Essays on Societal Cost of Alcohol and Related Issues - A Health Economic Analysis

Jarl, Johan

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A Health Economic Analysis

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To Helen

Bättre börda
man bär ej på vägen
än mycket mannavett.
Sämre vägkost
man ej släpar över fältet
än övermått utav öl.

Ej är så gott,
som gott man säger,
öl för människors ätt;
ty mindre en man,
ju mera han dricker,
vet till sig, vad tankar han har.

- Havamal, Den Höges sång. Vers 11 & 12. Översättning av Erik Brate

Better gear than good sense
A traveller cannot carry,
A more tedious burden than too much drink
A traveller cannot carry,

Less good than belief would have it
Is mead for the sons of men:
A man knows less the more he drinks,
Becomes a befuddled fool,

- Havamal, The Words of the High One, verse 11 & 12. Translation by W H Auden & P B Taylor

[En skål] för alkohol!
Orsaken och lösningen till livets alla problem.
- Homer Simpson (Homer vs. The Eighteenth Amendment)

To alcohol!
The cause of and solution to all of life's problems.
- Homer Simpson (Homer vs. The Eighteenth Amendment)

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Malmö,
September 2009

Johan Jarl

Abstract

The consumption of alcoholic beverages has wide effects, for example, causes premature mortality, prevents certain heart diseases, increases crime rates, and affects quality of life. The main problems with alcohol consumption from an economic point of view are lack of information for consumers when making consumption decisions, externalities, and the addictive nature. It is expected that this results in non-optimal consumption levels, causing higher costs than benefits. Studying the effects of alcohol consumption is thus important in order to increase information and to allow interventions and regulations to be implemented targeting market failures, with the overall purpose of improving societal and individual welfare.

The aim of this thesis is to study the effect of alcohol consumption on society, calculating the societal cost of consumption, and investigating possible improvements with regard to the estimation methods, data materials, and methodological assumptions. The focus of the latter is on issues related to labour market outcomes. Four research papers are included, together covering the aim.

Paper I conservatively estimates the societal cost of alcohol consumption in Sweden, including health and quality of life effects. The costs add up to a net cost of SEK 20.3 billion (0.9% of GDP) in 2002. To this should a partial estimate of reduced quality of life be added, totalling 122,000 QALYs. Sensitivity analyses indicate a sensitivity range of 50% of the net cost. However, even the lowest plausible estimate shows net societal cost of alcohol consumption.

Paper II investigates the effect of low alcohol consumption on health, measured as medical care costs and prevalence of alcohol-attributable diseases. It is found that low alcohol consumption increases medical care costs and episodes, with the exception for individuals above 80 years of age. Thus, the protective effect of low alcohol consumption for some diseases can not fully counter the detrimental effect from those diseases

where low alcohol consumption increases the risk. Based on the epidemiological literature, low alcohol consumption should therefore not be considered to improve health.

Paper III studies a methodological issue in connection to the wage equation; whether failure to account for individuals' drinking histories causes heterogeneity within commonly pooled consumption groups, potentially causing bias in econometric estimations. By applying a multinomial logit model, it is found that pooled drinking groups (current abstainers and light drinkers) are heterogeneous, and that this might implicate estimation bias due to confounding and misclassification. This study thus argues that it is imperative to account for drinking history when studying the effect of alcohol consumption.

Paper IV analyses the effect of women's alcohol consumption on the likelihood of being long-term absent from work. Drinking history and selection effects are controlled for by applying a Heckman model. Women who are not a long-term light drinker is associated with an increase in the probability of long-term sickness-related absence, except for the insignificant effect of being a current light but former heavy drinker. The strongest effect is found for former drinkers (18%) followed by former abstainers (15%). Surprisingly are both being a long-term abstainer and a long-term heavy drinker associated with an increase of around 10%. Several simulation models were estimated, for example investigating the potential societal gain in productivity if all women were long-term light drinkers. It is found that the effect of alcohol consumption on long-term sickness-related absence is rather small on an individual level, although the added societal effect is substantial.

It is shown in this thesis that alcohol consumption has a large societal impact. The societal cost was estimated in Paper I and Paper II – IV have supplied new information, with focus on the possible wage effect of alcohol consumption, in order to improve future estimations. Paper II rejects, based on the epidemiological literature, the possibility that the positive wage effect of low alcohol consumption is mediated through a protective health effect. According to Paper III, drinking history should be controlled for although this can not explain the commonly found inversed U-shaped relationship between alcohol and wages. Paper IV in turn suggests sickness-related absence as a mediator, potentially explaining (parts of) the alcohol –

wage effect. Finally, the thesis has shown that the results of cost estimations are sensitive to what type of data is being used. Compared to a society without alcohol, the current Swedish consumption increases long-term sickness-related absence when using epidemiological data (Paper I), and decreases absence when using microdata and econometric methods (Paper IV).

Key words: Alcohol consumption, Drinking history, Consumption groups, COI, Societal cost, Productivity loss, Wages, Health, Sickness absence, Sweden.

List of papers

This thesis is based on the following original papers referred to in the text by their Roman numerals:

I. **Jarl, J**., Johansson, P., Eriksson, A., Eriksson, M., Gerdtham, U-G., Hemström, Ö., Hradilova Selin, K., Lenke, L., Ramstedt, M. & Room, R. (2008) "The societal cost of alcohol consumption: an estimation of the economic and human cost including health effects in Sweden, 2002" *European Journal of Health Economics* **9**: 351 – 360.

II. **Jarl, J**., Gerdtham, U-G. & Hradilova Selin, K. (2009) "Medical net cost of low alcohol consumption – a cause to reconsider improved health as the link between alcohol and wage?" *Cost Effectiveness and Resource Allocation* (in press).

III. **Jarl, J**. & Gerdtham, U-G. (2009) "Wage Penalty of Abstinence and Wage Premium of Drinking – A misclassification bias due to pooling of drinking groups?" *Addiction Research and Theory* (in press).

IV. **Jarl, J**. & Gerdtham, U-G. "Does drinking and drinking history affect long-term sickness-related absence? – A Heckman analysis based on matched survey and register data from Sweden" *Submitted*.

