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## Studying Cultural Change

### *Were the Changes in Alcohol and Coffee Consumption in the Nineteenth Century a Case of Beverage Substitution?*

Ole-Jørgen Skog

*University of Oslo and Norwegian Institute for Alcohol and Drug Research, Oslo, Norway*

**abstract:** Was the decline in alcohol consumption, experienced in many countries during the nineteenth century, related to growth of the coffee culture? This question is approached first through a simple content analysis of qualitative data obtained from an empirical sociological study of inebriety in Norway in the 1850s by Norway's first sociologist, Eilert Sundt [1859], then by a time-series analysis of quantitative data on coffee and alcoholic beverages in Norway. The results confirm that coffee filled a cultural 'niche' created by the restrictive Norwegian alcohol policy in the nineteenth century. Sundt's qualitative data point clearly in this direction. Although the quantitative data – particularly on coffee – are far from ideal indicators of consumption, the results lend some credibility to the substitution hypothesis: The trends coincide fairly closely for the two beverages, and in the detrended series there are measurable signs of correlation when the confounding effects of economic development are controlled for. It is concluded that the political attempts to reduce alcohol problems in the nineteenth and early twentieth centuries, i.e. reduced availability and increased taxes, may have been alleviated by the growing popularity of coffee as an alternative, 'new' beverage for the population at large, and not just the higher social classes.

**keywords:** alcoholic beverages ♦ alcohol policy ♦ coffee ♦ cultural change ♦ distilled spirits ♦ time series analysis

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## Introduction

Besides being a biological necessity, the intake of beverages of different sorts serves a varied series of social functions. Of particular interest from a sociological point of view is the fact that drinking together is a way of being together – a vehicle for social interaction. In the industrialized part of the world, this fact is perhaps most easily recognized in relation to alcoholic beverages in their many different forms. Survey data from several countries show that about 90 per cent of alcohol is consumed in groups (Dight, 1976; Harford, 1978; Nordlund, 1981). We use alcoholic beverages – along with other tokens – to define the social content of a get-together, creating an atmosphere different from that of everyday life. We use them as intoxicants to enter another state of consciousness, with other rules for interaction with other people. We offer alcoholic beverages to our friends to welcome them when they visit, and perhaps also because they fulfil a need to do things together. And public houses, like pubs, bars and taverns, are institutionalized forms of beverage-linked togetherness. Of course, other beverages have interactive functions as well. Different types of soft drinks, coffee, tea, cocoa,

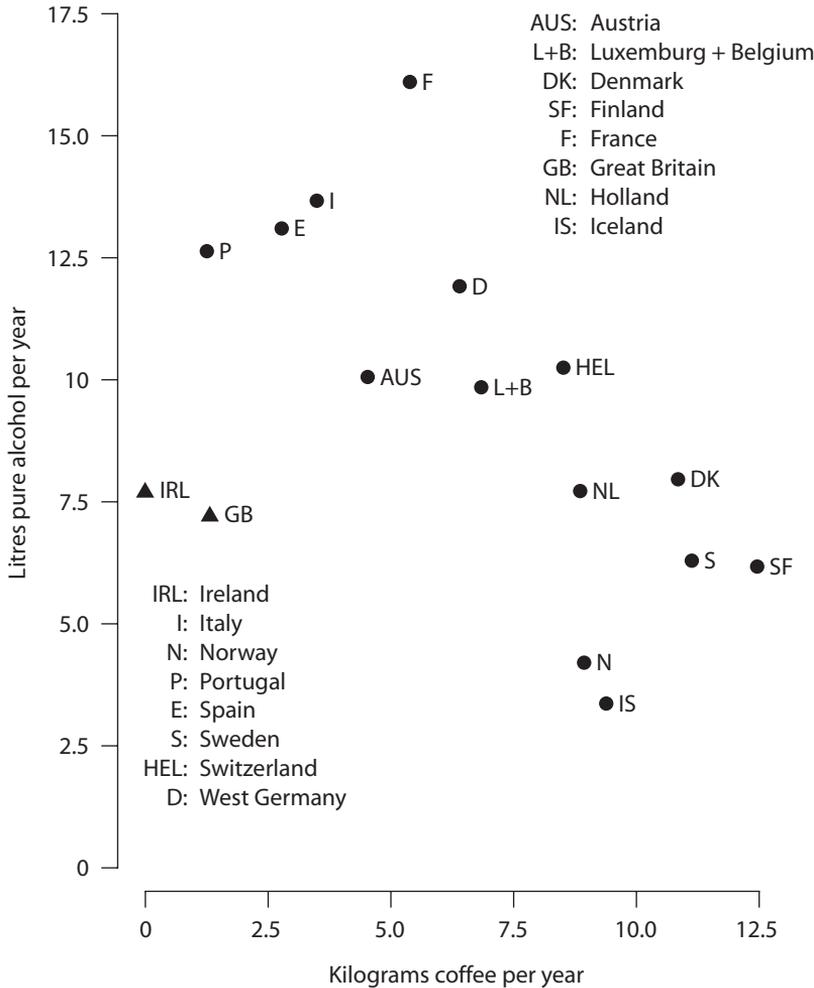
milk and milk-based products have played varying roles in different cultures throughout history. In Muslim cultures, coffee seems to have some of the same functions as alcohol in the Western world. And in certain epochs of Western history, coffee has been an important vehicle for togetherness, both in public and in private settings – and, of course, still is in many countries.

Coffee came to Italy, the Netherlands and England in the early seventeenth century and rapidly gained in popularity among the aristocracy and the middle classes. It reached the northern parts of Europe, as well as North America, during the second half of the century. In England and parts of Central Europe, the coffee house rapidly became an important public institution in the seventeenth and eighteenth centuries, while in the German states and the Nordic countries the rituals of coffee drinking were mostly imported into the spheres of private life. Alcohol, on the other hand, has been known from time immemorial in most cultures. However, the consumption of alcoholic beverages has varied greatly during different historical epochs. This is evident from different historical sources, although reasonably accurate statistics on alcohol consumption are available only for the past 100–150 years in most countries. Of particular interest are the nineteenth-century decreases in alcohol consumption in many countries. This new trend lasted well into the twentieth century, culminating with prohibition in countries such as the USA, Finland, Iceland and Norway. This decrease in consumption was obviously part of a larger process of cultural and economic change in which the growth of industrial capitalism, the organization of the working class, mass migration, etc., were essential elements. However, the fact that some countries did not experience the same decrease in consumption suggests that the causal mechanisms underlying these changes were not simple ones.

