 4 to 7 (0.14) people; at restaurant (0.4) or some other public place (0.22); in the evening (0.54) or at meal time (0.28)
24	10	0.94	0.06	323	**Wine at home**	Wine (0.8) and beer (0.2) drinkers; 1 to 3 (0.78) drinks; with family (0.55) or friends (0.4); 3 or fewer (0.46) or 4 to 7 (0.29) people; at home (0.67) or friends home (0.18); meal time (0.48) or evening (0.4)
25	4	0.75	0.5	14	**Not described**	

The majority, 1230 or 77%, of the described experiences were deemed to be typical drinking situations for the respondents (Figure 23). Whilst the proportion describing typical experiences varied by SOM category the proportion of typical was greater than 0.7 for the high reliability categories of the SOM / TAN analyses (Figure 24).

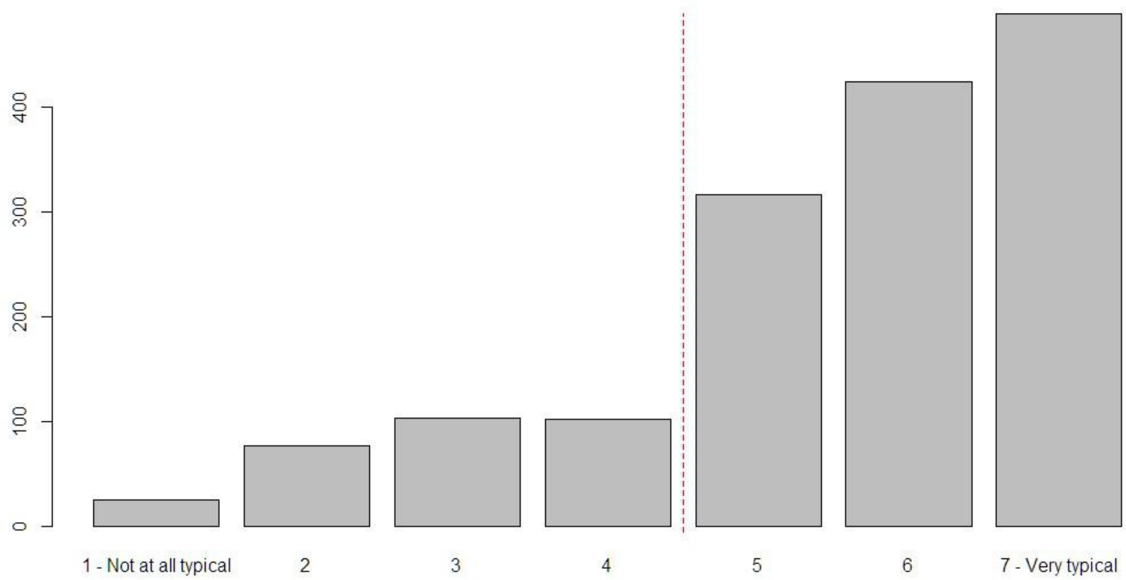

Figure 23. Frequency of responses to the question "How typical of your recent drinking experiences was this situation?" with respondents provided a 7-point scale for responses. The vertical dashed red line indicates the cut off used for typical versus atypical experiences. Score levels 5 through 7 were considered typical. Source: NSLC panel survey.

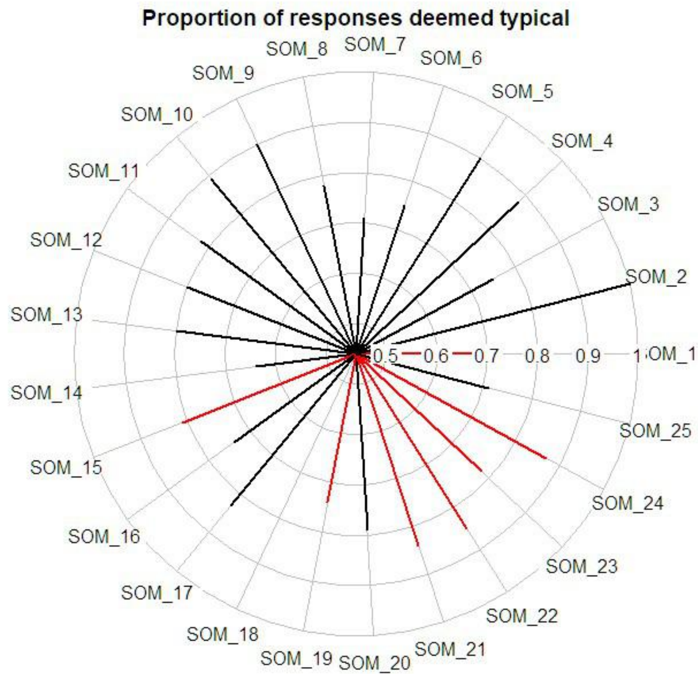

Figure 24. The proportion of responses in each SOM category that were classed as being typical based on responses to question 7. Red lines indicate most reliable categories used in subsequent analyses. Source: NSLC panel survey.

