

Changes in volume of drinking after changes in alcohol taxes and travellers' allowances: results from a panel study

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ABSTRACT

Aims The aim of this paper is to study short-term changes in alcohol consumption by subgroups of the population in Denmark, Finland and southern Sweden following large-scale decreases in alcohol taxation in Denmark and Finland and large increases in travellers' allowances in Finland and Sweden. **Design** General population random samples surveyed before and after the changes, using northern Sweden as a control site. **Setting** Denmark, Finland, southern Sweden and northern Sweden. **Participants** Respondents aged 16–69 years. **Measurements** Volume of drinking is the main measure reported. Changes are examined by gender, age, income and year 2003 consumption level. **Results** Consumption decreased or remained the same among women and men in all three study sites. Relative changes were similar across subgroups of age, gender and income in all countries. In absolute terms, there was a consistent differential change by age in Denmark, Finland and Southern Sweden, with the higher level of the young and lower level of the old converging. Women's and men's consumption converged in Finland and southern Sweden. The changes did not differ systematically by income. Changes were not larger among heavier drinkers. **Conclusions** The results did not confirm expectations: an increase in consumption larger than that in the control site could not be shown in any of the countries or subgroups of the population. If there has been an effect – as shown in aggregate data in Finland – it seems to have been stronger among the old than the young and, in Finland and southern Sweden, among women rather than men.

Keywords Panel study, policy change, taxes, travel allowance, volume of drinking.

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INTRODUCTION

It is well established that the price of alcohol, which can be influenced by the level of taxation, affects substantially the levels and patterns of drinking and rates of alcohol-related problems [1–4]. High taxes, particularly on distilled spirits, have been a major element of alcohol policy in all Nordic countries since the first decades of the 20th century. All except Denmark have also restricted alcohol availability substantially in other ways, for instance by requiring alcoholic beverages to be purchased in a limited number of government-owned outlets.

This paper examines whether alcohol consumption changed differentially in subgroups of the population in

three countries after recent increases in travellers' import allowances and a large-scale reduction in alcohol taxation in two of the countries. Subgroups defined by gender, age and income are also examined. Additionally we investigate whether the data show signs of light drinkers and heavier drinkers having changed their consumption differentially. A secondary aim is to examine how the aggregate level estimates of the changes in consumption from the survey compare with external aggregate level data.

Previous research

The most striking evidence of the effects of taxes comes from Denmark in 1917 when, in wartime conditions of food shortages, the spirits taxes were raised to over 12

times their former value. The rise resulted in large decreases in per-capita alcohol consumption and in acute and chronic health consequences of drinking ([5], p. 73). The main body of evidence of the effects of taxes and prices on consumption and problems comes from time-series or pooled cross-sectional time-series analyses [2,6]. Such studies on price elasticity show that changes in prices of alcoholic beverages tend to be followed by opposite changes in sales. The price elasticity estimates for Nordic countries [6] do not differ greatly, for instance, from estimates of elasticities in the United States [2], although the Nordic demand for beer seems to be somewhat more price-elastic than the US demand.

One may identify two weaknesses in time-series analyses. First, they require many time-points, which often means a long time-period, in order to be reliable, and it is uncertain to what extent the evidence from the historical period can be generalized to apply today. Secondly, this approach cannot be used to study whether effects of price differ by population subgroup, e.g. by gender, age, social strata or between light and heavy drinkers.

Econometric studies on differential price effects have been carried out mainly in the United States with cross-sectional survey data, where the effects of prices or excise taxes are derived from comparing consumption among individuals who live in geographical areas that have different price or excise tax levels. These studies have provided contradictory evidence of whether heavy drinkers are affected more or less by price changes than moderate drinkers [7,8]. Most studies on youth have concluded that excise taxes, particularly of beer, have a greater effect on frequent or heavy drinking than on less frequent or lighter drinking [2,9,10]. The general results in the econometric literature suggest a higher elasticity among younger than among older drinkers [2,11]. Reviewing the current econometric literature on the effects of price on alcohol consumption and problems, Chaloupka *et al.* [2] note critically the lack of and the need for 'natural experiments' that would compare the amounts of alcohol consumed by individuals or groups at different prices, with other variables held constant.

Previously, only a few studies have used such a research design to study differential effects of changes in taxes. Kendell *et al.* [12,13] used longitudinal data to study the effects of a rise in alcohol taxes in Scotland, finding that in relative terms men and women reduced their drinking equally, and in absolute terms heavy drinkers reduced their drinking at least as much as light drinkers. However, the results are likely to have been confounded by the regression to the mean effect. In Switzerland, a study of the effects of a substantial reduction in the tax on foreign spirits found an increased consumption of spirits in all subgroups studied, but younger age groups, particularly young males, were more affected by price than older age groups [14,15]. Also, the increase in consumption was relatively higher in moderate than in heavier drinkers, although regression to the mean effects may not have been controlled for sufficiently [15].