The nineteenth-century decline in alcohol consumption in some countries was probably the product of a multiplicity of different processes at both the micro- and the macro-level of social organization. In the present article we study one possible aspect of this process, namely the relationship between alcohol consumption and coffee consumption in the nineteenth and early twentieth centuries. The hypothesis to be tested is that the decline in consumption of alcoholic beverages in the nineteenth century was, in part at least, a substitution process, with coffee taking the place of alcoholic beverages.

This hypothesis is, *inter alia*, inspired by the observation that cultures with a high coffee consumption are also typically low consumers of alcoholic beverages. In fact, as can be seen from Figure 1, there is a reasonably strong negative correlation between coffee and alcohol consumption in European countries. Coffee consumption is highest in northern Europe, where alcohol consumption is lowest. In southern Europe, the situation is the opposite, and Central European States typically have medium consumption of both beverages. The two countries that fail to fit this pattern are Great Britain and Ireland, where tea, rather than coffee, is the dominant beverage.

One might perhaps raise the objection against the substitution hypothesis that the two beverages are fairly different in terms of effects on the central nervous system, and in terms of culturally determined conceptions of how these beverages affect our state of mind and our behaviour. Perhaps the two beverages were too different, particularly in countries where intoxication was an essential element of the drinking culture. However, I shall argue that such a substitution was still possible, because both beverages have other important attributes in common. Apart from the fact that both may be used as thirst quenchers, both may serve similar symbolic functions – in particular the function of being a vehicle for togetherness. The intoxicating properties of alcohol play an important role in the cultural images of these beverages, particularly in Anglo-Saxon and Nordic countries. This is not so with coffee, although even this beverage has a history as an intoxicant. (In fact, about a thousand years ago, orthodox Muslims in Arabia tried to prevent its use, since it was considered an intoxicating beverage and therefore prohibited by the Koran (Brecher, 1972). As we know, their crusade was not very successful.)



**Figure 1** Alcohol and coffee sales in 16 European countries. Average figures for 1976–80

Despite its reputation, however, in most cultures alcohol is often used not as an intoxicant, but for quite different purposes. Even in cultures where intoxication is considered fairly common and has a central place in cultural myths, only a limited fraction of the total consumption is used to bring about intoxication. The rest of the alcohol is consumed in smaller quantities and for other purposes, and the culture's conception of the beverage and its function is actually much less stereotypical than one might generally think (Simpura, 1983). Hence, the fact that our mental picture of alcohol is 'biased' towards intoxication, while this is not so for coffee, does not prevent a large functional overlap for these beverages.

Another relevant fact in relation to the substitution hypothesis is that the decline in alcohol consumption in the nineteenth century was to a large extent a reaction to drunkenness and the harmful effects of acute intoxication. Therefore, the fact that coffee was not conceived as an intoxicant, but instead the opposite, is an argument for rather than against substitution. It is not necessary that two products be as equal as possible in order to be potential substitutes for each other. A product is an ideal substitute for another if it shares some of its good qualities, but not its bad ones.

Several writers have, more or less explicitly, implied a possible substitution of alcohol with coffee, particularly with reference to the development in the seventeenth century (see, e.g., Schivelbusch, 1980). However, as far as I am aware no analyses of quantitative data actually supporting this interpretation have been published. Therefore, the aim of the present study was to make such an analysis. Since in many cultures the daily use of coffee seems to have been mainly confined to the upper social classes prior to the nineteenth century, we focus on the development in the nineteenth and early twentieth centuries using data from Norway.

If there was, in fact, a substitution process, the problem of causal ordering becomes pertinent. Did coffee push out alcohol, or was coffee pulled in by decreasing alcohol consumption? There are several reasons for assuming that the latter was the case. First of all, alcohol problems increased substantially in Norway during the first part of the nineteenth century, and this brought about a series of restrictions on production and increased prices in order to reduce consumption (Fuglum, 1972). Second, Sundt's data confirm this and suggest that coffee was pulled in rather than the other way round (Sundt, 1859). And, as we shall see, our own analysis points in the same direction, although it does not completely exclude more complex causal patterns.

## Data and method

The problem of beverage substitution during the nineteenth century is approached in two different ways. First, information about changes in beverage consumption have been obtained from a unique sociological study of inebriety in Norway in the 1850s by Eilert Sundt (1817–75). Via regional church leaders ('sogneprest', corresponding to the English rector), Sundt sent questionnaires to all school teachers in Norway asking them to assess the situation in their district by estimating the number of 'Temperate', 'Uncertain', and 'Inebriate' people there were among adult, married males of the working class and the landowning class. For obvious reasons, the response rate was very low in cities, while in the non-urban areas he received completed questionnaires from 2008 out of 2400 school districts. It has to be remembered that these communities were in general quite small and transparent – the average target population in these school districts was 96 married males. It also has to be remembered that only about 12 per cent of the population lived in cities and towns in this period.

In addition to the numerical estimates requested, 140 teachers and 69 priests sent him verbal descriptions of the drinking culture and how it had changed over the years. These reports covered 200 districts altogether. An analysis of the quantitative data, as well as a comprehensive summary of the verbal descriptions, was published in 1859. Coffee drinking was mentioned in 30 of the descriptions from 27 different districts.

Second, we use data from official records on annual sales of alcoholic beverages and imports of coffee, trying to establish whether the trends in alcohol and coffee consumption actually coincide to an extent compatible with our hypothesis. Next, we investigate whether there is a relationship on a year-to-year basis. It is well known that trends can be highly correlated, positively or negatively, without this signifying more intimate connections between the phenomena in question. In order to control for this possibility, we use the technique of differencing suggested by Box and Jenkins (1976) as a method by which to control for spurious correlation.

Annual sales data for coffee are not available except for the past few decades. As a proxy for such data, we have had to use statistics on imports. Annual data on imports of unroasted coffee in tons per year are available for the period 1829–31 and from 1835 onwards. These figures were obtained from N.O.S. Historical Statistics 1968 for the period 1828–1965, N.O.S. Historical Statistics 1978 for the period 1966–75, and from annual issues of the N.O.S. Statistical Yearbook for the remaining years.

