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**Are the fluctuations in the consumption of alcohol pro- or counter-cyclical? Empirical evidence from the Scandinavian countries using long-run time series data**

Jan Bentzen  
Valdemar Smith

Department of Economics  
The Aarhus School of Business  
Silkeborgvej 2, Prismet  
DK- 8000 Aarhus C  
Denmark

E-mail: [jb@asb.dk](mailto:jb@asb.dk); [vs@asb.dk](mailto:vs@asb.dk)

**Abstract:**

Traditionally, the Scandinavian countries have been characterized as spirits and beer consuming countries as these two beverages have been the far most popular alcoholic drinks through centuries. This has changed during the last couples of decades with wine consumption showing the highest growth rates in terms of alcoholic beverages – also in the cases where the retail sales system is highly controlled by the state, i.e. Norway and Sweden. But a century ago the historical background was decades of relatively heavy drinking behaviour with spirit as the preferred beverage. The political answer to the alcohol-induced, widespread negative health effects and social problems was the introduction of a directly, state-controlled system concerning handling and sales of alcohol (only Norway and Sweden, not Denmark), high alcohol taxes and other regulations. Therefore, it might be expected that alcohol consumption - especially in the last part of the 19<sup>th</sup> century and the beginning of the 20<sup>th</sup> century – would behave in a counter-cyclical manner, i.e. heavy drinking during severe recessions characterized by harsh economic conditions. Relatively good statistical sources are available concerning alcohol consumption levels in the Scandinavian countries, especially for Norway and Sweden where data for the specific beverages are published back to the 1850s. Using these long-run time series data for alcohol consumption levels the question of a counter-cyclical or pro-cyclical behaviour is addressed - with the business cycle measured as the GDP – and the empirical findings are that generally, alcohol consumption behaves in a pro-cyclical manner.

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## **1. Introduction**

The Scandinavian countries are usually characterized as spirits and beer consuming countries because these two beverages have been the far most popular alcoholic drinks through centuries. Until a few decades ago wine was consumed only in very modest quantities in these northern, climatically rather cold countries. For obvious reasons wine production is not possible or efficient in the Scandinavian countries and of course this has influenced the drinking behaviour. But from the beginning of the 1960s wine consumption suddenly increased in all of the Scandinavian countries and during the next three decades wine became a widespread, popular beverage – even with per capita consumption levels (measured in pure alcohol) surpassing spirits. At present, beer is still the most common alcoholic beverage in all of the three countries, but in relatively few years from now wine may well be the most popular, alcoholic beverage in one or more of the Scandinavian countries.

The drinking patterns in the Scandinavian countries have evolved – or converged – towards a continental behaviour as far as alcohol consumption is concerned. Additionally, in the wine consuming countries of Southern Europe beer has recently gained popularity and therefore a much more uniform pattern of alcohol consumption is seen today among the European countries. However, this historical shift in the drinking behaviour in Scandinavian countries – i.e. wine consumption becoming widespread and probably substituted for spirits and/or beer – is only the latest episode in a long development and history of each country's alcohol consumption.

Significant and even dramatic changes in alcohol consumption did in fact take place regularly during the latest couple of decades in these countries and the aim of this paper is to shed light on the long-run movements in wine, spirits and beer consumption in the Scandinavian countries. Using long-run time series data for alcohol consumption levels, i.e. from the middle of the 19<sup>th</sup> century, the question of a counter-cyclical or pro-cyclical behaviour of alcohol consumption is addressed - with the business cycle measured as the real GDP.

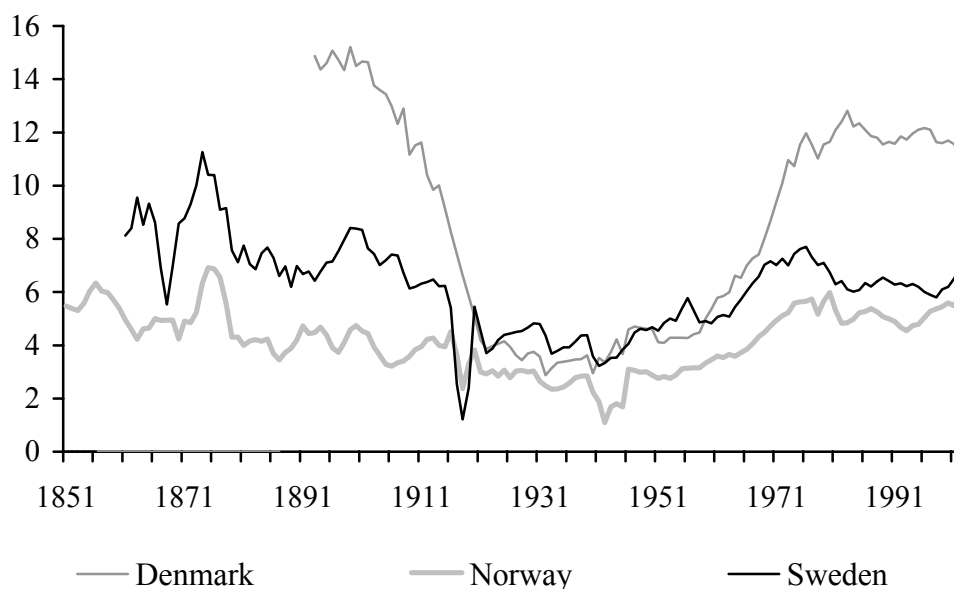
## **2. Long-run trends in alcohol consumption in the Scandinavian countries**