It has long been recognized that where alcohol is more available or cheaper across an easily crossed border, a substantial cross-border trade tends to develop that can have substantial effects in areas close to the border [16–19]. Cross-border shopping has become a substantial factor in the part of Sweden nearest to Denmark [20] and has been a considerable factor in Southern Jutland, Denmark [21].

Changes to be studied

Substantial changes have occurred in Nordic countries in alcohol excise taxes and in the alcohol allowances that travellers can bring across national borders without paying further taxes. In January 2004, the allowances for those entering Denmark, Finland and Sweden from other European Union (EU) countries increased to the general EU levels (Table 1). The effects to be examined in this study are listed below.

- For Denmark, the effects of a large reduction in Danish spirits taxes and a large increase in travellers' allowances for spirits imports. Danish taxes on spirits were lowered on October 2003 by 45%. As a result, recorded purchases of spirits rose by 16% but for all alcoholic beverages combined recorded consumption fell by 2% from 2003 to 2004 [22].

Table 1 Travellers' allowances for alcohol imports, in litres of each beverage in 2003 and 2004.

	<i>Within-EU to Denmark <1/2004</i>	<i>Within-EU to Sweden <1/2004</i>	<i>Within-EU to Finland <1/2004</i>	<i>Estonia to Finland <5/2004</i>	<i>General within-EU 'guidance': imports for own use</i>
Spirits	1.5	5	1	1*	10
Fortified wine	20	6	3	2*	20
Table wine	90	52	5	2	90
Beer	110	64	64	16	110

*Either spirits or fortified wine.

- For Finland, the effects of a large reduction in alcohol taxes and a large increase in travellers' allowances for alcohol imports. Finnish taxes on spirits were lowered by 44%, on fortified wine by 40%, on table wine by 10% and on beer by 32% in March 2004. In May 2004, Estonia entered the EU and within-EU travellers' allowances came into effect for travellers from Estonia. Estonia is located close to Finland and has substantially lower alcohol prices. Estimated total consumption of alcohol rose by 10%: recorded consumption by 6.5% and unrecorded consumption by around one-fourth [23].
- For southern Sweden, the effects of the large reduction in Danish spirits taxes and a considerable increase in travellers' allowances for alcohol imports. Estimated total consumption rose by 1%: recorded consumption declined by 8% and unrecorded consumption rose by 18% [20].

Study design

To investigate possible changes in alcohol consumption after introduction of these new policies, we analyse survey data which consist of individual-level data collected before and after the changes, with both a panel design and with repeated cross-sectional surveys, using northern Sweden as a control site. Volume of drinking is the main measure reported in the article. Other measures of drinking patterns will be referred to in order to confirm that the essential features of the change are captured by the analysis that is otherwise based on the volume of drinking.

Both absolute and relative changes will be examined. According to the theory of the collectivity of drinking cultures [24], aggregate changes will be composed of similar proportional rather than absolute changes in subgroups of the population. Technically, changes in the logarithm of consumption describe relative changes in consumption. However, absolute changes may be argued to be more important for public health. In relative terms, an increase from 0.1 litre to 0.2 litres is the equivalent of a change from 10 litres to 20 litres, i.e. in both cases there is a 100% increase, and indeed the difference between the logarithms of these values is exactly the same. From a public health perspective, however, the latter change is much more relevant.

METHOD

Data

Probability surveys of the adult population were conducted during the third quarter of 2003 in Sweden, Denmark and Finland. Those aged 16–69 years are included in the present analysis, as that age-range was

available in all three countries. In Finland, a postal survey was sent out by Statistics Finland on behalf of the National Research and Development Centre for Welfare and Health (STAKES) and returned by 2369 people, representing a completion rate of 60%. In Denmark, a telephone survey was conducted by a public opinion survey firm, Vilstrup, on behalf of the University of Southern Denmark. Sampling was conducted on the basis of random digit dialling, which included cell-phone numbers. A total of 1771 people aged 16–69 were interviewed. The cooperation rate among all respondents aged 15 years and older was 50% (American Association for Public Opinion Research formula 4 [25]). In Sweden, a telephone survey was conducted by Temo, a public opinion survey firm, for SoRAD (Centre for Social Research on Alcohol and Drugs) on similar samples to those for Denmark. For the purpose of the present analysis, two separate areas of Sweden were included in the design. The southern Sweden area (Gothenburg, Kronoberg, Halland, Blekinge and Skåne) is within easy reach of Denmark by bridge or ferry. The northern Sweden region includes an area stretching from about 150 km west of Stockholm up to 150 km from the Finnish border at the north end of Sweden. Altogether, 1243 individuals aged 16–69 were interviewed in the southern region in 2003 (51% completion and 53% cooperation rate among all respondents aged 16 or more), and 1152 in the northern region (49% completion and 52% cooperation rate).