Abbreviations

AAF	Alcohol attributable fraction
CHD	Coronary heart disease
CLFHD	Current light but former heavy drinker (regarding alcohol)
COA	Cost-of-alcohol
COI	Cost-of-illness
FA	Former abstainer (regarding alcohol)
FD	Former drinker (regarding alcohol)
ICD-10	International classification of disease, 10^{th} version
IIA	Independence of irrelevant alternatives
LA	Long-term (lifelong) abstainer (regarding alcohol)
LHD	Long-term (lifelong) heavy drinker (regarding alcohol)
LISA	The Longitudinal Integration Database for Health Insurance and Labour Market Studies
LLD	Long-term (lifelong) light drinker (regarding alcohol)
PYLL	Potential years of life lost
QALY	Quality-adjusted life-years
QoL	Quality of life
SEK	Swedish krona
ULF	The Swedish Survey of Living Conditions
US$	United States dollar

Introduction

Alcoholic beverages and consumption has been a central part of most human societies for millennia. Obviously no one knows for sure when, where and how alcohol was invented although archaeological evidences of beer jugs show existence of fermented beverages as early as 10,000 BC. Wine can be viewed in Egyptian pictographs from around 4000 BC (Hanson, 1995), and it became an important beverage and commodity at the time of the Roman Empire. There is evidence of wine trading in the Mediterranean regions as early as the 7th century BC. During the late Roman Empire, estimates of per capita wine consumption reaches 250 litres. Obviously, wine was a natural part of everyday life as it was cheep or even given out for free. The Roman state also used it for payment (Engs, 1995). In non-Roman provinces in northern Europe, classical authors report mead and beer drinking from the 1st century BC. Intoxication among Germanic tribes continues to be reported during the 1st millennium AD (Helling 1987). The perception of alcohol has differed within and between cultures and time periods, but has often been dual. For example, Platon critical was of drunkenness but did at the same time praise moderate wine drinking. Hippocrates, the father of modern medicine, claimed to have identified a number of medical properties in wine (Hanson, 1995).

The earliest written evidence about alcohol consumption in the Nordic countries appears around 1000 AD. Alcohol was at that time used both for religious purposes (common throughout history) and in secular life. The culture could be characterised as a binge-drinking culture where the ability to tolerate large amounts of alcohol was associated with positive attributes, at least for men (Helling 1987). It is interesting to note that the negative effects of over-consumption was early noted and recommended against. An

example of this can be seen in the extract from Havamal[1] in the beginning of this thesis. The first known Swedish book about the adverse effects of alcohol consumption is from 1557, written by the archbishop Laurentius Petri, who thereby is viewed by some as the founder of the Swedish temperance movement. Although adverse effects such as increased mortality, hangovers and "boil of the liver" were identified, moderation of consumption was advocated rather than abstention (Helling 1987). His words, however, seem to have gone largely unheard.

The consumption of alcoholic beverages has thus an extremely long tradition in human societies. Long is also the discussion about both the detrimental and beneficial effects of said consumption. It is perhaps not surprising that this debate still rages on, although the knowledge today is much larger, especially regarding how alcohol affects the body and thus our health but also how it affects society at large. The debate today tend to focus on whether the overall effect of low alcohol consumption is positive or negative, with some form of consensus on the detrimental effect of heavy drinking.

Why study the effects of alcohol consumption?

Why should we spend time, money and effort studying the effects of alcohol consumption? While there are many answers to this question, both general and specific, only two will be discussed here. First, from an economic point of view an individual is considered to be making a decision on whether or not to buy a certain good based on the utility s/he will receive from it. The utility is, of course, the benefit minus the cost. The utility is then compared to the utility of other goods (the opportunity cost) and, subsequently, the good with the highest utility is purchased. It can very well be argued that the information available for the individual is imperfect—that there are uncertainties around the magnitude of the benefit, the cost and the opportunity cost. Since individuals demand and buy alcoholic beverages, we can safely assume that the perceived benefit of consumption is higher than its perceived cost, but also that the perceived utility of alcoholic beverages is higher compared to other goods at the time of

[1] Havamal is probably created during the 10th century in Norway, although the oldest remaining text is from around 1270.

purchase. From an economic perspective, therefore, it is imperative to study the effects of alcohol consumption in order to minimise the uncertainty around the utility achieved from alcoholic beverages for each individual. That is, by increasing our knowledge of how alcohol consumption affects, for example, health and labour market outcomes, the individual will have a better chance of maximising his/her utility.

Second, alcohol consumption is a health-related behaviour and alcohol are in itself in many aspects a normal good (negative price elasticity and positive income elasticity). The state/government has thus large opportunity to reduce the societal harm of alcohol consumption by creating interventions and policies. However, in order to target the correct issues and to do so effectively, detailed information is needed. In modern (welfare) societies, the individual does not normally bear the full cost of the adverse effects of alcohol consumption, despite carrying most of the beneficial effects: health care is provided free of charge or at a substantially reduced price at the time of treatment while the enjoyment of consumption is provided to the consumer alone. This distorts the utility calculations discussed above, since the cost the individual faces is lower than the actual cost to society. That is, the total costs for all individuals might be lower than the total cost borne by society, resulting in above optimal consumption. While the representatives of society can introduce policies to correct for this (e.g., alcohol taxes and reduced availability) to effectively achieve optimal consumption, detailed knowledge about the effects of alcohol consumption is required.

Given an interest in the effects of alcohol consumption, why do we want to calculate the cost of alcohol consumption? A general motivation is that the effects of alcohol consumption range over a number of different outcomes. Among other outcomes, it affects the health of the drinker, it increases the risk of violent crime where both the drinker and others can suffer adverse effects, it can result in property damage from accidents such as car crashes, and it is considered to reduce productivity. These outcomes are difficult to compare, although converting these effects into a common unit—by giving the outcomes a value in monetary terms—makes comparison possible and intuitive. The conversion to a monetary unit is not without challenges, however, which will be discussed below.

More specific reasons normally brought forward regarding cost studies on alcohol consumption are (Collins et al. 2006):

- Economic estimates are often used in public debate to argue that policies on alcohol use should have high priority. Likewise, economic estimates are also used to argue for the liberalisation of current alcohol policy.
- Estimates help target appropriate problems and policies.
- Performing estimates identifies information gaps in research and data as well as possible refinements in the national statistical reporting system.
- Improved cost estimates may provide a baseline for economic evaluations that are needed in order to use (public) resources effectively.

It is the view of this thesis that developed and carefully performed cost studies can be very useful, especially with respect to the fourth comment above. A developed research field can play an important role in policy decision-making as well as in evaluating (public) health interventions.

However, cost of alcohol (COA) studies is a field under development. There are numerous estimations of cost components that can be/are being improved following a better theoretical understanding, the collection of better data, and improved methods. This thesis has two parts, the first estimates the cost of alcohol consumption, while the second part studies outcomes of alcohol consumption with the aim of improving future cost estimations. The focus on the latter part has been on the common, but rather counterintuitive, result of negative outcomes with respect to the health and labour markets due to abstention, and positive outcomes from low/light levels of consumption. More specifically does Paper II investigate whether the effect of alcohol consumption on health, as supplied by the epidemiological literature, is sufficient for explaining the wage premium experienced by low alcohol consumers compared to abstainers. Paper III investigates to what extent heterogeneity due to failure to account for past consumption can explain the wage penalty experienced by abstainers compared to low/light drinkers. Finally, Paper IV investigates the effect of alcohol consumption on long-term sickness-related absence from work while controlling for past consumption and possible selection effects. Thus, Papers II–IV address important issues in connection to COA calculations,

as they concern the validity of possible cost reductions following low/light drinking. The possible cost reductions related to labour market outcomes is often not included in existing COA studies, which is also the case in Paper I. The new information anticipated from Papers II–IV will be used to estimate an alternative cost of alcohol consumption to Paper I, extending the estimate of the cost of alcohol consumption in Sweden in 2002.