In order to estimate imports of coffee on a per capita 15 years old and above rate, annual figures for the population in this age group are needed. These figures are available from 1925 and onwards in the historical statistics. For the period 1846–1925, only 5-year averages are available. Annual estimates have been obtained from these figures by linear interpolation. For the period 1828–45, data on population by age are available from the population censuses of 1825, 1835 and 1845. Annual estimates have been calculated from annual mean population figures, and annual figures of live births by the method described in the Appendix.

Annual data on per capita alcohol consumption in the population 15 years and older have been obtained from N.O.S. Historical Statistics 1968 (1851–1966), N.O.S. Historical Statistics 1978 (1967–75) and annual issues of N.O.S. Alcohol and Other Drugs (1976–82). Annual consumption data are not available prior to this period. It is known from historical sources that alcohol consumption increased strongly in Norway during the first third of the nineteenth century. This increasing trend seems to have come to an end by the late 1830s; Fuglum (1972) has estimated that the consumption levels peaked at about 7 litres of pure alcohol per capita, or about 11 litres per adult 15 years and older.

Since economic development affects consumer demand of both goods, changes in income levels have to be taken into consideration. Failure to do so may conceal the negative relationship implied by the substitution hypothesis, particularly in analysis of the filtered data. Ideally, one should also control for the effect of changes in prices, but data on prices are not available. As an indicator of buying power, per capita private final consumption expenditures in fixed prices are used. These figures are available for the periods 1865–1939 and 1946–82 in the publications N.O.S. National Accounts 1865–1960, N.O.S. National Accounts 1949–62 revised edition, N.O.S. National Accounts 1962–78 and N.O.S. National Accounts 1971–82.

## Results

In this section, empirical testing of the substitution hypothesis with different techniques is reported. We start with a simple content analysis of Sundt's data and proceed with statistical analyses of the time-series data. First we analyse the co-variation between the trends. As this may sometimes produce misleading results, we then apply a much more conservative method, where trends are removed before the series are correlated. In this analysis, changes in the population's buying power are controlled for.

### *Sundt's qualitative data*

If the substitution hypothesis is correct, one would expect not only a temporal correspondence between the changes in consumption of the two beverages, but also a correspondence with respect to geographical distribution, as well as the distribution across social classes and social situations. Official statistics do not give this kind of information, but Eilert Sundt's data provided valuable insight into the changes in alcohol consumption, and to some extent even coffee consumption in this period.

A simple content analysis of the reports published by Sundt (1859) gave the following results. From the 30 reports on coffee consumption in Eilert Sundt's data, 8 explicitly state that the increase in coffee consumption was related to the decline in alcohol consumption – particularly the consumption of distilled spirits. It is also illustrating that in northern parts of the country a couple of Sundt's rapporteurs expressed fear that people might switch back to distilled spirits, since coffee had become so expensive.

By the end of the 1850s, it was reported from all over the country that inebriety had improved – often dramatically – during the preceding one or two decades. The geographical distribution of these reports and their assessments are reproduced in Table 1. In eastern, south-western and western parts of the country, about two-thirds of the reports explicitly stated that

**Table 1** Geographical distribution of verbal reports on changes in inebriety and of references to coffee in Sundt's data

District	% of pop.	No. of reports	Changes in inebriety			Coffee consumption	
			No response	Improved	Worse/No change	Much	Little
A East	39	74	17	50	7	5	0
B South-west	17	38	11	23	4	4	0
C West	17	25	8	15	2	1	2
D Middle	18	31	4	26	1	10	0
E North	9	32	5	27	0	8	0
Total	100	200	45	141	14	28	2

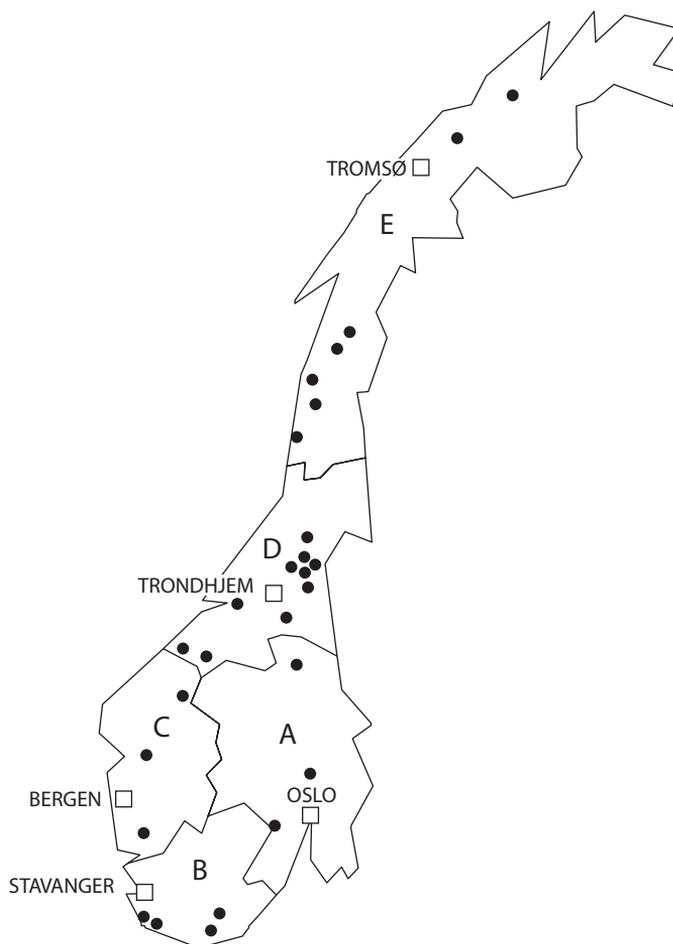
the situation had improved, while only one in ten indicated that the situation was unchanged or had worsened. The remaining reports did not say anything about changes. In the middle and northern parts of the country, six out of seven stated that the situation had improved; only one stated that no change had occurred. According to the rapporteurs, a total of 3.8 per cent of the married, male population were 'inebriates'. Furthermore, the prevalence of 'Inebriety' among the landowning class (56 per cent of the population) and the working class (44 per cent of the population) was identical. The situation is reported to have improved in both classes.

The geographical location of the 27 districts with reports on coffee are plotted on the map in Figure 2. From the 30 reports on coffee consumption, 28 stated that coffee had become very popular, and that consumption had increased strongly. Two reports, both from the western part of the country, stated that coffee was very seldom used. In fact, from this region there was only one positive report on coffee. The majority of the reports came from the middle and northern parts of the country – coffee was mentioned in nearly every third report in these regions.