New samples were interviewed on the same basis, again in the third quarter, and with the same data collection procedures and general completion rates in 2004 in each of the four sites. The numbers of respondents included in these new samples were 1142 for Finland (53% completion), 894 for Denmark (56% cooperation), 1251 for southern Sweden (47% completion, 54% cooperation) and 1227 for northern Sweden (44% completion, 55% cooperation). Approximately 1 year after the first interview, efforts were made to re-interview those interviewed in the 2003 samples who had agreed to a re-interview. This resulted in 1332 re-interviews in Finland (56% of the 2003 respondents), 1247 in Denmark (75%), 998 in southern Sweden (83%) and 930 in northern Sweden (83%).

The new Danish and Swedish samples in 2003 and 2004 were each weighted as a whole in terms of number of eligible respondents in the household [the number in the household eligible to be a respondent was approximated using available data on the size of the household and the number of children]. Post-weighting for age and gender (and region in Denmark and Finland) was used in order to restore the population distribution. Extreme weights were reduced to fall in the range between 3 and 0.33.

Measures

Volume of consumption was measured by beverage-specific quantity–frequency questions. First, questions were asked on the frequencies of drinking beer, cider or alcopops, of wine and of spirits, and additionally of strong wine for Sweden and Denmark and of class II beer (up to 3.5%, available in grocery stores) for Sweden. For those beverages that the respondent reported drinking, the typical quantity was requested. Volume of consumption was estimated by summing the products of the beverage-specific quantities and frequencies.

Abstinence was defined as having not drunk any alcoholic beverages in the previous 12 months. The frequency of heavy drinking occasions or binge drinking was asked as a frequency of drinking at least the equivalent of a bottle of wine in Sweden and Denmark and as the frequency of drinking six or more drinks for Finnish men and four or more drinks for Finnish women. Overall frequency of drinking was asked separately.

Income was measured by gross personal income in Finland and Sweden and by gross household income in Denmark, with different categorizations in each country. We combined some categories to arrive at the same number and similar approximate size of categories in each country.

Analysis and statistical methods

Unless specified otherwise the results are from panel data, i.e. based on individuals who responded in both 2003 and 2004 ('complete cases'). The main results are also shown for the cross-sectional data, i.e. for all respondents sampled for the first time in the given year.

Proportional changes in consumption were studied by fitting marginal models on log-transformed consumption, which was approximately normally distributed, using generalized estimating equations (GEE) [26]. These estimate average population consumption while adjusting the standard errors for clustering effects created by taking repeated measurements on the same individuals. In the models for gender and income, age was also adjusted for. A test for whether the changes were statistically significantly different by a socio-demographic variable was derived from the test of the interaction term between time (2003 versus 2004) and the socio-demographic variable.

Confidence intervals (95%) for the absolute changes were estimated by bootstrapping [27]. Using this method, numerous (here $n = 1000$) samples with replacement are drawn from the original data with the size equivalent to the original size of the data, and from each of these samples the change was calculated. The ordered N estimates form an empirical distribution that yields a 95% confidence interval when 2.5% of the top and bottom estimates are excluded.

Regression to the mean causes extreme observations (heavy and light drinkers) defined in one point of time to be closer to the mean in the next measurement, even if no real changes occurred. In order to study the real effect of the change by original level of drinking, net of the regression to the mean effect, we used the method suggested by Skog & Rossow [28]. With this method, a hypothetical comparison group is derived on the assumption that without the 'intervention', the log-transformed consumption would have followed the normal distribution and the distribution would have been stationary—without changes in mean and standard deviation. The regression equation in the hypothetical comparison group is then obtained by:

$$E(Y_2|Y_1) = a + b \cdot Y_1 = (1-r) \cdot m + r \cdot Y_1$$

where Y_i is log-transformed consumption at time i ($i = 2003, 2004$), r is the correlation that would have been observed without an 'intervention' and m is the logarithmic mean consumption. Only drinkers are included in the analysis. The estimate used for m is the mean in 2003. The estimate for the correlation is obtained using the third wave of the panel study, i.e. it is the postintervention correlation between log-transformed consumption values in 2004 and 2005. These were: 0.82 for Finland, 0.74 for Denmark, 0.74 for Southern Sweden and 0.73 for Northern Sweden. The estimate of the real effect of the intervention is obtained by comparing the observed regression line to the hypothetical regression line. The regression lines fitted on logarithmized consumption were also transformed to natural scale by using the formula given by Skog & Rossow [28].