In the 19<sup>th</sup> century considerable amounts of both spirits and beer were consumed – even compared to the present levels of alcohol consumption – but there is no long-run tradition for wine drinking in any of the Scandinavian countries. Until the late 1960s wine was considered partly as a luxury good, which was regularly consumed by only a small part of the population. Like other alcoholic beverages wine has usually been heavily taxed and therefore relatively good statistical sources are available when it comes to alcohol consumption levels. Thus, for Norway and Sweden per capita consumption levels of the specific beverages are published back to the 1850s and for Denmark data are available since the beginning of the 1890s with some exceptions.

Figure 1 shows the long-run development in the per capita alcohol consumption levels in each of the Scandinavian countries (litres per capita aged fifteen years and above) - the statistical sources concerning alcohol consumption are presented in more detail in the data appendix. It is clear that significant changes have taken place in the overall alcohol consumption over the past 100-150 years – most dramatic for Denmark. In fact, the Danish per capita alcohol consumption level was as high as 15 litres in the late 19<sup>th</sup> century, which is even higher than today's consumption level. However, from the beginning of the 20<sup>th</sup> century the alcohol consumption dropped drastically to a level

around 5-6 litres per capita where it stayed until the 1960s. Since then the Danish alcohol consumption has increased mainly driven by higher consumption of beer and wine.

**Figure 1. Alcohol consumption in the Scandinavian countries 1851-2002 (litres per capita, 100 pct alcohol, 15 years+).**



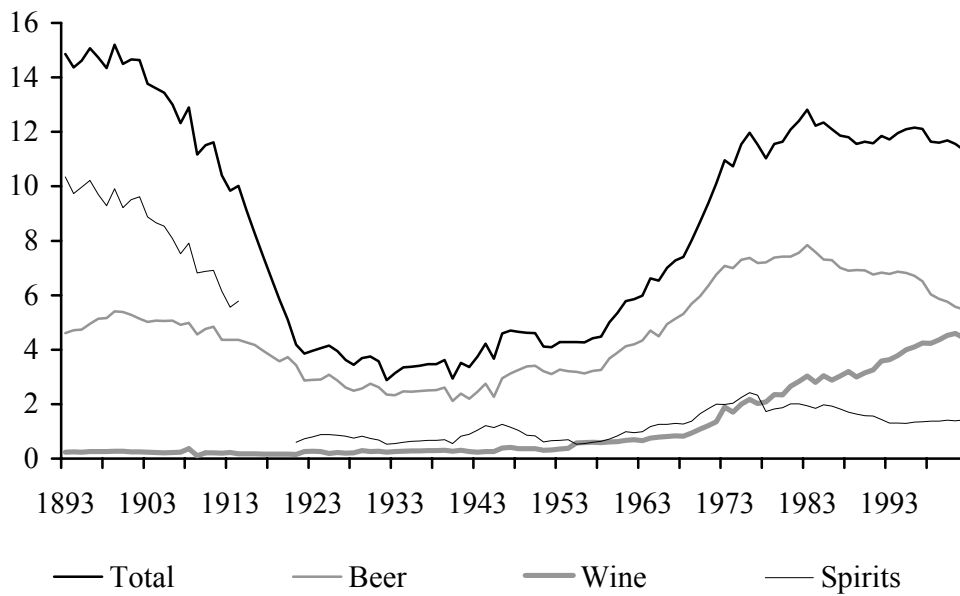
*Notes:* The data are calculated as litres per capita for the part of the population aged 15 years or above.  
*Sources:* Statistical sources as listed in the data appendix.

Contrary to the situation in many other countries there have been no periods of prohibition in Denmark and even though the temperance movement existed since the late part of the 19<sup>th</sup> century it never had any decisive influence on the Danish alcohol policies. Even though the temperance movements asked for prohibition in connection with World War I no policy actions in terms of ban and similar actions were taken. However, significant tax increases on alcohol were implemented in 1917 and the Danish alcohol taxes were at a relatively high level until Denmark joined the European Union in 1972. The main reason for the high alcohol taxes and duties was predominantly fiscal.

The Swedish experience is in accordance with the development in Denmark. Despite rather strong temperance movements, direct prohibition was not implemented. Instead taxes on alcohol were increased and in connection with World War I production and sales of alcohol was monopolised by the state from 1919, and the retail sale of alcohol was rationed by the introduction of the so-called ‘Bratt System’ – a ration book for each individual regulating the amounts of alcohol bought. The system was later abandoned in the 1950s.