Major critiques of cost studies

Cost-of-illness (COI) studies in general, and thus also COA studies, have often received much criticism. This criticism can be divided into two different categories: the problem of gaining reliable results, and how reliable results are used (Mänd 2004). The first criticism focuses on the fact that COI studies are not necessarily comparable, since different methods are often employed. This is a relevant criticism, and steps have been taken to overcome the problem, such as creating and continuously updating international guidelines in the area of substance abuse (Single et al. 1995, 2001, 2003; Collins et al. 2006). A related criticism is that results of studies within the same field range widely, and are therefore without value to decision-makers. These two aspects are relatively easy to correct if care is taken with regard to the choice of materials, methods and definitions, by having good documentation on what is done and, where possible, by following international guidelines (e.g. Jarl & Gerdtham 2005). The second criticism addresses the fact that COI studies are not helpful when allocating resources, since it is not an economic evaluation. This is mainly based on a misunderstanding, since the scope of a COI study is not for it to be used as an economic evaluation. Rather, it is designed to describe how costs for a certain disease/phenomenon are distributed in society, and to serve as a benchmark for further research (which are normally economic evaluations). There are other areas of criticism raised against COA studies, although these are often based on theoretical or methodological issues that are an inherent part of all research (see, for example, ICAP 1999).

Although the movement towards a more homogeneous methodology (largely as a result of international guidelines and an increased awareness of the importance of comparability (Jarl 2005)), full comparability is difficult to reach even within a single society (Bloom et al. 2001). Comparisons across societies are even more difficult if the cost of alcohol is taken as an estimation of the size of the problem (Polder et al. 2005). In a COA study,

many of the costs involved are due to general societal decisions about investment in health, social services, and other societal responses to health and social problems. Therefore, the costs are expected to differ vastly between different countries even if the actual size of the drinking problem is the same (van Roijen et al. 1995). This will be discussed further below.

It is the view of this thesis that COA studies performed with sound methodology are useful in alcohol research for the reasons identified above. The COA study also allows for careful comparison with other estimates as the international guidelines are followed. However, the most important reason for conducting COA studies is that they serve as a benchmark for future economic evaluations. In other words, economic evaluations of interventions targeting alcohol require detailed knowledge of the individual and societal effects of alcohol consumption, both of which are brought together and developed in COA studies.

Aim

The general aim of the thesis is to study the effect of alcohol consumption on society, calculating the societal cost of consumption, and investigating possible improvements with regard to the estimation methods, data materials, and methodological assumptions. The focus is on issues related to productivity costs in general and wage effects in particular.

Specific aims

Four specific aims were created in developing the thesis, coinciding with the aims of the four included papers:

I. To estimate the societal cost of alcohol consumption in Sweden in 2002, including health and quality of life effects. The study should allow for comparison with prior studies, and establish a sensitivity range of the point estimate.

II. To investigate if health is an appropriate explanation of the commonly-found wage premium associated with low alcohol consumption and wage penalty associated with abstention. This will be done by estimating the net effect of low alcohol consumption on

health, measured as medical care costs and prevalence of alcohol-attributable diseases in Sweden in 2002.

III. To study if failure to account for drinking history causes heterogeneity within pooled alcohol consumption groups, potentially causing confounding and/or a misclassification bias in econometric estimations. Three such pooled consumption groups will be investigated: abstainers, consisting of lifelong abstainers and former drinkers; light drinkers, consisting of former abstainers and lifelong light drinkers; and light drinkers, consisting of current light but former heavy drinkers and lifelong light drinkers.

IV. To analyse the effect of alcohol consumption on the likelihood of being absent from work, while controlling for drinking history and selection effects into employment. The focus will be on women's long-term sickness-related absenteeism.

Methods

This section will present and discuss some of the more important points regarding the methods used in the four papers, with special focus on discussions not included in the papers due to their short article format. For additional information, the interested reader is referred to the papers below.

Paper I

Paper I estimates the cost of alcohol consumption in Sweden from a societal perspective—a focus on the adverse effects of alcohol consumption that lead to a reduction in general societal welfare. The estimate is conducted within the cost-of-illness (COI) framework. Estimating costs requires comparing the actual situation to an alternative situation, also known as a counterfactual scenario. In the area of substance abuse, it is most common to compare the current situation to one without adverse affects of the risky behaviour, although this has not always been explicit in prior studies. There are an infinite number of counterfactual scenarios, although four have traditionally been discussed following Murray & Lopez (1999), including theoretical minimum risk. The definition of this scenario is the exposure that would result in the lowest risk to the population (Murray et al. 2003). To a great extent, the result of a COI study depends on the choice of counterfactual scenario, which in turn depends on the perspective of the study.

Theoretical minimum risk is often also equal to no exposure, for example when considering smoking or air pollution. There are, however, two exceptions to this: factors that only become a risk after a certain threshold, and risk factors that also have beneficial effects. The latter is relevant for alcohol consumption and implicates that a total reduction of the risk factor might be unwanted from a societal perspective, i.e. that minimum risk would be achieved by non-zero consumption. This makes it important to focus on the burden of a risk factor and not on specific outcomes, in order to facilitate the definition of the theoretical minimum. In the current study,

the counterfactual scenario of a society without alcohol consumption will be employed. Since minimum risk of alcohol consumption might be non-zero consumption, the counterfactual is a minimum gross cost scenario. The main reason for applying this scenario is so that the study will be comparable to earlier studies, as this counterfactual scenario has developed into a kind of standard in the field. An interesting move away from this "standard" will be suggested in future studies section below.

The study is prevalence-based, in that it estimates the costs for a certain population over a given time period. This means that the estimate is the present cost of problems or treatments that occur over a given time period, but where the cause of the cost could have taken place at any time up to and including the study period. The alternative would be an incidence-based study that measures the lifetime cost of new cases occurring over a certain time period. In COA studies, prevalence-based estimates are normally preferred due to the level of detailed knowledge required to understand the problem and the resulting costs in an incidence-based study. The complexity of a social phenomenon such as alcohol consumption makes incidence-based studies impractical (Kobelt 2002). However, the design of the current study is a mixture of prevalence- and incidence-base, which is actually the normal design for COA studies (Jarl & Gerdtham 2005). Costs that occur during the study year (such as health care costs) are included, which mostly are due to consumption in previous years. Also included are some costs that occur in future years as a result of a current problem, such as premature mortality and early retirement. These costs are calculated based on the number of cases for the study year, and includes future, discounted costs, since the effects continue to burden the society over several years. The alternative would be to estimate what the size of current population would have been without alcohol consumption in the past, a method called the demographic approach (Collins & Lapsley 2002). With constant consumption/harm over time, the only difference between estimates of these two methods should be the discounting of the future costs in the current study. Both methods are suggested in the international guidelines (Single et al. 2003), but the reason for choosing the prevalence-incidence mix is to enhance the study's comparability to other studies in the field, given that this is the most common approach.

When measuring the cost of alcohol consumption, the costs need to be identified, quantified, valuated and, where appropriate, discounted.