The effect of ageing by 1 year, as assessed on the basis of a cross-sectional comparison of age groups in 2003, was negligible in the whole samples (approximately 1% in one direction or the other). In Finland and Sweden, the effect in the youngest age group under consideration here was a slight increase in consumption (a couple of percentage points, or less than 0.1 litre per year) and in the older age groups a slight decrease in consumption of a corresponding magnitude. In Denmark the age pattern was not systematic.

RESULTS

In Denmark, where the spirits taxes decreased considerably, there was no sign in the panel data of an increase either among men or among women in total consumption (Table 2) or in spirits consumption (Table 3), but rather a decrease. However, the results from the panel data and the cross-sectional data differed markedly, particularly among men, for whom the cross-sectional data showed an increase in total consumption (Table 2). For

Table 2 Volume of consumption in centilitres per year in 2003 and the change in centilitres per year between 2003 and 2004 in the panel data and in the repeated cross-sections by country, age and gender.

	Denmark			Finland			Southern Sweden			Northern Sweden		
	<i>n</i> (2003)	2003	Change	<i>n</i> (2003)	2003	Change	<i>n</i> (2003)	2003	Change	<i>n</i> (2003)	2003	Change
Volume: panel data												
All	1247	558	-44*	1267	499	-37*	1002	451	-29	945	297	13
Gender												
Men	588	762	-50	532	713	-81*†	451	625	-54	458	395	36
Women	659	341	-38*	735	314	1	551	287	-6	487	185	-13
Age (years)												
16-29	229	812	-133*‡	314	518	-77*	257	750	-197	198	355	-22
30-49	538	470	-42*	509	513	-34	406	374	23	405	283	5
50-69	480	506	11	444	467	-9	339	335	26	342	280	39
Volume: cross-section samples												
All	1771	572	62	2243	514	-33	1287	470	24	1196	316	26
Gender												
Men	800	792	106	1013	743	-80	585	655	-14	578	426	46
Women	971	356	15	1230	286	12	702	295	48	618	193	17
Age (years)												
16-29	354	832	-79	564	579	-125*	359	662	-137‡	275	379	96
30-49	738	488	85	849	524	-1	512	425	64	487	307	15
50-69	679	494	134*	830	452	2	416	375	103	434	290	-8

*Bootstrapped 95% confidence intervals exclude 0 (i.e. change is significant at the 5% level). †The bootstrapped 95% confidence interval for the difference between men and women excluded 0 (i.e. difference in change between genders is significant at 5% level). ‡The bootstrapped 95% confidence interval for the difference between the changes in the first and the third age group excluded 0.

Table 3 Consumption of spirits in centilitres per year in 2003 and the change in centilitres per year between 2003 and 2004 in the panel data by country, age and gender.

	Denmark		Finland		Southern Sweden		Northern Sweden	
	2003	Change	2003	Change	2003	Change	2003	Change
All	84	-13*	88	0	90	-5	55	-5
Gender								
Men	119	-24*	155	-9	137	-2	89	-11
Women	47	-2	28	8	47	-8	18	0
Age (years)								
16-29	229	-60*†	66	0	204	-89*†	54	-11
30-49	49	-5	67	-5	48	-2	45	3
50-69	36	7	134	7	62	45	65	-11

*Bootstrapped 95% confidence intervals exclude 0 (i.e. change is significant at the 5% level). †The bootstrapped 95% confidence interval for the difference between the changes in the first and the third age group excluded 0 (i.e. difference in change between these age groups is significant at 5% level).

spirits consumption, the cross-sectional data did not differ from the panel data.

In Finland, where there was a tax decrease and the availability of alcohol increased through the possibility of importing cheap alcohol from Estonia, a decrease in overall consumption was reported among men in both panel and cross-sectional data, and there was no reported increase in men's spirits consumption or in women's overall or spirits consumption (Tables 2, 3).

In southern Sweden, the availability of alcohol increased through the possibility of importing larger

amounts of alcohol from Denmark, with prices for spirits even lower than before. The panel data for southern Sweden show no increase in the total consumption or in spirits consumption. Here, too, the cross-sectional data show somewhat different results, with an increase in consumption among women. In fact, the only group that shows signs of increase in consumption both in the panel and the cross-sectional data concerns men in the control site, northern Sweden.