There are surprisingly few reports (five from three districts) on coffee consumption in the eastern part of Norway, which is the region with by far the highest population density and the largest cities. The probable explanation is that coffee reached widespread popularity in these regions first and was therefore 'old news' not worth reporting by the end of the 1850s. In the middle and northern parts, on the other hand, coffee drinking was probably of more recent origin and this would explain why it was so frequently mentioned. In western parts of the country, coffee had apparently not yet become the drink at the time. Since alcohol consumption had apparently decreased strongly in this part of the country, the latter observation suggests that changes in alcohol consumption came first, and that these changes 'caused' the increase in coffee – rather than the other way round.

The decrease in alcohol consumption was of a general character – not just in geographical terms, but also across social situations. The situations and functions most frequently mentioned in the descriptions include holidays and celebrations, visits by family, friends and neighbours, hard work, travels, markets and auctions and illnesses.

First and foremost, alcohol was consumed quite heavily during official holidays like Christmas, weddings, and in connection with christenings and funerals. A wedding typically lasted for several days – up to eight in some parts of the country – as did many christening parties and funerals. During the 1840s and 1850s these older traditions had started to change. The consumption of distilled beverages was declining and to some extent was being substituted by wine, beer and coffee, according to the reports. The celebrations too were curtailed, typically lasting for only a day or two by the end of the 1850s.



*Figure 2* Geographical distribution of reports on coffee consumption in Eilert Sundt's data

According to the reports, alcohol – particularly distilled spirits – was considered a necessity in connection with hard manual work and on travels. Going to town often meant a full day or several days' journey for the farmers and peasants, and alcohol was a way of coping with stress in a harsh climate. In the fishing season, alcohol likewise played a significant role, particularly in the middle and northern parts of the country. By the end of the 1850s, the role of distilled spirits for these purposes was waning. However, the customs did not disappear altogether. During Prohibition (1916–27), fishermen could actually get distilled spirits from the pharmacy when going to the large herring fisheries in Lofoten in Northern Norway, provided that they had obtained a recommendation from a well-respected man in their community (Johansen, 1985).

It is also frequently reported that the use of distilled spirits as medicine was strongly reduced in this period. A woman giving birth was considered an exception in this respect, and it is reported from many parts of the country that distilled spirits were still used – often in large quantities – to relieve after-pains.

With the exception of medical purposes, coffee fulfilled many other functions. It was not simply a thirst quencher and a stimulant, it had also acquired symbolic meanings and served as a vehicle for social interaction. It was taken at parties and celebrations, and in several

reports it was mentioned on an equal footing with beer, wine and distilled spirits. It was frequently served to visitors. One rapporteur from the southwestern part of the country states that 'strong coffee is served at any time of the day to visitors, and is considered as one of the best things that can be served'. It was also used in connection with hard work and travels. In a report from the eastern part of the country, it was stated that 'during hard work, distilled spirits are now seldom used, but sometimes coffee, which the workers themselves say gives them more strength'. A rapporteur from the northern part of the country states that 'instead of the old "fishing-liquor", one now brings the kettle for making coffee'.

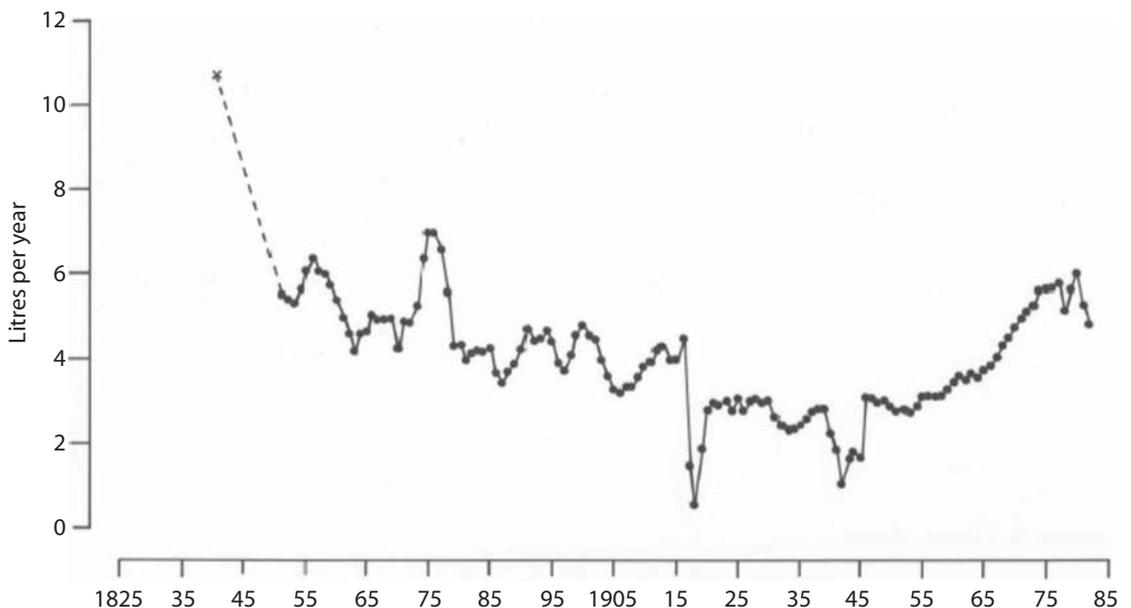
About a half of all reports on coffee give general descriptions along the lines that coffee is now frequently used and that 'the smell of coffee is coming from every cabin', as one rapporteur expressed it. In the other half of reports, coffee is mentioned in connection with one or several specific types of social situation (summarized in Table 2). It seems clear that coffee had acquired a strong and multifaceted set of use values at this time.

**Long-term trends**

As in most countries, the consumption of alcoholic beverages in Norway has varied considerably over the past 150 years (Figure 3). From an estimated level of nearly 11 litres per adult in the late 1830s, consumption dropped by nearly 50 per cent during the next 15 years, i.e. an average annual reduction of about 4 or 5 per cent per year. The details of this process of decline

**Table 2** Distribution of references to coffee according to type of social situation in Sundt's data. (Note that references to several situations occur in some reports)

Work and travels	Holidays and celebrations	Treating visitors	Meals	Non-specific	Totals
6	8	5	3	15	37



**Figure 3** Per capita sales of alcohol in Norway

are unfortunately unknown. The general trend during the rest of the century was also decline. However, the rate of change was significantly less during this second stage of the great decline – about 0.7 per cent per year on average (estimated via regression on time). Superimposed on this overall trend was a highly irregular pattern of short-term increases and decreases partly related to fluctuations in the population's buying power (Skog, 1986a), but they may also have been a result of micro-level processes of a more indeterminate and less systematic nature (Skog, 1986b).