Identifying, quantifying and discounting the costs is straightforward from a methodological point of view, although the level of the discount rate could be argued. In this study, a rate of 3% is used, as per Swedish recommendations in cost-effectiveness analyses (Swedish Pharmaceutical Board 2003). The third step—how to valuate the opportunity cost of alcohol consumption—requires further discussion. Market prices are normally a good representation of opportunity costs, although this is not the case in, for example, the Swedish health care sector since it is not subject to market valuations. In such cases alternative methods will be used, such as micro-costing and the replacement cost principle.

The consumption of alcohol produces both external and internal costs. External costs affect others, while internal costs affect the consumer. External costs form the larger part of societal costs, since internal costs are considered to be offset by the benefits of consumption. In other words, the consumer is considered to compare the costs and benefits of consumption before making a consumption decision—a standard assumption in economic theory. However, if the consumer is not aware of the cost of consumption (lack of information), then there will be no internal benefit to compensate for the internal cost. That is, when the internal cost is not willingly and freely borne by the consumer it is considered a societal cost. The social cost calculated in this study is, therefore, the sum of internal costs not willingly and freely borne by the consumer plus the external costs. This follows the definition used by Markandya & Pearce (1989), where internal (private) costs are defined as costs that are "knowingly and freely borne by the consumer or producer himself" (Markandya & Pearce 1989).

The terminology used in this study differs somewhat from other studies in the field. For example, the current study sets out to estimate the cost of alcohol consumption while Single et al. (2003) measure the cost of abuse and use a strict definition of internal cost involving rationality. However, the practical implications are the same, since the concept of abuse in Single et al. (2003) was used to denote all adverse effects, i.e., abuse was defined as alcohol consumption causing adverse effects.

Connected to the discussion of costs is why transfer costs should not be included in estimates of societal cost. Transfers, such as taxes, insurance premiums and the like, do not affect the amount of resources available in society. The cost for the payer is countered by the benefit to the receiver,

making it a societal zero-sum game. However, possible administrative costs in connection to transfers do utilise resources and would not exist in the counterfactual scenario; it should therefore be estimated where appropriate. A special case is theft, which can be viewed as an involuntary transfer. However, stolen goods normally lose value compared to a legitimate secondary market, and this value reduction is considered an actual societal loss. A final type of cost that should be mentioned is deadweight loss. According to economic theory, deadweight loss is a result of economic inefficiency cased by taxes (Pindyck & Rubinfeld 2001). This results in a loss of surplus in society and should be considered a societal cost. However, as there are different standards regarding whether deadweight losses should be included in cost estimates in different areas of economics, and since the cost is normally not included in COA or COI studies, the deadweight loss estimate is only included as a sensitivity analysis in the current paper.

The beneficial effects of alcohol consumption are much debated. This paper estimates the net cost of alcohol consumption, which is the beneficial effects subtracted from the detrimental effects, but also the gross cost is reported. Theoretically, the estimation of net cost is a result of the employed counterfactual scenario. However, it should be noted that only beneficial effects resulting from reduced risk of certain diseases based on epidemiological research is included. The rather common (inversed) U/J-shaped relationship between level of alcohol consumption and different labour market outcomes, where moderate drinking often shows the most beneficial outcomes, should ideally be included. This is not the case, however, due to two main reasons: the possible protective effect outside epidemiology is still much debated and sometimes even argued to be non-existent (e.g., Melberg 2006; Room 2006), and the magnitude of the possible protective effect has a wide variance between studies (e.g., Hensing & Wahlström 2004; Peters 2004; Barrett 2002).[2] Beyond this are benefits included in the estimate based on the same reasoning as for external and internal costs (i.e., the benefits known to the consumer at the time of consumption, such as the pleasure of consumption, are excluded since they are private benefits). Reduced mortality, for example due to

[2] This issue is, however, discussed in this thesis in connection with the results of Papers II-IV, see synthesis section below.

protective effects on Ischemic heart disease, is assumed not to be a part of the individual's decision to consume alcohol and is therefore considered a societal benefit.

Alcohol consumption, as mentioned above, is complex with regard to costs because of its widespread societal effect. Direct costs (i.e., resource utilisation due to alcohol consumption) occur in the health care, social services and criminal justice sectors, and in research, policy and prevention. Indirect costs (i.e., resources not produced due to alcohol consumption, also known as productivity losses) occur due to premature mortality, long- and short-term morbidity, and early retirement. The indirect costs are estimated using the human capital method, as this is the method recommended by the international guidelines. However, since the question of whether and how productivity losses should be estimated is disputed, the results are presented separately and several sensitivity analyses regarding estimation methods are performed, including friction cost (Koopmanschap et al. 1995) and costs in added life-years (Johannesson & Melzer 1998). Finally, a cost category rarely included in COI studies due to methodological problems is intangible costs—costs that do not affect available resources such as pain, suffering and distress. This study is the first COA to estimate intangible costs, although it is limited to quality of life (QoL) losses due to mortality, for alcohol consumers themselves, for victims of crime, and for problem drinkers' relatives and friends. We employ a quality-adjusted life-years (QALY) approach commonly used within health economics to quantify health by combining life-years and health-related quality of life (Dolan 2001). One QALY denotes one year in perfect health, and any loss of QALYs should be interpreted as losses of years with full quality of life.

Paper II

The methodology in this study coincides with Paper I where appropriate. The same basic theories and estimation techniques applicable to health care costs are used. However, due to the different focus of the study, some methodological adjustments are required.

Regarding diseases where alcohol consumption is a contributing cause, Paper I estimates the number of cases attributed to alcohol by employing the following formula:

$$AAF = \frac{\sum_{i=1}[P_i * (RR_i - 1)]}{\sum_{i=0}[P_i * (RR_i - 1)] + 1} \quad (1)$$

where i denotes drinking categories, P_i is the prevalence rate of alcohol consumption and RR_i is the relative risk of disease for the i^{th} category (Rockhill et al. 1998; UK Strategy Unit 2003). As Paper II sets out to estimate the medical care cost of *low* alcohol consumption, the attributable fraction needs to be adjusted to allow calculation of the Alcohol Attributable Fraction (AAF) for each consumption group:

$$AAF = \frac{[P_i * (RR_i - 1)]}{[P_i * (RR_i - 1)] + 1} \quad (2)$$

However, if (2) was applied to all alcohol consumption groups and the results were added together, it would total somewhat more alcohol-related cases as compared to (1). There is no theoretical or empirical preference for either formula. In order to obtain a conservative estimate of the number of medical care cases attributable to low alcohol consumption, the proportion attributable to low alcohol consumption calculated from (2) is applied to the number of cases estimated by (1).

Estimating the AAF requires information about the relative risk of disease of low alcohol consumption. This is not available for injuries or diseases that are fully attributable to alcohol, such as alcohol dependence syndrome (ICD-10 code F10.2) and alcoholic gastritis (K29.2). Two assumption are therefore made: first, chronic diseases without relative risks are assumed to only affect the harmful consumption group (i.e., the highest consumption group), and second, injuries and accidents are assumed to equally affect harmful and hazardous consumption only (the two highest consumption groups). These assumptions will result in an underestimation of the negative effect of low alcohol consumption.