In Finland and in southern Sweden the gap between men's and women's consumption became smaller in both

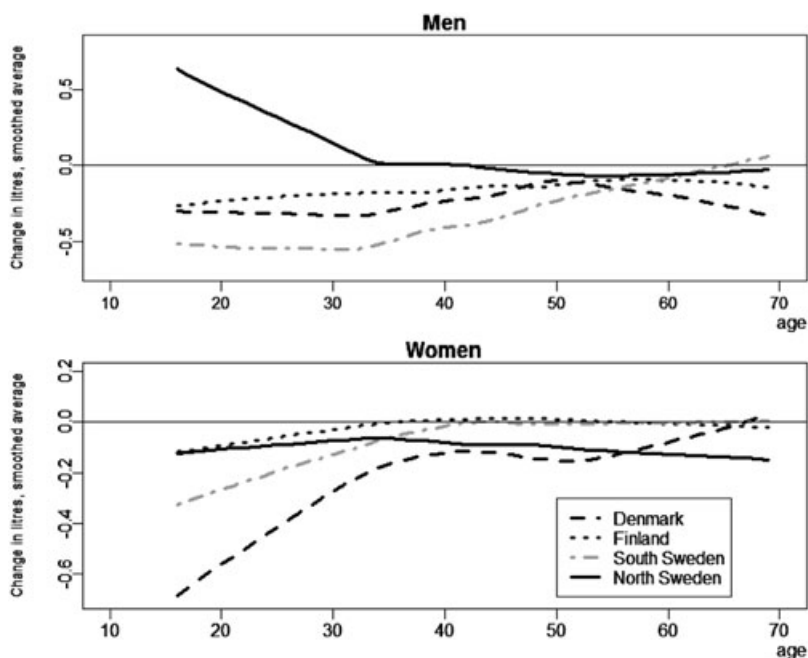


Figure 1 Smoothed average of change in the volume of consumption from 2003 to 2004, in litres of pure alcohol per year by gender, age and country on the basis of the panel data

the panel and the cross-sectional data (Table 2); this convergence was statistically significant only in Finland. The convergence could not be attributed to the consumption of spirits (Table 3).

There was a consistent age pattern in the changes of total alcohol consumption in Denmark, Finland and southern Sweden in both the panel and cross-sectional data (Table 2). The older age groups increased their consumption more, or decreased less, than the younger groups; this differential effect reached statistical significance only in Denmark. A similar pattern was visible, although less strong, in northern Swedish panel data but not in the northern Swedish cross-sectional data. The same pattern was also seen in spirits consumption in Denmark (even more so in the cross-sectional data; not shown as a table) and southern Sweden (statistically significant in both countries), but not in Finland and northern Sweden (Table 3). Figure 1, which is based on the panel data, illustrates the same phenomenon with age as a continuous variable and the lines in the figure indicating smoothed average changes in consumption from 2003 to 2004. Among both men and women there is a clear age difference in the change in consumption, which is different in northern Sweden compared to the three affected areas.

Changes in the median volume of consumption, the 90th percentile point, the frequency of drinking overall and of binge drinking by age and gender were also examined (not shown as tables). Frequency of drinking showed some signs of convergence by age in Denmark, Finland and, among women, in southern Sweden. However, as it is the older age groups who drink more frequently, this

time it was the younger age groups who showed signs of a larger increase (or a smaller decrease) in drinking frequency than did the older groups. Otherwise, the results of these comparisons were, by and large, in line with the results for volume.

There were great variations in the average changes from one income category to the other, but there was no systematic linear change and very little indication of those with lower incomes having increased their consumption more or decreased less compared to other income groups (Table 4). The result in Denmark was similar for spirits and for total consumption.

GEE models were fitted on the logarithms of consumption in order to test whether there were statistically significant relative differences between population subgroups in changes in consumption. None of the interaction terms between time (2003 versus 2004), on one hand, and gender, age group or income group (categorized as in Tables 2–4), on the other hand, were statistically significant.

Figure 2 shows the connection between total consumption in 2003 and that in 2004. The broken line shows the expected relationship in the case that there had not been any changes in the distribution of consumption. The deviations of the observed, solid regression line from the expected line are indicative of effects of the alcohol policy changes. Parallel lines indicate a similar relative effect of policy changes across different consumption levels. The conclusion from the figures is that there was very little indication of differential changes in consumption by original level of drinking, and in no country can it be claimed that heavy drinkers have increased their

Table 4 Mean volume of consumption in centilitres per year by income category* in 2003 and change in centilitres per year between 2003 and 2004, by country.