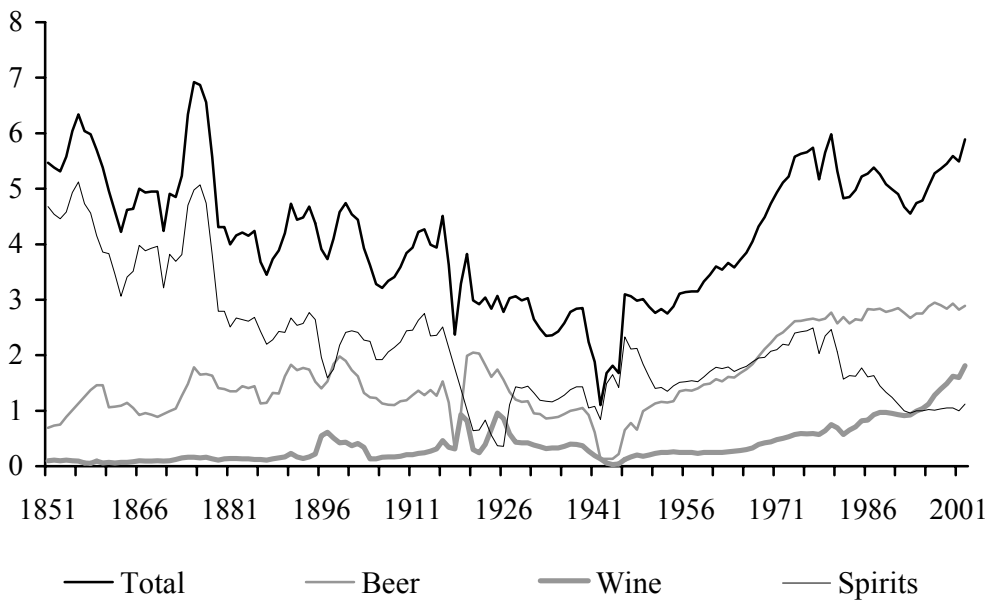
Two centuries ago Norway experienced significant alcohol problems and per capita alcohol consumption was as high as 13 litres around 1830-40. Naturally, the temperance movements gained momentum and in 1919 direct prohibition was decided. However, due to protests from wine producing countries, the ban on wine ceased in 1922 and so did the ban on strong wine in 1923. Finally, in 1926 sales of strong alcohol was allowed again. At the same time the retail and wholesale alcohol sales system changed to a system of state monopoly which still exists.

**Figure 2. Consumption of alcoholic beverages, Denmark 1893-2002 (litres per capita, 100 pct alcohol, 15 years+).**



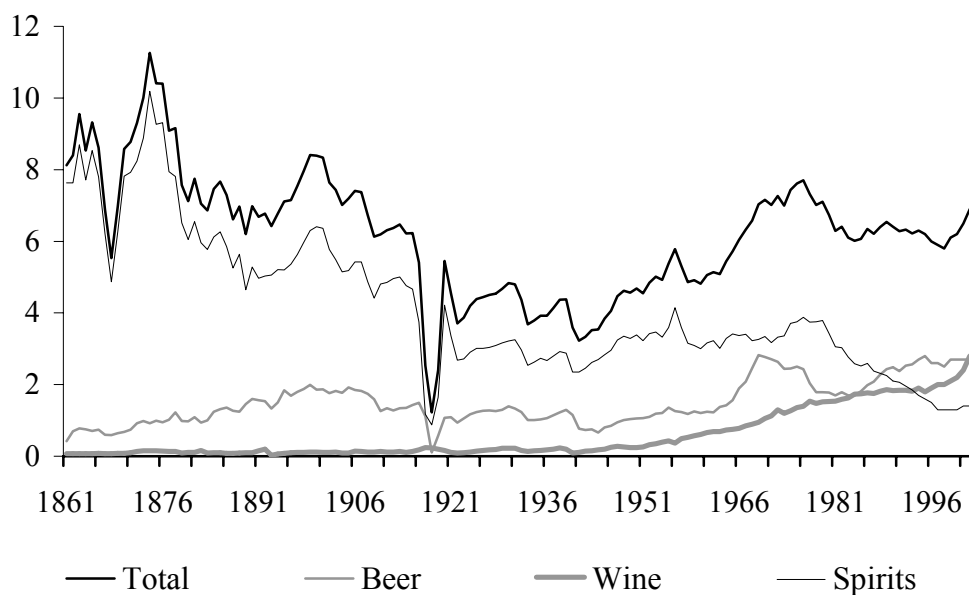
Sources: Statistical sources as listed in the data appendix.

**Figure 3. Consumption of alcoholic beverages, Norway 1851-2002 (litres per capita, 100 pct alcohol, 15 years+).**



Sources: Statistical sources as listed in the data appendix.

**Figure 4. Consumption of alcoholic beverages, Sweden 1861-2002 (litres per capita, 100 pct alcohol, 15 years+).**



Sources: Statistical sources as listed in the data appendix.