Paper III

This study investigates if heterogeneity is present within commonly pooled consumption groups. This is done by studying how the determinants of the wage function, including wages, affects the selection into different alcohol consumption groups. A non-linear multinomial logit (MNL) model is applied where alcohol consumption is the dependent variable. The MNL

model is appropriate when the dependent variable has more than two unordered outcomes.

$$\Pr(y_i = j) = \frac{\exp(\beta_j x_i)}{\sum_{k=0}^{j} \exp(\beta_k x_i)} \quad (3)$$

where y is the dependent variable, j+1 is the number of alcohol consumption groups and **x** is individual characteristics. When removing the indeterminacy in the model by assuming $\beta_0 = 0$ we can calculate the probability of success of each outcome:

$$\Pr(y_i = j) = \frac{\exp(\beta_j x_i)}{1 + \sum_{k=0}^{j} \exp(\beta_k x_i)} \quad (4)$$

We can also calculate the odds ratios that are independent of other outcomes (Green 2000):

$$Ln \frac{P_{ij}}{P_{i0}} = \beta_j x_i \quad (5)$$

Thus, an important assumption in the model is the Independence of Irrelevant Alternatives (IIA). This implies that the odds among two alternatives are not influenced by other alternatives. Thus, if "irrelevant" alternatives are added or removed from the dependent variable, this should not influence the odds of the remaining alternatives (Long & Freese 2006). The most well-known example credited to McFadden is a person who can choose between taking the car or a red bus to work, assuming a probability of 0.5 (an odds ratio of 1) that the car is used. If a third alternative is introduced—a blue bus—the odds of taking the car over a red bus should not be affected. More reasonably, it would be expected that the two types of buses share the 0.5 probability, i.e., each having a probability of 0.25. This assumption is normally tested for by comparing the full model to a restricted model where at least one alternative is removed. Unfortunately, existing tests have been shown to be unsatisfactory for applied research, increasing the importance of fulfilling the theoretical conditions for the IIA property (Cheng & Long 2007). In other words, the alternatives of the dependent variable must be dissimilar and cannot be substitutes for each

other in order to avoid problems due to the IIA assumption. Phrased differently, the decision-maker must consider the alternatives independently (Long & Freese 2006), as the problem with IIA can be considered as failing to account for the fact that the red and blue buses are similar and substitutes. The theoretical conditions are considered to be fulfilled in the current study with respect to the alcohol consumption categories.

Besides studying the potential heterogeneity within consumption groups, a test is also performed in an empirical setting regarding the sensitivity of estimation results due to failure to account for drinking history. The empirical model used is a replication of the first model estimated in van Ours (2004) but with a differently defined alcohol variable. This will give an empirical indication on whether bias caused by heterogeneity as a result of a failure to account for drinking history can be expected within pooled alcohol consumption groups.

Paper IV

The fourth study investigates the likelihood of sickness-related absence from employment due to alcohol consumption. Three specific methodological issues are identified as requiring special consideration in the study. First, a large proportion of the Swedish population is, for different reasons, not in paid employment and therefore does not receive any sickness-related absences even when sick. On the one hand, earlier research has shown some evidence that there is a significant relationship between alcohol consumption and the risk of being non-employed. For example, people with drinking problems and recovering alcoholics have been shown to have negatively affected probabilities for employment (MacDonald & Shields 2004; Mullahy & Sindelar 1993, 1996; Johansson et al. 2006). On the other hand, other studies have failed to find a significant effect (Feng et al. 2001; Tekin 2002 for men). Although no consensus has been reached in applied research, based on economic theory is alcohol consumption expected to have an effect on employment probability. For example, if alcohol consumption negatively affects health (cp. Papers I and II), reduced health status should reduce the likelihood of being in paid employment. Thus, a selection effect into employment is expected, where problem drinkers and those with alcohol-related health problems are employed to a lesser extent. This has consequences for the data, as long-term sickness-related absence is observed contingent on the outcome of

another variable—the likelihood of employment. This is dealt with by estimating a maximum-likelihood probit model with sample selection (see below).

The second methodological consideration is that alcohol consumption has been shown to affect both short- and long-term health. That means that both past and current consumption are expected to influence health and other outcomes mediated through health (cp. Paper II). In addition, negative changes in alcohol consumption over time have been suggested to be markers for (alcohol) problems; i.e. an individual reduces their consumption or stops altogether due to (alcohol) problems (e.g., Rodgers et al. 2007). In other words, it is expected that individuals with the same current level of consumption will face different outcomes due to their drinking histories. This is addressed by constructing an alcohol variable that takes both current consumption and drinking history into account and subsequently focuses on (non-) changes in consumption (see Material section below).

The third methodological issue to consider is reverse causality. The question under investigation is how alcohol consumption affects the likelihood of long-term sickness-related absence. However, being absent from work might affect alcohol consumption, such as when an individual uses alcohol for self-medication or experiences reduced social control when spending time at home (e.g., Aira et al. 2008; Suh et al. 2008). Although no specific adjustment is made for this in the study, the employed alcohol variables can be interpreted as measuring the change (or non-change) in consumption. As the change in alcohol consumption by definition takes place before the current wave, it can be argued that the alcohol variable is actually the lag of the change in consumption. The question that remains regarding reverse causality is whether this lag of a change in consumption is long enough to indicate causality. This study takes a conservative approach and only discusses associations, although causality is assumed in the simulation models in Paper IV and in the Synthesis section below.

The effect of alcohol consumption on the likelihood of long-term sickness-related absence is modelled as a probit equation:

$$y_{1i} = r_i\beta_1 + x_i\beta_2 + u \qquad (6)$$

where y_1 is equal to 1 if absent from work and 0 otherwise, **r** is a set of alcohol consumption variables that incorporates both current and past consumption, **x** is a set of control variables including health and u is the error term. The selection equation that controls for selection into employment is modelled as:

$$y_{2i} = r_i\gamma_1 + z_i\gamma_2 + v \qquad (7)$$

where y_2 is equal to 1 if employed and 0 otherwise, **z** is a set of control variables, and v is the error term. It is expected that $\beta_1>0$ and $\gamma_1<0$. If the potential correlation between the errors of the two equation is non-zero (ρ), the estimate of y_1 in (6) will be biased unless we control for selection. We estimate equation (6) as a maximum-likelihood probit model with sample selection where β_1, γ_1, and ρ are estimated jointly using the Stata software and the heckprob command. In applied work needs **z** be a superset of **x** in order for the model to be indentified. That is, **x** and **z** includes variables that are normally controlled for in the wage equation (see below), where **z** also includes, in addition to the determinants of **x**, some determinants specific to **z**. The national unemployment rate and having a small child have been deemed suitable variables for identification based on empirical testing. The unemployment rate should capture the business cycle effect beyond a pure time dummy. Having a small child is considered especially appropriate for the focus on women, as women still take parental leave more often than men.