Changes in alcohol consumption patterns

Respondents were asked to identify the most significant changes to their current drinking experiences compared to typical experiences of 12 months previously[8]. Altogether 649 respondents (41%) identified no change (or in 6 cases did not know or remember) in their typical drinking experiences. The dominant type of change was in the amount of alcohol drunk (n=428, 27%) followed by who the respondent drunk with (n = 360, 22%) and the type of alcohol (n = 341, 21%, Figure 25).

[8] From the survey instrument, question 9: "Please use the table below to identify ***the most significant changes in your current typical drinking experiences*** compared to your typical drinking experiences of 12 months ago? Use the mouse to move items from the left column to the right to reflect things that have significantly changed. If they have not changed leave them in the left-hand column."

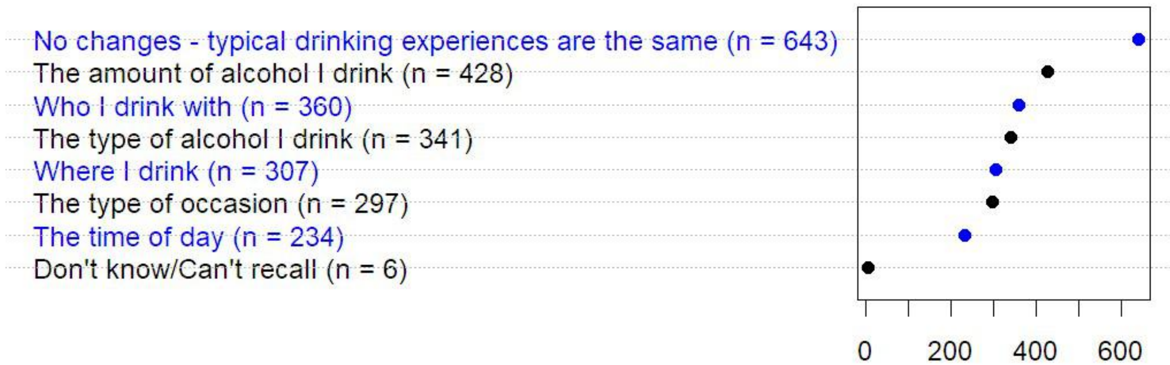

Figure 25. Counts of responses to changes in typical drinking situations. Source: NSLC panel survey.

Topic modelling[9] was used to explore the explanations given for changes in the typical patterns of drinking. The dominant topic was Topic 5 which was about people changing and wanting to change aspects of their life (Table 6). Thereafter topics 1, 8 and 6 were most common (Figure 26).

Table 4. Examples of explanations with a high proportion of Topic 5: "Developing a taste for

- *Simply wanted a change; tired of draft*
- *I was tired of drinking the same old Capt. Morgan wanted a change.*
- *Had surgery and my tastebuds changed*
- *Because I started a relationship with a craft beer lover who broadened my tastes.*

The second most common reason given for change (and hence second most common topic) was the desire to try new things as well as just experimenting with new drinks (Topic 1, Table 5).

[9] Topic modelling is a statistical modelling technique that works with words in a body of texts called the corpus. In this analysis the corpus was the set of responses people gave to the following question: "If a close friend or relative asked you why these most significant changes came about, what would you tell them?" Topic models are distributions of words over topics (with the number of topics selected by the analyst) and thence distributions of topics over documents. The analyst selects the number of topics to use and then the algorithm fits the word probabilities to these topics. All texts are stemmed (i.e. words are converted to their basic stem so words like "rain" or "raining" are treated as the same stem, "rain") and very common but not particularly useful words (e.g. "the", "and", "for") are removed. A brief introduction to topic modelling is presented in Blei (2012). For the analyses presented here the R package stm (Roberts, Stewart, & Tingley, 2014; Roberts, Stewart, Tingley, et al., 2014) was used.