Spirits and beer have always been produced in all of the Scandinavian countries and consequently, they have been integrated parts of the food and drinking culture for centuries. Figures 2-4 also show the significant structural shifts with strongly increasing shares for wine and the marked declines for spirits in Norway and Sweden. Today, beer is in fact the most popular drink but this might look different in the future if the present trends in beverage shares continue. Denmark is the first of the Scandinavian countries – in the post WWII period – to become a place where wine is regularly consumed and in levels comparable to other European countries. Being a part of continental Europe Denmark has adhered to relatively more liberal alcohol policies compared to Norway and Sweden, which may explain the higher Danish consumption levels. Of course, Denmark lags behind countries in Southern Europe concerning wine consumption, e.g. Italy with approximately 50 litres of wine per capita and for France the annual level is 60 litres per capita (direct measures in volumes), cf. also Anderson (2004).

In spite of the restrictive alcohol policies – i.e. regulations and taxation – all Scandinavian countries seem to have entered tracks of strongly increasing wine consumption levels, where Norway with the most restrictive policy seems to lag most behind. The main reasons for increases in wine consumption are probably the rising living standards steaming from the strong growth rates of real incomes and more open economies, i.e. especially the tendencies developed from the early 1960s - the Scandinavian populations travelling on holidays to Southern Europe - where wine was also abundantly and cheaply available compared to the conditions in the home countries! As no grape wine production takes place in the Scandinavian countries consumer habits or preferences for wine had to be adopted from outside.

## **The national retail systems**

As mentioned above state monopolies in production, trade and sales were established in Norway and Sweden at the beginning of the 20<sup>th</sup> century for alcoholic beverages, although there were some exemptions for beer. Still today, Norway and Sweden have state monopolies, although they are only in effect regarding retail sales of alcohol (again with some exemptions for beer). For the production and wholesale of alcohol – beer, wine or spirits - a licence is needed and furthermore, spirits production is a state monopoly in Norway. Denmark is the exception with none of these regulatory systems. However, all the Scandinavian countries have used heavy taxation in order to create considerable fiscal revenues and - usually presented as an important motive - also to curb all kinds of alcohol consumption.

*Sweden* has organized the retail system of alcoholic beverages as a state-owned monopoly ‘Systembolaget’ operating through shops (less than 500) or local agents in 575 communities. The monopoly covers spirits, wine and strong beer. But light beer is available in other shops too and the Swedish breweries can sell strong beer (above 3.5% alcohol) directly to restaurants. At the retail level spirits, wine and strong beer may only be sold to persons aged 20 years or more. Today, there are no quantitative restrictions on the amounts of wine individuals may buy, but as the ‘Systembolaget’ is a state monopoly with a policy of supporting ‘a healthy drinking culture’ they are not striving to attract customers to the shops.

Since the 1950s, some effort has been devoted to the objective of making customers substitute wine for spirits because wine is considered healthier relative to spirits and therefore a relatively faster introduction of wine in the consumption of alcoholic beverages has taken place despite the otherwise restrictive retail sales system. Until 1994 ‘Systembolaget’ had an effective monopoly also in the case of quantities sold to e.g. restaurants, but this part of the monopoly ceased in 1995 and there are currently 200 licensed, private import companies supplying wines to ‘Systembolaget’, restaurants, hotels, etc.

After Sweden joined the European Union in 1995 problems were expected for the sales monopoly in the market-oriented community. However, in 1997 the EU Court of Justice ruled that ‘Systembolaget’ was not in contradiction with an EU membership because it was created due to public health considerations. Moreover the Swedish system was not found to discriminate between foreign and Swedish products. Still a gradual liberalization of the border trade regulations, i.e. personal imports of (cheaper) alcoholic beverages, has taken place and more important the monopolies in import/export, wholesales and production (spirits) have disappeared.

*Norway* has a system rather similar to the Swedish system and ‘Vinmonopolet’ was established in order to control a widespread misuse of spirits – ‘aqua vitae’. Norway is not a member of the European Union, but partly due to trade-agreements – and the general liberalization of international trade – the state-monopoly was split up in the mid 1990s and, similar to the changes in Sweden, ‘Vinmonopolet’ is today only a retail sales monopoly. In total, there is less than 200 sales outlets, and the low density of alcohol stores combined with the geography of Norway, i.e. mountains, forests, a lot of snow in the wintertime, etc. makes it difficult for people living outside urban areas to buy alcohol.