Consumption of alcoholic beverages reached a minimum level during the prohibition era, which in Norway lasted from 1916 until 1927. In particular, consumption was very low during World War I. From 1910–14 to 1915–19 consumption dropped by about 40 per cent. During the 1920s, consumption remained fairly stable at about three litres per year, and it is interesting to observe that the repeal of prohibition did not produce any marked increase in consumption. After World War II, consumption rose steadily, as in most other industrialized states, the rate of increase being particularly strong during the late 1960s and the early 1970s.

The trend in coffee consumption can be read from Figure 4. In the 1830s, consumption was very low – little more than 1 kg of unroasted coffee per adult. This amounted to no more than one or two cups of coffee per week, and coffee consumption obviously did not play any significant role in the average Norwegian's daily life during this period. However, in the late 1830s consumption began to increase, reaching a level of about 5–6 kg (corresponding to one or two cups per day) 20 years later. During this period, coffee gradually became transformed from an exclusive and exotic drink of the higher social classes to an everyday beverage of the common man and his wife. The consumption of this new drink continued to increase throughout the century, but at a much slower rate. During the period 1835–50, the average annual increase (estimated via regression on time) was 7.3 per cent, while this was 1.1 per cent during the period 1851–1914.

In 1915 and 1916, nearly twice as much coffee was being imported as during the preceding years. In 1917, imports were back at the normal level, while they were substantially below normal in 1918 due to blockade. The increase in 1915 and 1916 was probably – at least to some extent – motivated by the intention to increase stocks (prices were increasing rapidly), but it

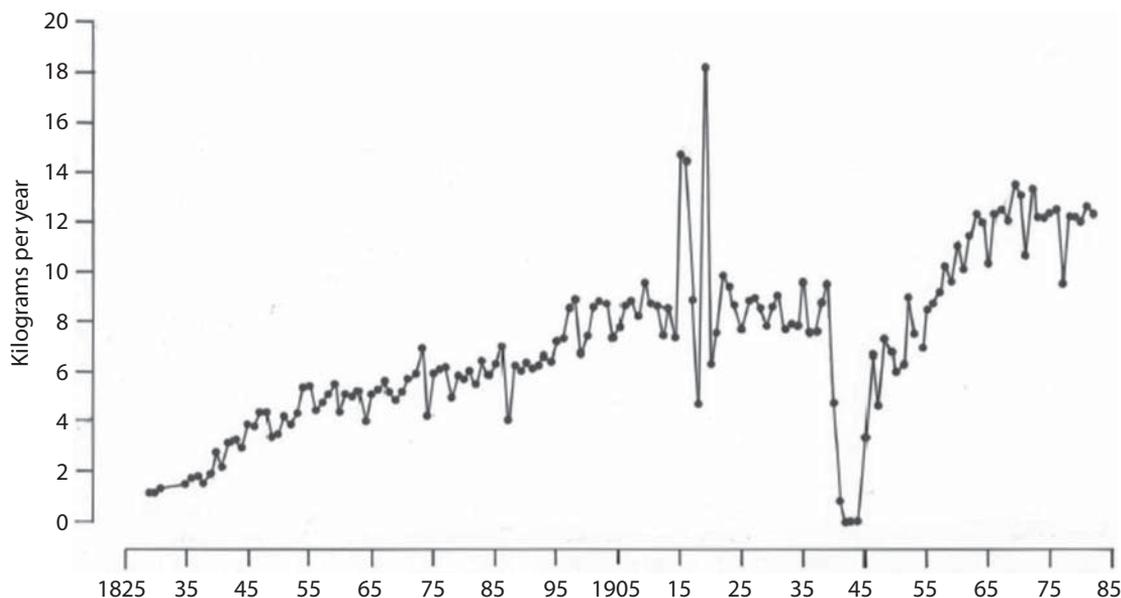


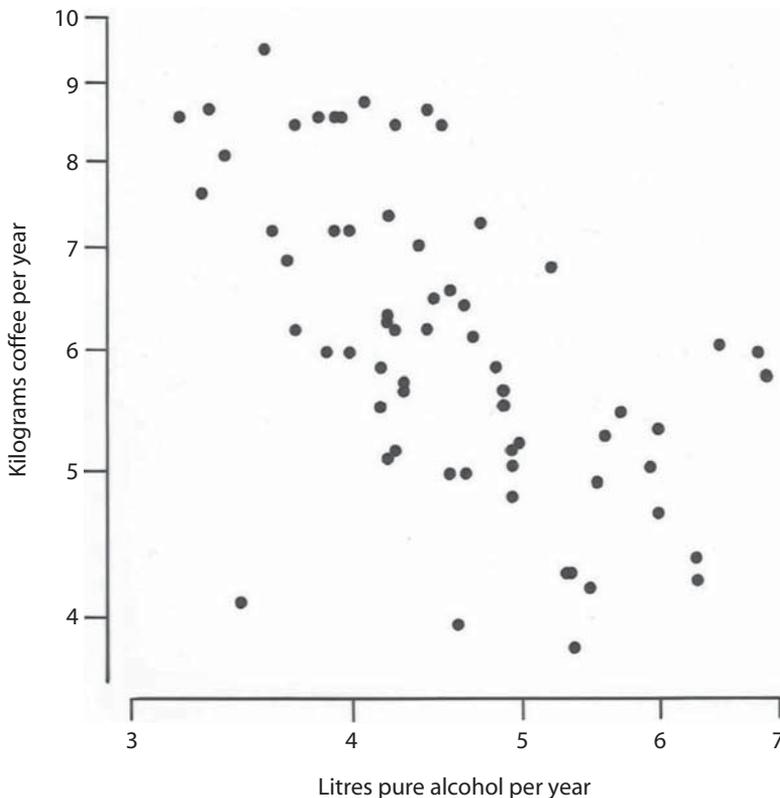
Figure 4 Per capita imports of coffee in Norway

is probably also true that coffee consumption increased strongly during World War I. The fact that imports in 1919 were higher than ever supports this interpretation. During the period 1915–19, imports were 50 per cent higher than in the period 1910–14, and from 1920 onwards imports were back at the same level as before the war.