	Denmark			Finland			Southern Sweden			Northern Sweden		
	%	2003	Change	%	2003	Change	%	2003	Change	%	2003	Change
Men												
Income category												
1 (lowest)	11	784	-175	11	739	-28	14	1016	-133	10	319	93
2	15	655	-22	9	769	-159	8	444	-128	10	468	-118
3	31	707	76	32	670	-115	21	552	32	27	376	21
4	26	679	-67	29	720	-62	39	537	-13	37	404	79
5 (highest)	18	932	-147	19	735	-55	17	634	-130	16	430	9
All	100			100			100			100		
Women												
Income category												
1 (lowest)	12	385	-91	20	329	1	22	391	-32	21	159	5
2	22	283	26	36	315	4	22	219	-18	23	153	2
3	35	307	-45	20	273	15	26	273	14	29	150	4
4 (highest)	31	368	-51	24	336	-14	31	283	2	26	273	-58
All	100			100			100			100		

*Denmark: gross household income; Finland and Sweden: gross personal income.

consumption more, or decreased less. Transforming the regression lines into the natural scale (not shown as a figure) did not change this conclusion.

DISCUSSION

According to the results of this study, the total volume of consumption and spirits consumption in the total samples from Denmark, Finland and southern Sweden did not increase. This was true for both men and women, but it was more striking among men than among women. With such large changes occurring in alcohol policies, these results were unexpected and we attempt to put them into context here.

In Denmark, beer and wine taxes were lowered considerably already at the beginning of the 1990s in order to reduce imports from Germany [29]. Subsequently, registered per capita consumption rose from about 11.5 litres per inhabitants aged 15 or more to about 12.1 litres, but returned to the original level by 1998 [30]. Spirits taxes were not reduced until 2004, and then registered spirits consumption increased by 16% but total consumption decreased by 2% [22]. Hence, the finding of no increase in total consumption in our data is roughly in agreement with data on registered consumption. However, the registered increase in spirits consumption in 2004 was not visible in our data. One explanation is that the increase in registered spirits consumption was offset by a decrease in spirits border trade, as reflected in Danish tax revenue statistics which report a fall from 10 to 7 million litres of total spirits (i.e. not pure ethanol) in border trade imports

between 2003 and 2004 (<http://www.statistikbanken.dk/statbank5a/default.asp?w=1280>).

In Sweden, there has been a long period of increasing consumption, until a downturn in the trend in 2004. Tax-free travellers' allowances in Sweden have risen gradually from 1995 onwards when Sweden joined the EU. The quota for spirits rose from 1 litre to 2 litres in 2001, to 5 litres in 2003 and 10 litres in 2004. The quota for wines rose from the original 5 litres to 20 litres in 1998; it had risen to 26 litres by 2001, and it rose further to 52 litres in 2003 and to 90 litres in 2004. The quota for beer was originally 15 litres, but it had risen to 32 litres by 2000, and it rose again to 64 litres in 2003 and to 110 litres in 2004. By 2003, the relative importance of imported consumption in the region next to Denmark had increased so much that imports exceeded registered consumption ([20], table 15). We expected the substantial rises in travellers' allowances in 2004, combined with a large tax reduction for spirits in Denmark, to increase consumption in 2004. Unrecorded consumption has indeed been estimated to have increased by 18% (due to tourist imports and smuggling), but a reduction in registered consumption resulted in a mere 1% increase in total (recorded + estimated unrecorded) consumption [20]. Hence, our results are not at odds with the overall data for Sweden in showing no increase in consumption in Sweden from 2003 to 2004. It appears that the increasing imports have changed from being an addition to Swedish consumption to substituting for alcoholic beverages which would normally have been purchased in Sweden.