Traditionally, *Denmark* has adhered to liberal, market-oriented systems. Taxes have been used primarily for fiscal purposes and except for a minimum age of 18 years for sale at restaurants, there

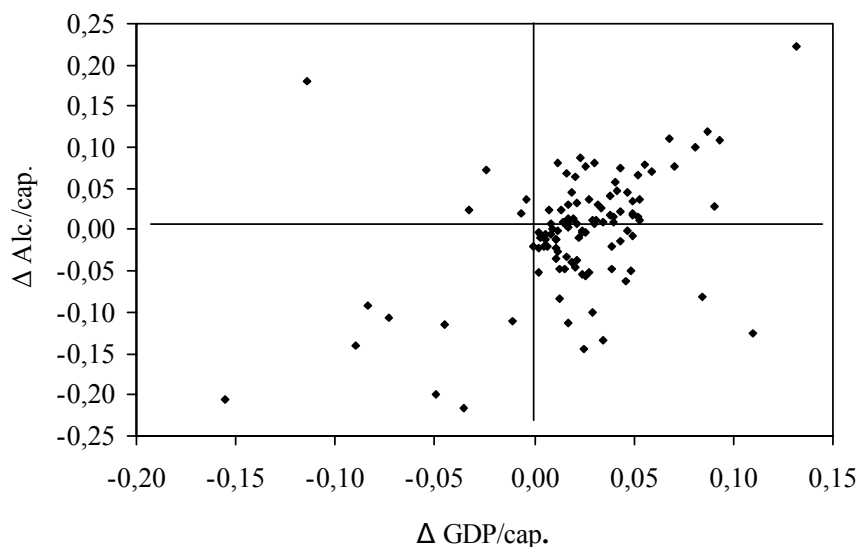
have generally been no impediments to alcohol consumption. Recently, a limit of 15 years was introduced for the sale of alcohol from retail shops. Furthermore, after the Danish membership of the European Union in 1972, free trade and harmonization of tax systems have contributed to the continuous increase in the absolute alcohol consumption levels, especially for wine – cf. figure 2 - which shows a significant increase in the consumption of wine from the early seventies. In fact, a tax cut of 75 per cent on wine was effectuated after 1972, and the tax rates on beer and spirits were fixed in absolute terms, and again in the 1990s a further lowering of Danish alcohol taxes was effectuated in order to complete the harmonization of the Danish tax levels towards other countries in the European Union. Accordingly, it is evident that much more attention has been paid to fiscal consideration and obligations to the EU-membership than to health and social arguments in the Danish alcohol policies.

Norway and Sweden both decided not to enter the EU in 1972 and hence, both countries were able to formulate their own fiscal policy, especially with regard to the taxation of alcoholic beverages. In Sweden real alcohol prices were relatively constant during the 1960s, but they have been rising since the beginning of the 1970s. Thus fiscal considerations have been of significant importance to the Swedish taxation of alcoholic beverages. Norway also decided to stay outside the EU in 1994, by a referendum, and therefore, Norway has no legal problems withholding a high level of taxation on alcohol - but there are increasing problems concerning border trade in relation to both Denmark and Sweden.

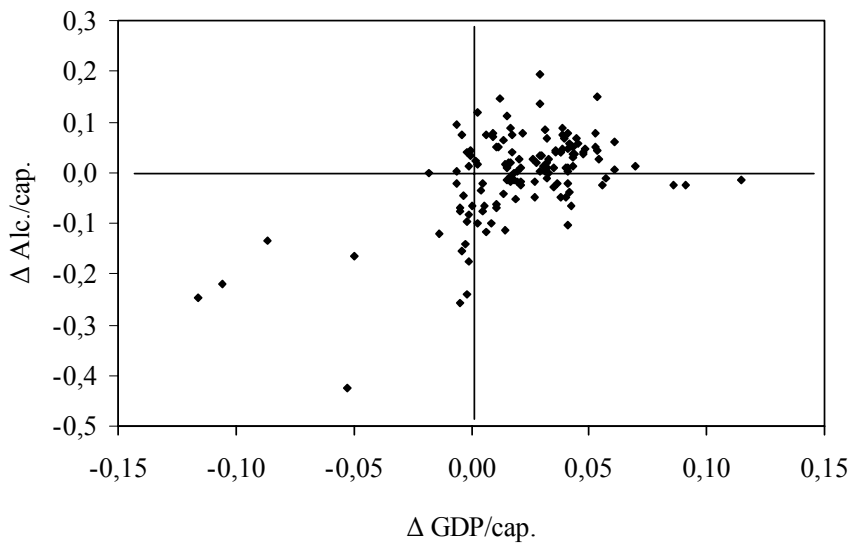
### 3. Alcohol consumption and the business cycle - a short-run relationship

In order to address the question of the relationship between the general business cycle - measured as real GDP per capita - and the consumption of alcohol, scatter plots of log differences of these variables are exhibited in the figures 5, 6 and 7 for the respective countries. When using values in log differences, only short-run relationships are revealed as information about level values are filtered away via the difference operator.