After World War II, coffee consumption increased to about 12 kg per adult, corresponding to an average of approximately 0.5 litres of coffee per day. (Instant coffee is not included in this figure.) This level was attained by the end of the 1960s, and consumption has not changed very much in the years since then.

The general trends in alcohol and coffee consumption during the nineteenth and the early twentieth centuries thus seem to be compatible with the hypothesis of beverage substitution. Coffee consumption began to increase at about the same time that alcohol consumption started to decrease, and growth was strongest in the period when the decline in alcohol consumption was largest. Even the development during the first part of the prohibition era corresponds with expectations. First, alcohol consumption decreased, while coffee consumption increased, and when alcohol consumption increased again following World War I, coffee consumption decreased. Admittedly, the special circumstances during World War I may allow for alternative interpretations.

The development following World War I is obviously a very different matter, and there are no signs of substitution effects. In the following we therefore concentrate on the period 1851–1914 and analyse the relationship between the two variables more closely. The relationship is illustrated in the double-logarithmic correlation diagram in Figure 5. The coefficient of correlation is  $-0.59$ .



The first question to be addressed is whether the close correspondence between the trends in the consumption of the two beverages is coincidence. It is common knowledge that the presence of trends increases the probability of strong (positive or negative) correlations between phenomena that are not related to each other in any deeper sense (for some illustrations, see Skog, 1988). When testing the significance of such correlations, trends have to be taken into consideration. Bartlett (1955) has shown that the standard error of a cross-correlation is proportional to the square root of the product sum of the autocorrelation functions of the two series.

The estimated autocorrelation functions are shown in Figure 6. The estimated standard error of the cross-correlation is 0.31, and using a one-tailed test it can be concluded that the correlation is significant at the 5 per cent level, but not at the 1 per cent level. It therefore appears unlikely that the negative correlation observed is simply a product of 'chance' and due to the fact that both series contain long-term trends.

In order to form an idea of the strength of the hypothesized substitution effect, we have estimated a model in which coffee (C) is regressed on alcohol consumption (A). Since other factors besides the changes in alcohol consumption must obviously have had an impact on coffee consumption, and since these factors must be expected to have had a temporal structure, the model was estimated using an autoregressive noise term (N). Preliminary identification

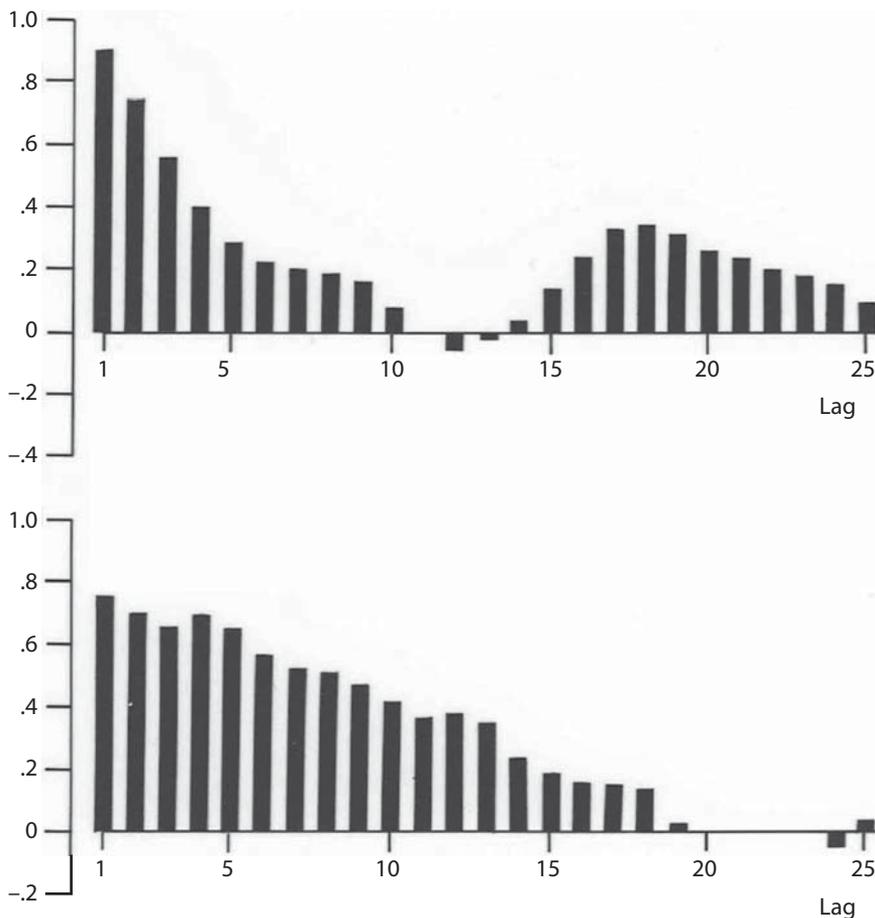


Figure 6 Estimated autocorrelation functions for alcohol (top) and coffee (bottom) 1851–1914

suggested a process of first order. Using the algorithm suggested by Cochrane and Orcutt (1949), we obtained (standard errors in parentheses):

$$\ln C_t = 2.43 (1.40) - 0.41 (0.23) \ln A_t + N_t$$

The parameter estimate for the noise model was 0.67. Diagnostic tests did not uncover serious autocorrelation in the residuals. The data therefore suggest that a 1 per cent decrease in alcohol consumption was accompanied by a 0.4 per cent increase in coffee consumption. The actual increase in coffee consumption is consequently much larger than would be expected on the basis of the trend in alcohol consumption alone, and this implies that substitution is at best only a partial explanation for the increase in coffee consumption – a fact which is also evident from the fairly large parameter estimate for the noise.

### *Short-term changes*

If the substitution hypothesis is correct, one might expect co-variations between the two series of a more short-term nature as well. This is obtained by differencing the series, i.e. by analysing annual changes rather than annual levels of consumption. When interpreting this result, we are up against two problems – an unfavourable signal/noise ratio and the confounding effects of increasing buying power.