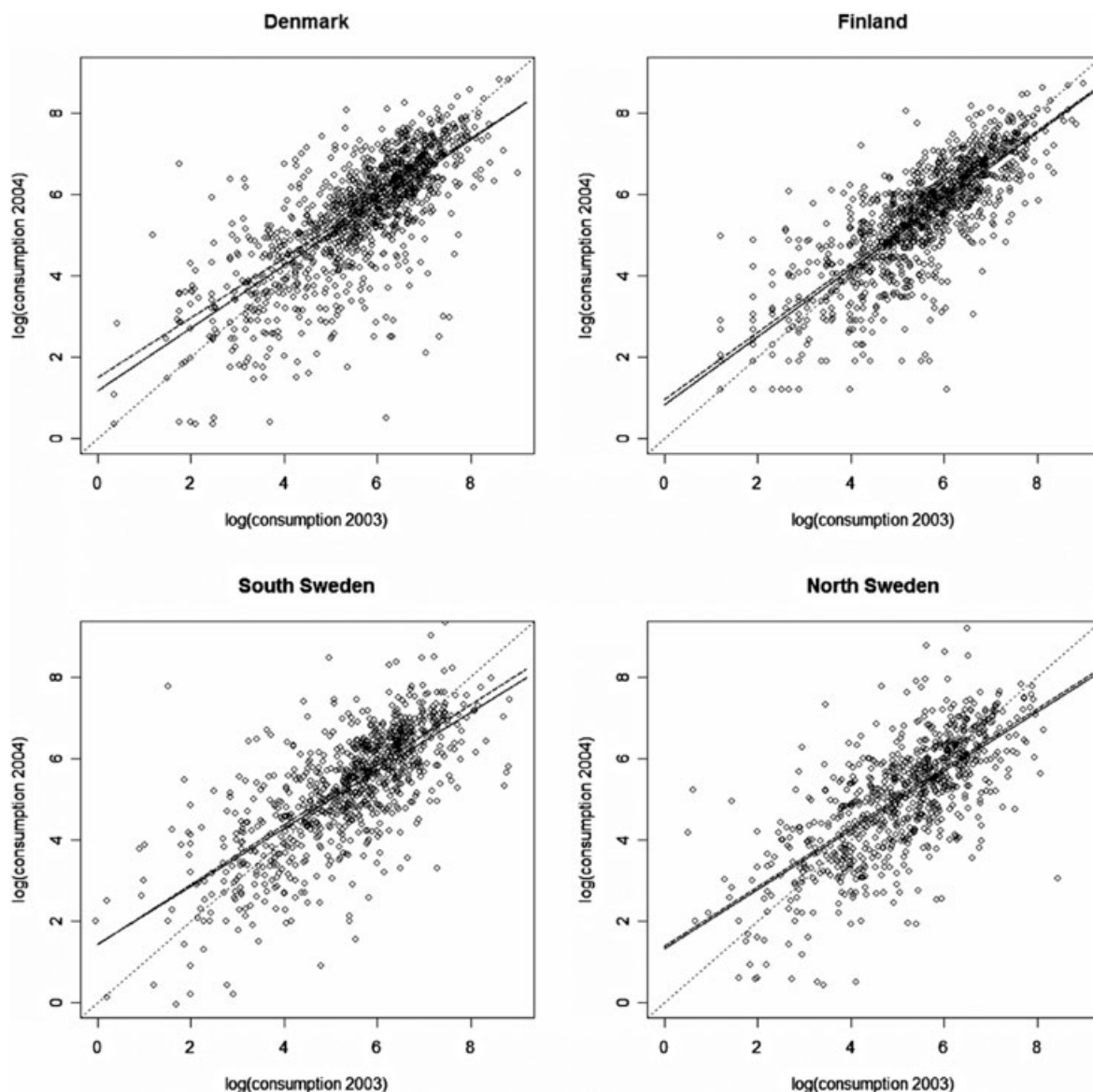


Figure 2 Scatterplots of logarithmized consumption in 2004 against that in 2003 by country. The observed regression line is marked with a solid line, the expected regression line is marked with a broken line and the diagonal is marked with a dotted line

It seems that in both Sweden and Denmark at least some kind of temporary saturation point has been attained, with consumption having levelled off in Denmark and beginning to decrease in Sweden. Elsewhere, periods of rising consumption have often been followed by a period when consumption stabilizes or falls. Researchers have talked about ‘the long waves of alcohol consumption’ ([31], p. 7). The timing of these waves is often not linked in an obvious way to economic factors or policy intervention. Most of the southern European wine cultures, for instance, are still in a long period of falling consumption, which started in France as long ago as in the 1950s.

In Finland, the relation between external data and our data is somewhat different. According to best estimates,

total consumption in 2004 increased by 10%—recorded consumption by 6.5% and unrecorded by one-fourth—as a response to the tax cuts and rises in travellers’ allowances [23]. However, this increase is not seen in our data. The same result of no increase was obtained when using a graduated-frequency measurement of alcohol consumption that was available in the Finnish data [32]. Two hypotheses have been proposed to explain the discrepancy between survey and aggregate level data [32], both of which probably bear some truth.

According to the first hypothesis, it was heavy drinkers rather than ‘normal drinkers’ who increased their consumption in 2004. Because heavy drinkers often do not respond to surveys, the effect might well remain unnoticed in a survey, thus explaining the discrepancy

between our results and aggregate data. This hypothesis would appear to be contradictory to the 'distribution of consumption model' [24], on the basis of which the total drinking population is expected to change similarly when consumption changes. This theory does, however, predict a higher increase in the number of heavy drinkers than the rate of increase in per capita consumption (indeed, a quadratic relationship: a 1.1-fold increase in consumption would be expected to result, on average, in a $1.1^2 = 1.21$ -fold increase in the number of heavy drinkers [5]). Yet, the theory would also predict an increase among the majority of drinkers.