**Figure 5. Scatter plot of real GDP per capita and alcohol consumption per capita (15 years+) for Denmark, 1893-2002 (values in log differences).**

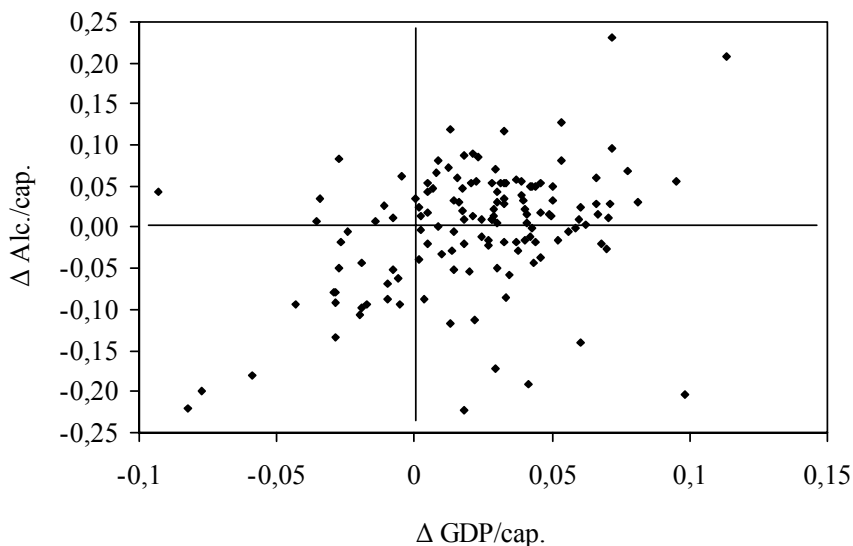


**Figure 6. Scatter plot of real GDP per capita and alcohol consumption per capita (15 years+) for Norway, 1865-2002 (values in log differences).**



Note: A few outliers with extreme values are not included in the graph.

**Figure 7. Scatter plot of real GDP per capita and alcohol consumption per capita (15 years+) for Sweden, 1861-2002 (values in log differences).**



Note: A few outliers with extreme values are not included in the graph.

For all three Scandinavian countries there is no doubt about a pro-cyclical relationship between the growth rates of GDP and alcohol consumption as revealed by the plots in figure 5, 6 and 7. The conclusion is generally also found for sub-samples of the data - even for data related to the 19th century - and therefore not much evidence is found in favour of a hypothesis of 'heavy drinking in

harsh times' as an escape from poverty and severe social problems. For the specific beverages, i.e. beer, wine and spirits, the cross correlation coefficients are reported in table 1.

**Table 1. Cross correlations between GDP per capita and per capita consumption of beer, wine and spirits (Log differences).**

	Denmark	Norway	Sweden
GDP : Beer	0.461	0.345	0.244
GDP : Wine	0.178	0.406	0.118
GDP : Spirits	0.201	0.154	0.359

Note: The data used when calculating the correlation coefficients are 1893-2002 for Denmark, 1865-2002 for Norway (the data for GDP only covers this period, but the alcohol consumption data goes back to 1851) and 1861-2002 for Sweden.

The conclusion from table 1 is in accordance with the plots in the figures above as all correlations are found to be positive. Hence, in the short run there is a pro-cyclical pattern for the overall consumption of alcohol as well as for the specific alcoholic beverages. In the long run there is less doubt about substitution processes taking place between beer, wine and spirits as exhibited in the graphs in figures 2-4. Looking at these data covering more than a century, the general pattern for all the Scandinavian countries is a steady decline in the consumption of spirits in favour of increasing consumption of beer and wine - where the consumption levels of the latter has increased tremendously since the 1960s and probably will be the most important alcoholic beverage in the future evaluated from the present trends in consumer behaviour.

From an economic point of view alcohol consumption is expected to be influenced by real income and real prices of the specific alcoholic beverages - as well as other variables, of course. From the presented graphs and correlation analysis there seems to be evidence of a positive income effect, but data for prices of the alcoholic beverages are not available for the long time span covered by the consumption and income data already exhibited. Therefore, in order to obtain an estimate of the (short-run) income effect in alcohol consumption an autoregressive distributed lag model (ARDL) is applied to the data:

$$\Delta \ln A_t = \alpha + \sum_{i=0}^p \beta_i \Delta \ln Y_{t-i} + \sum_{i=1}^q \delta_i \Delta \ln A_{t-i} + \varepsilon_t \quad (1)$$

First differences of income (Y) and alcohol consumption (A) measured in per capita terms are included in the RHS of (1) with a suitable number of lags following the general-to-specific estimation technique. The parameter estimates are reported in table 2.

The resulting parameter estimates are found to be very significant, although the models for Norway and Sweden still suffer from ARCH errors, which will remain even when extending the number of lags. Assuming the ARDL models are reasonably well representing short-run relationships in alcohol consumption - in spite of the missing price variables, which may cause bias in the parameter estimates - the best available estimates of the income elasticities are the  $\beta_0$ -parameter estimates.

Thus, the short-run income elasticities are relatively high, especially for Norway and Sweden, and even if the magnitudes are somewhat exaggerated due to missing variables, the conclusion is still a strongly pro-cyclical alcohol consumption pattern.