Economic factors may effectively mask a negative correlation at this level of analysis. An increase in the buying power of the population affects consumption of both alcohol and coffee in the same direction (see below) and therefore gives a positive contribution to the covariance between the two series. This positive contribution may completely neutralize a negative contribution stemming from the alleged substitution effect. Therefore, buying power should be controlled for in the analysis.

Buying power measured by private final consumption expenditures in fixed prices shows an average annual rate of increase of 1.1 per cent during the period 1865–1914. For the same period it has been shown that the income elasticity of alcoholic beverages (estimated on differenced data) was 2.3 (Skog, 1986a). The fact that alcohol sales decreased during this period, despite the positive effect of increasing buying power, is due to the fact that other factors pulled in an opposite direction (cf. Skog, 1986a, b).

The correlation between annual changes in coffee imports and buying power is also positive, but much smaller than for alcohol. We obtain  $r = 0.24 (0.12)$ , which is significant at the 5 per cent level, but economic development apparently explains only 4 per cent of the variations in the rate of change in coffee imports. This is probably partly due to the fact that we are considering imports rather than sales. However, this is only part of the explanation. Regressing changes in coffee imports on changes in buying power (B), using a third-order autoregressive noise term, we obtain (standard error in parentheses)

$$\Delta \ln C_t = 0.71 (0.38) \Delta \ln B_t + \Delta N_t$$

The operator  $\Delta$  denotes differencing, i.e. that annual changes were analysed. The parameter estimates for the noise model were  $-0.81$ ,  $-0.58$  and  $-0.37$  at lags 1, 2 and 3, respectively. Diagnostic tests did not uncover serious autocorrelation in residuals.

The elasticity estimate of 0.71 is surprisingly small compared to the one found for alcohol. It suggests that coffee reacted very much like ordinary consumption goods in this period, whereas alcohol reacted like luxury goods, responding quite strongly to changes in buying power. Since Norway was quite a poor country at the end of the nineteenth century, and since coffee was still a new product only just starting to become an integral part of everyman's daily life, one might have expected that it would have behaved like a luxury product with an elasticity well exceeding 1. However, this estimate may very well be biased downwards owing to the substitution effect.

In order to get an idea of the strength of the hypothesized substitution effect, we fitted a regression model to the data, with alcohol consumption and buying power as input variables and coffee as output variable. The noise was presumed to be autoregressive of third order, and we obtained

$$\Delta \ln C_t = -0.02 (0.01) + 1.88 (0.81) \Delta \ln B_t - 0.34 (0.18) \Delta \ln A_t + \Delta N_t$$

The parameter estimates for the noise model were  $-0.82$ ,  $-0.60$  and  $-0.38$  at lags 1, 2 and 3, respectively. The diagnostic checks of the model suggested neither autocorrelation in residuals nor cross-correlations between residuals and buying power and alcohol, respectively.

As expected, a substitution effect is visible similar in strength to that obtained from the raw data. In fact, the point estimate indicates that a 1 per cent decrease in alcohol consumption was accompanied by a 0.34 per cent increase in coffee consumption. The statistical significance is once again a borderline case, however, and the evidence is therefore quite fragile.

We also observe that by taking alcohol sales into consideration the elasticity estimate for coffee is substantially increased, i.e. from 0.71 to 1.88. The point estimate therefore suggests that coffee actually reacted like a luxury product during this epoch, and that our first estimate is biased due to omission of the alcohol variable. However, it should be observed that the standard errors of these estimates are fairly large.

This can be explained as follows. In years when buying power increases strongly, the factors producing a downward trend for alcohol consumption are counteracted and alcohol consumption may fail to decrease. There is therefore no room for substitution and only a fairly modest increase in coffee consumption can be expected. On the other hand, when buying power decreases, a strong decrease in alcohol consumption would be expected, leaving a large cultural 'niche' to be filled with coffee. Therefore, coffee consumption may actually increase in spite of the decreased buying power, or it may only decrease moderately. In the absence of a substitution effect, coffee consumption should have responded much more strongly to changes in buying power. However, the presence of a substitution effect seems to have allowed coffee consumption to 'escape' the coercive power of reduced income.

## Conclusion

The relationship found in the differenced data is certainly not strong in terms of explained variance, even after controlling for the effect of economic development. It is most unfortunate that annual alcohol data for the period 1835–50 are not available, since the much higher rates of change during this period would have significantly improved the statistical power of tests based on annual data. However, the evidence points in the right direction, although it seems clear from the numerical value of the estimated substitution parameter that the increase in coffee consumption is only partly explained by the decrease in alcohol consumption. According to the estimated substitution parameter, a decrease in alcohol consumption from 11 litres in 1840 to 4 litres in 1914 should induce a 50 per cent increase in coffee consumption, which is considerably less than the increase actually observed. The economic development in this period was obviously another important explanatory factor.

Provided that the results can actually be interpreted as evidence for a substitution process, a relevant problem is that of the causal order of the events. As usual, there are at least three different possibilities: (1) The decrease in alcohol consumption comes first, and these changes cause changes in coffee consumption. Coffee 'fills' the cultural 'niche' created when alcohol consumption declines. (2) The increase in coffee consumption comes first, and declining alcohol consumption is an effect. In this case coffee is actively 'squeezing' alcohol out of the market. (3) Both trends are the product of the same cultural process.

Suppose that the first mechanism was operating, i.e. that alcohol was the cause and coffee the effect. If one tried to estimate the income elasticity of coffee without taking changes in alcohol consumption into consideration, one would strongly underestimate this elasticity. However, the income elasticity of alcohol would not be underestimated by omitting coffee from the equation, since coffee is not a cause of alcohol consumption in this case. If the second mechanism was operating, the result would be the opposite.

The fact that we obtained a very large increase in the elasticity for coffee, but not for alcohol, might be taken to suggest that the first mechanism is a more likely candidate than the second. However, the third mechanism may also produce the same asymmetry. If a certain (unidentified) aspect of the process of cultural development in this period was responsible for both trends, but produced a larger change in coffee consumption than in alcohol consumption, the observed asymmetry could result.

The problem of identifying the nature of the causal mechanisms operating in substitution processes like the one considered here is notoriously difficult. More data would be needed, and even if such data could help us to resolve some of the statistical problems, we would still be confronted with some fairly difficult epistemological problems. It is not at all obvious that the distinction between the three possibilities is a clear one for the kind of phenomena we are concerned with here. It is not unlikely that all three mechanisms may be operating more or less simultaneously, and in that case the problem of causal order is more a question of degree than either/or.