Table 5. Examples of explanations with a high proportion of Topic 1: "Trying new things"

- *I chose a Nova Scotia product and love it. (I try to always purchase NS products when possible*
- *I am trying to diversify my friendship circle and I am single so new environments & situations are a good thing.*
- *Hellene Blonde Ale was being offered as a taste test at my local NSLC. When they told me it was only 4.2% alcohol I decided to try it; it was delicious. I haven't gone back since.*
- *I am dating someone new, we do different things together.*

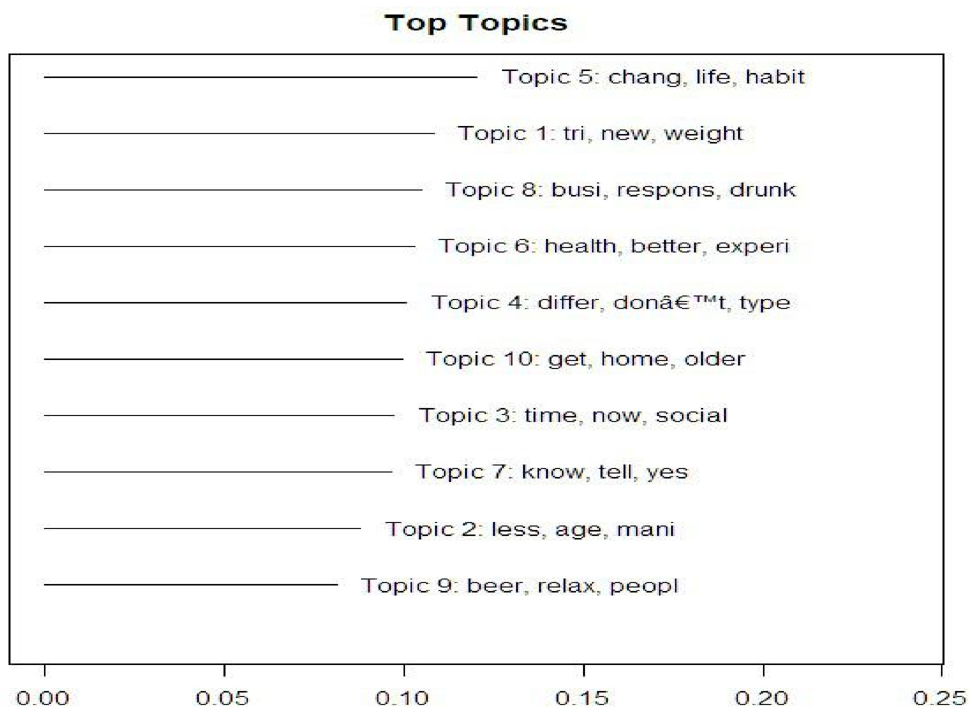

Figure 26. Topic proportions by FREX score for the 606 responses to how people would explain the changes to a friend or family member. Topic 4, second word is "don't".

Table 6. Highest probability and highest FREX score terms for topics in the best fitting topic model (n topics = 10).

A topic model with 10 topics, 606 documents and a 690 word dictionary.								
Topic 1 Top Words:	Highest Prob	tri	new	thing	weight	signific	healthi	love
Trying new things	FREX	tri	new	weight	love	sure	watch	alway
Topic 2 Top Words:	Highest Prob	less	age	mani	spend	need	live	introduc
Changing circumstances	FREX	less	age	mani	spend	need	live	introduc
Topic 3 Top Words:	Highest Prob	time	now	move	social	can	realli	friend
Changing social conditions	FREX	time	now	social	can	event	great	retir
Topic 4 Top Words:	Highest Prob	like	wine	enjoy	differ	just	glass	don't
Reasons for drinking wine	FREX	differ	don't	type	like	dinner	wife	special
Topic 5 Top Words:	Highest Prob	chang	want	tast	life	take	tire	habit
Developing a taste for change	FREX	chang	life	habit	tast	control	person	relationship
Topic 6 Top Words:	Highest Prob	health	better	money	experi	healthier	save	make
Healthier living	FREX	health	better	experi	healthier	save	make	lifestyl
Topic 7 Top Words:	Highest Prob	friend	alcohol	famili	know	tell	yes	longer
Alcohol: what family and friends know	FREX	know	tell	yes	alreadi	amount	cost	expens
Topic 8 Top Words:	Highest Prob	drink	dont	just	feel	busi	use	respons
A range of change factors	FREX	busi	respons	drunk	dont	drink	none	anymor
Topic 9 Top Words:	Highest Prob	beer	relax	peopl	craft	local	interest	good
Changing interests	FREX	beer	relax	peopl	craft	help	increas	met
Topic 10 Top Words:	Highest Prob	get	much	home	older	noth	work	prefer
Getting older and wiser	FREX	get	home	older	noth	applic	parent	issu

Topic 8 (“A range of change factors”) comprised a diverse set of factors associated with change in drinking patterns that included health issues, changes in knowledge or information, exposure to new drinks or drinking patterns and life pressures.