**Table 2. Parameter estimates of the ARDL models.**

	Denmark		Norway		Sweden	
$\alpha$	-0.019*	(-2.78)	-0.030*	(-2.68)	-0.034*	(-3.07)
$\beta_0$	0.806*	(5.37)	1.480*	(5.06)	1.444*	(5.46)
$\delta_1$	-	-	-	-	0.321*	(4.87)
$\delta_2$	0.252*	(3.01)	-	-	-0.512*	(-7.80)
$\bar{R}^2$	0.25		0.15		0.44	
DW	1.82		2.20		1.93	
LM(2)	1.29	(0.52)	2.08	(0.35)	3.57	(0.17)
LMARCH(2)	0.35	(0.84)	5.41	(0.07)	39.72	(0.00)

Note: *t*-values of the parameter estimates in parenthesis and with a \* indicating significance at least at the 5 per cent level. LM(2) and LMARCH(2) are Lagrange Multiplier tests for second order residual autocorrelation and second order autoregressive conditional heteroscedasticity, respectively, with *p*-values in parenthesis.

In the long run there is no evidence for a positive relationship between income and alcohol consumption levels - for obvious reasons as there will be a natural limit to the human intake of alcohol. Evaluated from the parameter estimates from table 2 the long-run elasticity between the *growth rates* of income and alcohol consumption will be zero for all three countries (as first differences of the variables are estimated in (1), only relationships between growth rates can be evaluated - not level values). Consequently, the next question to address in the following part 4 will be whether there is some kind of 'mean reversion' in the long-run level of alcohol consumption.

#### 4. Alcohol consumption in the long run: a mean reversion process or a random walk?

When evaluating the data for alcohol consumption from figure 1 these variables seem very much to exhibit random walk behaviour, i.e. be non-stationary I(1)-variables. Testing for unit root behaviour by the Dickey-Fuller test statistic is reported in table 3.

**Table 3. Unit root test of alcohol consumption levels (log values).**

	Denmark	Norway	Sweden
DF/ADF	-1.068{0}	-2.212{0}	-2.342{2}
N	109	151	139

Note: N is the number of observations, and the number of lags in the augmented DF-test indicated by the {}-parenthesis.

The conclusion from the DF/ADF-tests is in all three cases non-stationarity as the critical value is -2.88 at the 5% level of significance according to MacKinnon (1991). When taking a closer look at figure 1 an alternative interpretation of the unit root hypothesis - especially for Norway and Sweden - might be an asymmetric adjustment process towards a long-run level of alcohol consumption that is non-zero. Such an alternative hypothesis to the random walk behaviour as tested for in table 3 might be the so-called TAR-model (threshold autoregressive model) as presented in Enders and Granger (1998), see also Enders and Siklos (2001). In the present case of alcohol consumption levels the most obvious version of these models will be the TAR model with a linear attractor - the latter being the average long-run level of alcohol consumption. The threshold model (TAR) with a linear attractor is defined by (2) and (3), see Enders and Granger for further details:

$$\Delta \ln A_t = I_t \gamma_1 (\ln A_{t-1} - \bar{A}) + (1 - I_t) \gamma_2 (\ln A_{t-1} - \bar{A}) + \sum_{i=1}^p \omega_i \Delta \ln A_{t-i} + \varepsilon_t \quad (2)$$

where  $\bar{A}$  is the average value of  $A_t$  and  $\varepsilon_t$  is a white noise disturbance term. The indicator function,  $I_t$ , is defined as:

$$I_t = \begin{cases} 1 & (\ln A_{t-1} \geq \bar{A}) \\ 0 & (\ln A_{t-1} < \bar{A}) \end{cases} \quad (3)$$

An extension of this model is the M-TAR-model (Momentum TAR) where the indicator function is changed to:

$$I_t = \begin{cases} 1 & (\Delta \ln A_{t-1} \geq \bar{\Delta A}) \\ 0 & (\Delta \ln A_{t-1} < \bar{\Delta A}) \end{cases} \quad (4)$$

Hence, the model in (2) along the two versions of the indicator function, i.e. (3) and (4) respectively, is used to test the unit root hypothesis versus the TAR and M-TAR models. The test statistics are reported in table 4, where the Enders-Granger  $\Phi\mu$ -statistic ( $\Phi\mu^*$  for M-TAR) concerns the rejection of the unit root null hypothesis in favour of the TAR and M-TAR models from (2).

**Table 4. Test statistics of the TAR and M-TAR models.**

	Denmark		Norway		Sweden	
	TAR	M-TAR	TAR	M-TAR	TAR	M-TAR
$\gamma_1$	-0.015	-0.015	-0.027	0.051	-0.050	0.001
$\gamma_2$	-0.012	-0.012	-0.088	-0.081	-0.101	-0.182
Lags(p)	0	0	0	0	2	3
$\Phi\mu$	0.575	-	2.969	-	3.015	-
$\Phi\mu^*$	-	0.572	-	2.581	-	6.853*

Note: Critical values for  $\Phi\mu$  and  $\Phi\mu^*$  reported in Enders and Granger (1998). An \* indicates a significant test-statistic at least at the 5 per cent level of significance.