Finally, in this study the results of the estimation is utilised in a simulation model, predicting how changes in alcohol consumption affects long-term sickness-related absence. By multiplying the predicted probability of absence for the whole sample with the average number of sick days among those with long-term sickness-related absenteeism, the expected number of days absent per individual is obtained. Assuming different (counterfactual) prevalence rates of alcohol consumption (assumed successful interventions) and re-predicting the expected number of days absent provides the difference in long-term sickness-related absence between different scenarios. This change in long-term sickness days can then be expressed as productive working years or in monetary terms. For the latter is the Human Capital Approach applied.

A second probability is also predicted as a suggestion of future methodological extension: the conditional probability. By accounting for the selection effects in the main model, the predicted conditional probability accounts for the changes in employment probability when estimating the probability of long-term sickness-related absence. The conditional probability is calculated as:

Pr(long-term absence=1 | employment=1) = Pr(long-term absence=1, employment=1) / Pr(employment=1)

That is, the probability of absence given employment is the ratio between the probability of success in both the main and the selection equation and the probability of success in the selection equation. The probability of absence for those working is thus adjusted for the probability of employment. The latter probability will also change when the prevalence of alcohol consumption is changed. This approach is tested in this thesis as a possible method for capturing the concurrent workforce effects of changes in alcohol consumption.

Material

Papers I and II

In order to conduct a COA study, numerous different primary and secondary data sources are required. In addition to this, results from earlier studies are also needed to establish the roll of alcohol consumption in societal outcomes. Examples of this are studies establishing the increased relative risks of certain diseases following alcohol consumption. To list all data sources would be counterproductive; as a result, only the most important data sources are discussed here. The interested reader is referred to Johansson et al. (2006) for additional information.

Table 1, Alcohol consumption groups, grams pure alcohol per day

	Men	**Women**
Abstainers	0	0
Low consumption	>0 – <40	>0 – <20
Hazardous consumption	>40 – <60	>20 – <40
Harmful consumption	>60	>40

Source: Rehm et al. 2004

Prevalence data on alcohol consumption among the Swedish population are acquired mainly from the 2002 Monitoring study, a monthly telephone survey regarding alcohol consumption over the past 30 days. Compared to a recall period of 12 months, the Monitoring study overestimates the number of abstainers, as very irregular drinkers might have month long abstention periods without being year long abstainers. This is adjusted for by applying information from the same study in 2004 when both 30 days and 12 months were used as recall periods. The abstinence rates are thus based on a 12-month recall period. Four alcohol consumption groups are used (see Table 1), based on the recommendations made in the WHO Global Burden of Disease study (Rehm et al. 2004), differentiated by age and gender. Prevalence data of alcohol consumption and data used for estimating health care costs are employed in both Papers I and II. The additional data discussed below are only used in Paper I.

Health care

Alcohol-related diseases are taken from Rehm et al. (2006), and supplemented with diseases identified by UK Strategy Unit (2003) and Jarl et al. (2006). In turn, respective relative risks are gathered from meta-analyses in the field. Alcohol-related accidents and injuries with an AAF are taken from a Finnish study that investigated the proportion of accidents with a cause, either underlying or contributory, that included an alcohol diagnosis (Mäkelä 1998). An exception to this is motor vehicle accidents, where Swedish data were used. As the AAF for injury morbidity is considered to be lower than for mortality, adjustments are made following recommendations (Rehm et al. 2004, 2006).

Information on the number of inpatient disease-specific cases is taken from the National Inpatient Discharge Register. The disease-specific cost per case is unknown but shadow prices are determined by an administrative process that accounts for different resource utilisation connected to different diseases, in relation to total costs of the hospital/clinic. The basis for the cost information is two large administrative districts for health care, Region Skåne and Stockholm County Council. There is no national register for the number of outpatient and primary health care cases in Sweden that includes diagnoses. Data from Västra Götalandsregionen, a large administrative area, is employed instead. This is based on a project that has been running for several years collecting information on diagnoses in outpatient and primary care. The cost per case for outpatient and primary care is not disease-specific. Instead, it is an average cost per visit, weighted for resource utilisation based on type of visit and what medical personnel are involved. This data was acquired from Landstingsförbundet (2003).

Social services

In Sweden, the treatment of substance abuse and dependence are part of the social services sector, as opposed to the health care sector. In essence, there are two types of costs to be estimated, the *treatment of adults with substance abuse* and *child and youth welfare*. Total costs for social services are found in yearly reports (Socialstyrelsen 2004), although the alcohol-related costs are not reported separately. Prior research is drawn upon to establish the alcohol-related fraction.

Crime

Two types of crime costs are estimated in the current study: costs due to the consequences of crime, and costs due to responses to crime. The consequences of crime mostly affect health care costs and productivity losses, and are estimated under a specific heading. The responses to crime are mostly borne by the justice system and the data material primarily consists of crime statistics and annual accounts from the Police and Prison Service. The AAF for different crimes are either calculated directly from the data (drunk driving) or established after reviewing relevant studies. The English Social Cost of Crime project (Brand & Price 2000) has also served as an important source when estimating the cost of alcohol-related crime.

Research, policy and prevention

There is no structured information available in Sweden regarding what organisations are involved in alcohol research, policy and prevention. In addition, very few organisations have data on what proportion of their overall costs are dedicated to alcohol-related questions. Based on research by Midanik (2006), major sources for alcohol research were identified. Regarding policy and prevention, only the largest and best-known organisations and agencies were included in the estimates (based on the research team's prior knowledge), such as *The Alcohol Committee*, *The National Board of Health and Welfare*, and *ANT Education*[3]. Annual reports were then collected to obtain total costs. Representatives from the different organisations were asked to estimate the alcohol-related proportion of the total cost when this figure was not available in the annual reports. In some cases, it fell to the research team to estimate the alcohol-related fraction. Due to the data deficiency and the high time cost involved in obtaining the data, this cost category is underestimated, especially since not all of the organisations and agencies have been identified.

Productivity

The identified alcohol-related diseases and injuries/accidents, with respective relative risks and AAF, are the same for the productivity cost category as outlined in the health care sub-section above. Data on deaths

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[3] Alcohol, Narcotics, and Tobacco Education.

are obtained from the Swedish Cause of Death Register. Register-linked data on early retirement with underlying causes are used for both productivity losses due to early retirement and long-term sickness absence. The latter is based on an assumption of similar disease structure for both areas, a necessary assumption as no current and appropriate data on long-term sickness-related absence with underlying cause was available (cp. Paper IV). However, the total number of days of long-term absence was available from the National Social Insurance Agency. The effect of alcohol consumption on short-term sickness-related absence was determined by conducting an analysis based on the Swedish Survey of Living Conditions (the ULF survey, see below).

The Human Capital Approach was used to calculate the productivity costs. Market productivity was valued according to official Swedish wage statistics and discounted 3% annually. Non-market productivity loss was valued according to the replacement cost principle (van den Berg et al. 2004), which employs the market price for similar services. Time spent in different non-market production was established from a time use study by Statistics Sweden (2002), and is age and gender specific.