Deaths from liver diseases increased in Finland by an incredible 30% in 2004 and a further 20% in 2005 [33]. This indicates that consumption increased at least among those heavy drinkers who have already damaged their livers before 2004. According to a recent result, the increase in total alcohol-related mortality from 2001–03 to 2004–05 among men aged 25–59 was 25%, but only 1% among those employed [34]. The corresponding percentages among women were 9% and 1%. However, these results on mortality do not exclude the possibility that 'normal drinkers' also increased their consumption, as the time lag between increased drinking and death from an alcohol-related cause for a healthy working adult may be several years. We used the survey data to study whether heavy drinkers increased their consumption more than lighter drinkers, but there were no signs of such differential changes in any of the countries among those who responded to the survey. A similar conclusion has been reached using the same survey data but different methodology to overcome the problem of regression to the mean [35].

According to the second hypothesis 'normal drinkers' increased their consumption as well, but for unknown reasons those who increased their consumption either dropped out of the survey or concealed the increase when responding. In previous analyses [32], multiple imputation was used to study whether selective dropout between 2003 and 2004, by known background factors in 2003, could be used to explain the unexpected findings in Finland. According to the results, selective dropout explained a part, but not all, of the discrepancy in results between survey studies and external data among men. It is likely that there are selective dropout processes that cannot be captured with the measured background variables, i.e. the urban young men (or any other given group) who responded in 2003 and were then, for instance, moderate drinkers and who dropped out by 2004 may have increased their drinking more than men with similar characteristics but who responded in 2004.

One limitation in the current study is indeed this problem that we share with many other survey studies, namely the ever-growing problem of non-response in

survey samples. Because of this problem, surveys may be becoming ineffective instruments to capture the effects of even such large policy changes as were observed in the Nordic countries around 2004. In general, a survey is a useful tool for studying phenomena in the general population. The more the phenomenon is restricted to a small part of the population, and particularly if it is a marginalized part of the population that has a poor response rate, the less effective household surveys will be in measuring it.

Even though we did not observe an increase in consumption in the whole sample, it was important to check whether there were divergent trends in subgroups of the population that would have cancelled each other out at the population level. When relative changes were examined, no statistically significant divergent trends in consumption were observed by age, gender or income category, which is in agreement with what was expected on the basis of Skog's theory of the collectivity of drinking cultures.

When absolute changes were examined, a convergence in consumption by gender was observed in southern Sweden and in Finland, although the effect was statistically significant only in the latter country. Further, a differential trend by age was found, with the lower consumption level of the older age groups and the higher consumption of the younger age groups converging. The age convergence was statistically significant only in Denmark, but it was consistent across countries and types of data (panel versus cross-sectional) and it was not observed, at least not to the same extent, in the control site of northern Sweden. The effect of the cohort ageing by 1 year between 2003 and 2004 cannot have caused this result, because this effect should have resulted in an opposite effect (due to ageing, older people decrease their consumption, the youngest increase theirs). If this result is interpreted in terms of a stronger effect of the policy changes on older age groups, then it contrasts with previous results finding youth to be most affected by changes in prices [2,11]. In the aforementioned Swiss panel study, the young were also found to be more affected [14,15]. If the long waves of alcohol consumption in the Nordic countries are starting to point downwards, it seems that the younger age groups may be the first ones to pick up the new trend.

In the economic literature, it is well established that the uncompensated or income-constant price elasticity of a good rises as the proportion of income spent on that good rises [9]. On the basis of this, and assuming that poorer subgroups of the population spend a larger part of its income on alcohol, one could expect a higher income elasticity among the poor, as well as among the young. In this study, people with the lowest income did not report higher changes in consumption than other groups of the

population. In contrast to this finding, however, a comparison of educational levels in an annual health behaviour survey in Finland found that among men it was mainly the group with lowest education which increased its consumption in 2004 [36].

In conclusion, the current study could not show any increases in consumption in the survey data, which is in contrast to the known consumption increase in Finland and in agreement with the development in total consumption in Denmark and Sweden. If there has been an effect, it seems that it has been stronger in absolute terms among the old rather than among the young and, in Finland and southern Sweden, stronger among women than among men. In relative terms there were no signs of differential changes, nor were there signs of the change being larger among heavier drinkers. The lack of significant changes in reported consumption in these population surveys despite substantial changes in price is an unexpected finding, and not in accordance with expectations from the general economic literature. The findings pose substantial puzzles for further research.

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