We shall not embark on a detailed analysis of this problem. Suffice to say that there are at least a couple of good reasons for suspecting that the causal arrow stretching from coffee to alcohol is much weaker than the arrow in the opposite direction. One reason is the fact that the decrease in alcohol consumption in the period in question was sometimes a direct product of reduced availability due to increasing restrictions on production as well as on-premise and off-premise sales of alcohol (Fuglum, 1972). For instance, in the middle of the 1890s a whole series of restrictions produced a reduction in alcohol consumption of about 20 per cent. As can be seen from Figure 4, there was at the same time a significant increase in coffee imports. It is difficult to believe that the political processes leading to these restrictions were caused by increased popularity of coffee.

In summary, the evidence seems to be sufficient to allow the conclusion that the birth and growth of the Norwegian coffee culture was intimately related to the transformation of the Norwegian alcohol culture in the nineteenth century. It is very likely that this substitution came about because the reduction in alcohol consumption created a cultural 'niche' that coffee could fill. Although it may seem unlikely that the growth of the coffee culture could be conceived as a primary cause of the decline in alcohol consumption, one cannot exclude the possibility that a secondary mechanism of this sort was in operation. If coffee filled the cultural 'niche' left open by reduced alcohol consumption, which again was caused by political restrictions, it may have prevented public opposition and thus paved the way for further reduction in alcohol consumption.

Granted that this interpretation is correct, one may ask whether such mechanisms have any implications for the present debate about prevention of alcohol-related problems. Would it be possible to reduce alcohol consumption – and hence alcohol-related problems, according to accepted theories (cf. Bruun et al., 1975; Moore and Gerstein, 1981; Edwards et al., 1994) – by stimulating the consumption of other beverages?

This is a difficult question. On the one hand it is difficult to control this kind of cultural development by political measures. Changes in consumer preferences are the product of complex processes at both the micro-level and the macro-level; the micro-level processes in particular are difficult to predict and control (for a more detailed discussion of this unpredictability, cf. Skog, 1986b). On the other hand, consumer preferences are in general influenced

by external factors such as prices and availability of the commodity, and this applies to alcoholic beverages as well (Bruun et al., 1975; Popham et al., 1976; Lau, 1975; Edwards et al., 1994). However, the political feasibility and actual outcome of control measures of this type may be limited and highly dependent on the historical context. The availability of acceptable alternative beverages may be crucial. A well-known principle in folk psychology is that it is easier to remove a certain type of behaviour if constructive alternatives are offered. The same may be true at the cultural level. The puzzle is to find out what the acceptable alternatives are – and this is obviously a more difficult task at the cultural level than at the individual level.

## Appendix

According to the population census in 1825, the total population of Norway by the end of that year was 1 051 318, of which 269 851 were below 10 years of age, while 174 753 were in the age span 10–19 years. The number in the age group 10–14 was estimated as follows.

Of those born in the period 1806–15, 50.2 per cent belonged to the cohort 1811–15. During this epoch, about 3 per cent of the 15-year-olds died before reaching the age of 20. Combining these figures, we find that 51.0 per cent of the age group 10–19 should be in the age range 10–14, and hence that the population below 15 years of age should be about 359 000 in 1825. By the same method, one can calculate that the population below 15 years of age was 429 000 in 1835. In 1845 the figure was about 446 000 according to N.O.S. Historical Statistics 1968.

Starting with the estimated population figure for 1825, annual estimates of the population below 15 years of age were obtained for the period 1826–45 as follows. From the population estimate for year  $t$ ,  $P(t)$ , the next year's live births,  $B(t + 1)$ , were added. From this an estimate of those who entered the next age group,  $E(t + 1)$ , was subtracted. This was estimated as a constant fraction of the birth rate 15 years earlier, this fraction being the probability that a newborn would survive his 15th birthday, denoted  $s$ . Also subtracted was an estimate of the number of persons dying during a period of one year in this age group,  $D(t + 1)$ . This was assumed to be a constant fraction of those below 14 years of age by the end of year  $t$ , i.e.  $P(t) - E(t + 1)$ , the fraction being the annual mortality rate for the age group 0–14 years, denoted  $d$ . Symbolically we may write

$$P(t + 1) = P(t) + B(t + 1) - E(t + 1) - D(t + 1)$$

$$E(t + 1) = s \times B(t - 14)$$

$$D(t + 1) = d \times [(P(t) \times E(t + 1))]$$

which simplifies to

$$P(t + 1) = (1 - d) \times P(t) + B(t + 1) - s \times (1 - d) \times B(t - 14)$$

Age-specific death probabilities are available from 1871 and onwards. These do not appear to have changed very much during the next few decades. Using the data for the 1870s, it is found that the probability that a newborn would survive his 15th birthday was 0.773. Furthermore, in the age group 0–14 years, a standard population with age distribution corresponding to the death probabilities is found to have had an annual mortality rate of 19 per 1000. In the calculations, we have assumed that roughly the same figures were valid for the period 1825–45, and we have used the values  $1 - d = 0.98$ , and  $s \times (1 - d) = 0.76$ .

The resulting estimates for the population below 15 years of age fit the figures obtained from the 1835 and 1845 census very well. For the year 1835 we estimate this population to have included 430 000 people, while for the year 1845 the estimate is 445 000. The first figure is 1000 too high compared to the census figure, while the second is 1000 too low. The resulting

estimates of the population 15 years and older become 757 000 and 875 000 and the estimation errors should therefore be less than 0.2 per cent. This is within acceptable limits for our purpose.

The population trend has been estimated for other parameter values as well, but it turns out that the values actually chosen are the ones giving the best fit.

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**Biographical Note:** Ole-Jørgen Skog has been Professor of Sociology at the University of Oslo since 1995. He has also been Scientific Director for the Centre for Advanced Study at the Norwegian Academy of Science and Letters (2000–2003) and Director for the Norwegian Institute for Alcohol and Drug Research 1988–1994. He is an elected Fellow of the European Academy of Sociology and the Norwegian Academy of Science and Letters. His main research topics have been sociology of deviance, in particular alcoholism and drug abuse, suicide and crime, but also social diffusion theory, social network theory and rational choice theory.

**Address:** Department of Sociology, University of Oslo, P.O. Box 1096 Blindern, NO-0317 Oslo, Norway. [email: o.j.skog@sosiologi.uio.no]