Intangible costs

Intangible costs (pain, worries, suffering etc.) are quantified as losses in quality of life (QoL), measured in quality-adjusted life-years (QALYs). Cost components that are estimated are QoL losses due to premature mortality, for problem drinkers' families and friends, for the consumers themselves, and for victims of certain alcohol-related violent crimes. QoL losses due to mortality are valued according to a study of the Swedish population's QoL weights (Burström et al. 2001), while losses due to violent crimes are valued according to a UK study (Dubourg et al. 2005). QoL losses for alcohol consumers themselves are based on a study by Kraemer et al. (2005). The estimation of QoL losses among family and friends of problem drinkers is based on a study performed within the Swedish COA project. In a telephone survey, 3,000 individuals were asked to complete the WHOQOL-BREF questionnaire, including follow-up questions regarding the respondents' possible relationship to a problem drinker. The QoL weights attained are not preference-based and are therefore not ideal for calculation of QALYs. "WHOQOL-BREF-weighted

life years" might be a better term for the QoL losses for family and friends, although it is assumed in the current study that this is equivalent to QALYs.

Papers III and IV

The ULF survey

The fundamental data material for Papers III and IV is the Swedish Survey of Living Conditions (ULF), which is linked to income data from the National Income Tax Statistics. Since 1975 Statistics Sweden has conducted annual systematic surveys of living conditions in the form of one-hour personal interviews. Included are individuals 16–84 years of age, except for 1988–89 and from 2002 onwards, where the upper age limit was removed (Statistics Sweden 2006). At intervals of eight years, the survey has placed specific focus on health-related issues, starting with the two-year wave of 1980–81. Detailed questions regarding alcohol consumption have been included since the second health-related wave (1988–89).

The ULF data is a mixture of cross-section and panel information, although the start of the panel is somewhat unorthodox. The first health-related wave began as a cross-section and it was not until the second wave that it was decided that a panel should be included. In order to utilise the maximum information, the panel was based on the cross-section from wave one. This means that non-responding individuals in wave one could have become part of the panel and respond for the first time in wave two.[4] In addition, in order to be included in the panel, the individual had to be available for participation in wave two; in other words, the individual had to be alive and still a resident of Sweden. This obviously threatens to create some form of positive selection bias that is, unfortunately, impossible to study. To keep the data representative of the Swedish population (i.e., to counter attrition and natural ageing), complementary additions of individuals has been made in each wave, resulting in a situation where the exact size of the panel depends on which wave is considered the first. In addition to this are there, according to detailed analyses of the data material, individuals that participate in several waves but who are not officially part of the panel (i.e.,

[4] Personal communications with Per Olof Fredriksson, Statistics Sweden, 080522.

repeated cross-section). Taken together, these issues make it difficult to disentangle the panel characteristics from the general survey.

Table 2 shows the sample size for the ULF survey for each health-related wave, including non-response rates and panel size. The non-response rate has increased over the years, although most of the difference is between wave one and two.

Table 2, Annual variation of sample size and non-response, the ULF survey

Wave	**1980–81**	**1988–89**	**1996–97**	**2004–05**
Sample	17,312	16,741	14,950	13,530
Responses	14,964	13,295	11,697	10,177
Non-response (%)	13.6	20.6	21.8	25.3
Panel (% of response)	>40	>40	53.0	44.2

Source: Statistics Sweden 1995, 2006

The LISA material

The Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA) contains register data for all Swedish individuals above the age of 16. The register's first year is 1990, although many of the variables' starting years occur during the first half of the 1990s. The contents of the data can be grouped as demographics, education, employment and unemployment, income and social insurance, family and household, and workplace and firm information. The LISA data is matched to the information in the ULF survey, mainly focusing on the social insurance variables (see Paper IV below). This allows, for example, the study of health-related behaviours in connection to actual labour market and income-related outcomes.

Alcohol consumption

The alcohol consumption variables in Papers III and IV are created especially to account for drinking history. This follows from the working hypothesis that individuals with the same current level of consumption may face different outcomes based on differences in past consumption. Based on the cut-off points for consumption groups (see Table 1), the panel information in the ULF data is utilised to create the drinking groups in Table 3. The variables are based on information from two sequential waves where an individual is defined as a long-term abstainer if s/he abstained in

both waves. A former drinker is one that consumed alcohol in the first wave and abstained in the second (i.e., switched from consuming to abstaining). A former abstainer is one that switched from abstaining to consuming (i.e. was an abstainer in the first wave and consumed alcohol in the second). All other variables are likewise defined.

Table 3, Alcohol consumption groups, controlling for current and past consumption

Current \ Lag	**Abstain**	**Low**	**Heavy***
Abstain	Long-term abstainer	Former drinker	N/A
Low	Former abstainer	Long-term light drinker	Current light but former heavy drinker
Heavy*	N/A	Long-term heavy drinker	

** Hazardous and harmful consumption is merged into heavy consumption in order to avoid having very few observations in each consumption group.*

Current alcohol consumers are thus divided into four different consumption groups: former abstainers, long-term light drinkers, current light but former heavy drinkers, and long-term heavy drinkers. Current abstainers are divided into two groups: long-term abstainers and former drinkers. In Paper III the term *lifelong* is used instead of *long-term*. Although the latter term is considered more appropriate, there is no difference in definition.

Measurement errors in alcohol consumption

The alcohol variables used in Papers III and IV are based on self-reported alcohol consumption in the ULF data set. Comparing the average yearly alcohol consumption as found in the ULF data to the official Swedish estimate conducted by the Centre for Social Research on Alcohol and Drugs (SoRAD) at Stockholm University shows large differences (see Table 4). Some differences are expected due to different assumptions about alcohol content in certain alcoholic beverages, but this cannot explain more than marginal differences. In all likelihood, the ULF data are underestimated with regard to the Swedish population due to two effects: underreporting and unrepresentative sample. For example, respondents tend to have a harder time recalling frequency of consumption compared to quantity (Lemmens et al. 1992). Self-reported figures, therefore, should not be interpreted as actual absolute consumption (Berggren & Nystedt 2006).

The sample in the ULF data set is expected to be unrepresentative with respect to the marginalised heavy users who account for a large part of total alcohol consumption. In many cases, this group is difficult to reach due to their detrimental levels of consumption and life situations. The Bohman et al. (2007) report states that most individuals in Sweden consume substantially less than the estimated average yearly consumption, due to the rather small group of heavy users constituting a large weight in the population average. As such, if it is accepted that the sample is not representative of the population but rather the population excluding the marginalised heavy users, the measurement error is considered to be much lower than Table 4 indicates. Although this cannot be tested at this stage, the measured alcohol consumption in the ULF survey is assumed to be a good representation of the included population.

Table 4, Comparison of yearly alcohol consumption per individual in the ULF and SoRAD estimates, grams of pure alcohol[*]

	Wave one	**Wave two**	**Wave three**
SoRAD estimate[**]	6,160 (7.7 l)	6,400 (8.0 l)	8,240 (10.3 l)
ULF survey	1,317 (21.4%)	3,826 (59.8%)	3,902 (47,4%)

Source: Bohman et al. (2007)
** One litre of pure alcohol is the equivalent of 800g of pure alcohol. **Estimate of wave one is based on 1989 and wave two on 1996. Wave three is the average of 2004-05*

The low estimate in wave one in the ULF survey is most likely due to the different wording of the alcohol-related questions. In wave one, the respondents were asked about their alcohol consumption during a normal week while in waves two and three they were asked about the previous week. Asking about normal consumption is a known source of under-reporting, which, as a result, is expected to be larger for wave one.