- *When I was in my early twenties I used to drink a lot and drive while drunk. When I was 25 I stopped drinking for 25 years. Now I only Drink one or two beers about 3 or 4 times a year.*
- *I was just diagnosed with cancer, it's been difficult to deal with this news.*
- *More and better choices in beer. Greater knowledge and appreciation of wine based on travel and self-education.*

Topic 4 (Reasons for changing to wine) was a collection of explanations for why respondents drank wine: reflecting pragmatic issues, factors associated with relationships and just liking wine.

- *Easier to carry a bottle of wine than several beer [sic] when walking.*
- *My girlfriend likes to have a glass of wine with dinner, so I join her*
- *I still enjoy the occasional glass of wine*
- *To enjoy company with wife around a good meal at dinner time*
- *This is typical of enjoying a good meal at home with a glass of wine*
- *I like wine and like to try different types*

Topic 10 (Getting older and wiser) related to age and how people reflected on drinking less as they got older and wiser. The topic also highlights how people have other pressures acting on them (such as work pressure) which impact their desire to drink.

- *Stress at work and my partner is working shift work*
- *Because I’m getting old and prefer to be home*
- *No idea, just getting older I guess.*
- *That drinking comes second to all that maters [sic] like work and family and other commitments*
- *Having trouble getting a restful sleep when I drink close to bedtime*

Topic 3 (Changing social conditions) concerned changing life circumstances such as having children, retirement and changes in friendship networks.

- *The growth of the friend group happened naturally*
- *We have kids. We have obligations and cannot participate every time.*
- *My close friends have now moved and passed away*
- *More opportunities as these events are available very 2 weeks and I am hosting them*
- *I've been trying to be more social since my breakup, and going out for drinks is one of the ways I socialize with my friends on the weekends*
- *Retired now can enjoy happy hour*

Topic 7 (Alcohol: what family and friends know) was frequently concerned with the effects of alcohol and the relationships to family and friends. Alcoholism was mentioned several times as were references to family secrets.

- *Information in the news and media about the negative effects of alcohol*
- *Lower alcohol percentages, improved flavors.*
- *On vacation, with friends and more invitations come up to go out for*
- *My close friends & family already know the answer.*
- *Family illness.*
- *Alcohol was slowly destroying my life*
- *Yes, I have talked to friends about drinking less.*

Topic 2 (Changing circumstances) had to do with things such as alcohol tolerance, and dietary concerns but also changing relationships and big events like buying a house.

- *My system cannot handle a lot of drinks esp. Hard liquor or a lot of red wine*
- *Flavor and less side effects.*
- *I guess my son and his girlfriend introduced me to the many varieties of local beers and the fun of sharing them.*
- *Bored. access to a new liquor store nearby which has a different variety (west side)*
- *Diet and concern about over consumption*
- *Just that I prefer not to risk feeling less than sharp the next morning*
- *Age is a factor*
- *I've been busier and spending time with people who drink less. Also I have less money to spend*
- *I am on a diet and am limiting my alcohol content*
- *I bought a house*

Lastly, Topic 9 (Changing interests and values) included explanations related to changes in interests (greater interest in sport or getting fit or greater interest in craft beers) and contingent events such as poor health or doing bad things.

- *I enjoy craft beers especially unusual brews.*
- *Because I quit smoking over a year ago.*
- *Increased interest in pool*
- *Due to poor heath*
- *I think I have increased my intake from one to two glasses because I like the taste of a good wine, and it helps me relax if I've had a stressful day at work.*
- *I like the craft beer but I find them more of a sipping beer*
- *I made bad choices while drinking with the wrong people.*
- *Part of getting in shape routine*
- *Dating experiences*

Discussion

Global wine consumption patterns reflect a flattening out of per capita consumption for countries with similar consumption profiles to Canada. These same trends are in evidence in Nova Scotia with an apparent slowing down of per capita consumption.

Looking at trends of change in a sample of Nova Scotia residents suggests several factors that could be associated with flattening wine consumption profiles:

- Older people may drink less and hence, as the population ages per capita consumption drops off;
- An older demographic implies more responsibility (children, owning houses) and hence drinking less;
- Increasing concern for health and fitness suggests drinking less.

Changes in what people drink and with whom may be more associated with:

- The desire to try new things;
- Changing social circumstances (e.g. new friends or partners);
- Financial constraints.

Consumer preferences are clearly very much more complex than this brief examination permits. There are a host of macro- to micro-factors that impinge on an individual's experience of consuming alcohol. In this report we have touched on some of the most obvious with a view to informing the risk modelling carried out for the AgriRisk project.

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