For Denmark and Norway the unit root behaviour of alcohol consumption levels is not rejected in favour of the alternative models, but for Sweden the  $\Phi\mu^*$ -statistic is above the 5 per cent critical value (approx. 5.02) and therefore the M-TAR model cannot be ruled out in this case. Hence, for Sweden the long-run development of alcohol consumption might be described as an asymmetric adjustment process (cf. the  $\gamma$ -parameters from table 4) with a linear attractor given by the average level of alcohol consumption for the whole sample period 1861-2002.

## 5. Conclusion

The aim of this analysis has been to analyse both the cyclical aspects and the long-run movements in wine, spirits and beer consumption in the Scandinavian countries. Using long-run time series data for alcohol consumption levels, i.e. from the middle of the 19<sup>th</sup> century the question of a counter-cyclical or pro-cyclical behaviour is addressed in particular. Although the Scandinavian countries are quite similar in many respects as concern history, culture, languages and lifestyles they do in fact differ with respect to drinking habits and alcohol and wine consumption levels. Significant changes in alcohol consumption levels have taken place both in the long run and during shorter periods, e.g. the latest couple of decades.

The conclusion from the correlation analysis between growth rates of income and alcohol consumption points in the direction of a strong positive relationship. Moreover, in the short run there is a pro-cyclical pattern for the overall consumption of alcohol as well as for the specific alcoholic beverages of beer, wine and spirits. Using an autoregressive distributed lag model (ARDL) the short-run income elasticities are also found to be relatively high, especially for Norway and Sweden, again suggesting a strongly pro-cyclical alcohol consumption pattern.

The outcomes of the analysis of estimating the ARDL models indicate that the long-run elasticity between the *growth rates* of income and alcohol consumption will be zero for all three countries. Because first differences of the variables are estimated in this model, only the relationships between growth rates can be evaluated. The last part of the analysis deals with the question, whether alcohol consumption in the long run can be considered as a mean reversion process or as a pure random walk. Using the TAR-model (threshold autoregressive model) and M-TAR-model (Momentum TAR) the results suggest that alcohol consumption in Sweden can be described as an asymmetric adjustment process with a linear attractor given by the average level of alcohol consumption for the whole-sample period 1861-2002. However, alcohol consumption in Denmark and Norway exhibit more evidence of pure random walk behaviour.

## References

Anderson, K., ed. (2004): *The World's Wine Markets. Globalization at Work*. Edward Elgar, London.

Enders, W. and C.W.J. Granger (1998): Unit-Root Tests and Asymmetric Adjustment With an Example Using the Term Structure of Interest rates. *Journal of Business & Economics Statistics*, 16 (3), 304-311.

Enders, W. and P.L. Siklos (2001): Cointegration and Threshold Adjustment. *Journal of Business & Economics Statistics*, 19(2), 166-176.

MacKinnon, J.G. (1991): Critical values for cointegration tests. In Engle, R.F. & Granger, C.W.J.: *Long-run Economic Relationships*. Oxford Economic Press.

## Appendix: Data sources

Statistisk Aarvog (The Danish Statistical Yearbook), var. issues 1893-1965, Statistics Denmark.

[www.statistikbanken.dk](http://www.statistikbanken.dk) (The Statistical Databank), Statistics Denmark.

[www.sbb.no](http://www.sbb.no) (The Statistical Databank), Statistics Norway.

[www.sbc.se](http://www.sbc.se) (The Statistical Databank), Statistics Sweden.

Historisk Statistikk (Historical statistics), Statistics Norway.

Statistisk Aarsbok (The Swedish Statistical Yearbook), var. issues 2000-2004, Statistics Sweden.

Sales statistics for spirits, wine and beer in Sweden (Alkoholinspektionen, [www.fhi.se](http://www.fhi.se)), Sweden.

Nordic Alcohol Statistics 1994-1998 (Stakes 2000), Finland.

Hansen, S. Aa. (1974): *Economic growth in Denmark* (in Danish), Copenhagen.

Kaergaard, N. (1991): *Economic Growth* (in Danish), Copenhagen.

Krantz, O. (2001): *Swedish Historical National Accounts 1800-1998 – Aggregated Output Series*. Working Paper, Department of Economic History, University of Umeaa, Sweden.

The abovementioned statistical sources have been used for the construction of annual data for alcohol consumption levels measured in litres of pure alcohol – including the specific beverages of beer, wine and spirits – and data for real GDP and population (aged 15 years and above).

Data for Denmark before 1960 were collected from the annual statistical yearbooks and in some cases some data had to be estimated, especially when converting the volumes in litres of beer, wine and spirits into litres of 100 per cent alcohol. Data for alcohol consumption covers the time period

1893-2002 for Denmark (with the exception that data for spirits is missing for 1915, 1917-18 and 1921), 1851-2002 for Norway (data missing for 1998, but estimated) and 1861-2002 for Sweden.

Data for real GDP and population (+15 years and above) for Denmark and Sweden correspond to the time periods covered by the alcohol consumption statistics. For Norway data cover the time period 1865-2002 (i.e. shorter time span than the alcohol data series) and data for GDP are missing for 1940-1945 (estimated for the purpose here as the level of GDP in the late 1930s correspond well to the level immediately after WWII).