An additional advantage of using alcohol consumption groups in estimations instead of a continuous variable is that the expected bias from measurement errors is reduced. The alcohol consumption variables coded above measures considerable changes (or non-changes) in consumption. The used variables are therefore considered to be more reliable as measurements errors generally will not affect if the individual is an abstainer or consuming low, hazardous or harmful quantities of alcohol.

Long-term sickness-related absence

Long-term sickness-related absence is defined as experiencing at least one spell of absence from employment longer than 28 days during a given year. The 28-day cut-off point is due to the Swedish compensation system. The employer pays sick pay to the employee during the first part of the absence; after a certain period this responsibility shifts to the Social Insurance Agency and the employee receives a sickness benefit. It is only when an absence becomes the responsibility of the Social Insurance Agency that it is registered in national data. As a result, no register data is available for national sick pay, only for sickness benefits. The length of the employer responsibility period (sick pay) has differed over the years covered by Paper IV, with the longest being 28 days in 1997. In order to have the same definition of long-term sickness-related absence in all of the years covered by the study, this becomes the necessary cut-off point. The alternative would be to exclude 1997, which would substantially reduce the sample size, making efficient estimations impossible. In addition for an individual to be considered long-term absent, the individual needs to be employed or otherwise have a productive main activity (runs a company or works in a family business/farm). The reason for this additional definition is that sickness-related absence is normally considered in relation with market production. However, also unemployed[5] individuals in Sweden who become sick can receive sickness benefit. This working definition will capture unemployed in the selection equation of Paper IV, allowing alcohol consumption to be a determinant of the probability of being unemployed (non-employed).

[5] Note that unemployed are a part of the non-employed group, although the latter includes additional groups, e.g. students, home workers, and individuals with early retirement.

Results

This section will briefly present the results of each of the four papers included in the thesis.

Paper I

The societal cost of alcohol consumption in Sweden in 2002 is estimated as both net and gross costs in Paper I—that is, both with and without including the cost savings caused by the beneficial health effects of alcohol consumption. Without accounting for the beneficial health effects, it is estimated that alcohol consumption caused over 3,000 deaths in 2002. If the beneficial health effects are included, the estimate instead shows a net saving of about 850 lives. In other words, alcohol consumption saves more lives than deaths it causes. However, looking at the potential years of life lost (PYLL), the net effect is almost 28,000 (64,000 gross). The reason for these conflicting results is that alcohol consumption tends to save lives among older individuals with fewer remaining years to live, while it causes deaths among younger individuals with many remaining life years. Calculated as number of life years lost, alcohol consumption in Sweden is clearly detrimental. This can also be seen from the number of alcohol-related medical care cases (see Table 5).

Table 5, Summary of health effects due to alcohol consumption in Sweden, 2002

	Net health effects	**Gross health effects**
Number of deaths	-849	3,022
Number of PYLLs*	27,962	63,962
Number of medical care cases**	761,565	895,043

** PYLLs=Potential Years of Life Lost, calculated in relation to gender- and age-specific life expectancy. ** Excluding co-morbidity*

In terms of reduced quality of life, measured as QALYs, the net effect is a loss of almost 122,000 QALYs (145,000 gross), as shown in Table 6. The larger part burdens consumers themselves, followed by their families and

friends. The QALY loss estimated for victims of crime is a partial estimate, which is reflected in its relatively low cost. The QoL results presented here should be interpreted with care, as the different estimates might not be compatible due to the use of different data sources.

Table 6, Summary of quality of life effects due to alcohol consumption in Sweden, 2002

Number of QALYs lost:	Net health effects	Gross health effects
from mortality	24,603	48,168
for consumers	68,804	68,804
for friends and relatives	27,168	27,168
for victims of crime	1,216	1,216

The direct net cost of alcohol consumption sums to SEK 9.9 billion (11.0 billion gross), as shown in Table 7. Cost burden to the social services sector is the largest cost category, which is due to the fact that treatment of alcohol abuse and dependence falls under its area of responsibility. About 40% of social services costs are due to alcohol-related child and youth welfare cases, which can be caused by both problem drinking by adults or the child itself. The lowest cost category is Research, Policy and Prevention, which is a substantial underestimate for reasons discussed above. The beneficial health effects of alcohol consumption only affect the direct cost estimates for health care, so the full difference between net and gross direct costs can be found here. More specifically, the beneficial health effects mainly cause savings with inpatient care, as this is where those diseases are normally treated (cp. Paper II). The cost estimation of pharmaceuticals is clearly underestimated as it only includes drugs used to treat alcohol dependence. However, drugs used in health care treatments are included under those specific headings. One of the rare cases of non-state funded health care in Sweden is the Employer Assistance Program (EAP), which provides non-acute medical care through the workplace and is paid for by the employer. It constitutes, however, a small proportion of the total alcohol-related health care costs. Table 7 show that costs due to responses to crime is much higher than those due to the consequences of crime. The difference is not as large as it appears, however, as many of the costs associated with the consequences of crime are reported in the Health Care and Productivity Loss categories. If all alcohol-related costs due to crime were to be counted in the crime category, it would total a net cost of SEK 4.2 billion (both direct and indirect costs).

Table 7, Summary of direct costs of alcohol in Sweden, 2002 (SEK million)

	Net	Gross
Health care costs	**2,189**	**3,294**
Inpatient care	774	1,680
Outpatient care	690	797
Primary care	593	683
Pharmaceuticals	22	22
Co-morbidity	58	60
EAP	53	53
Social service costs	**4,364**	**4,364**
Treatment adults	2,600	2,600
Child and youth welfare	1,764	1,764
Crime costs	**2,850**	**2,850**
Consequences of crime*	273	273
Police investigation	846	846
Prison costs	895	895
Procedure and courts	390	390
Other responses to crime	446	446
Research, policy, prevention	**479**	**479**
Research	36	36
Policy and prevention	443	443
Total	**9,882**	**10,987**

** Crime costs burdening other sectors, such as health care and productivity losses, are reported under those categories.*

Table 8, Indirect costs of alcohol in Sweden, 2002 (SEK million)

	Net	Gross
Productivity costs	**10,447**	**18,394**
Mortality	3,069	8,520
Early retirement	2,423	3,177
Crime	614	614
Long-term sickness absence	3,167	4,908
Short-term sickness absence	1,175	1,175

The indirect net cost of alcohol consumption in Sweden amounted to SEK 10.4 billion (18.4 billion gross), which is about the same magnitude as the direct costs (Table 8). The largest part of this is due to long-term sickness-related absence (cp. Paper IV) and mortality. The mortality cost in particular is sensitive to whether beneficial health effects are included or not. It should be remembered that the indirect costs includes future costs, discounted to present value. This method was chosen in order for the estimates to be comparable with other studies in the field. The indirect cost due to crime is the productivity loss following incarceration.

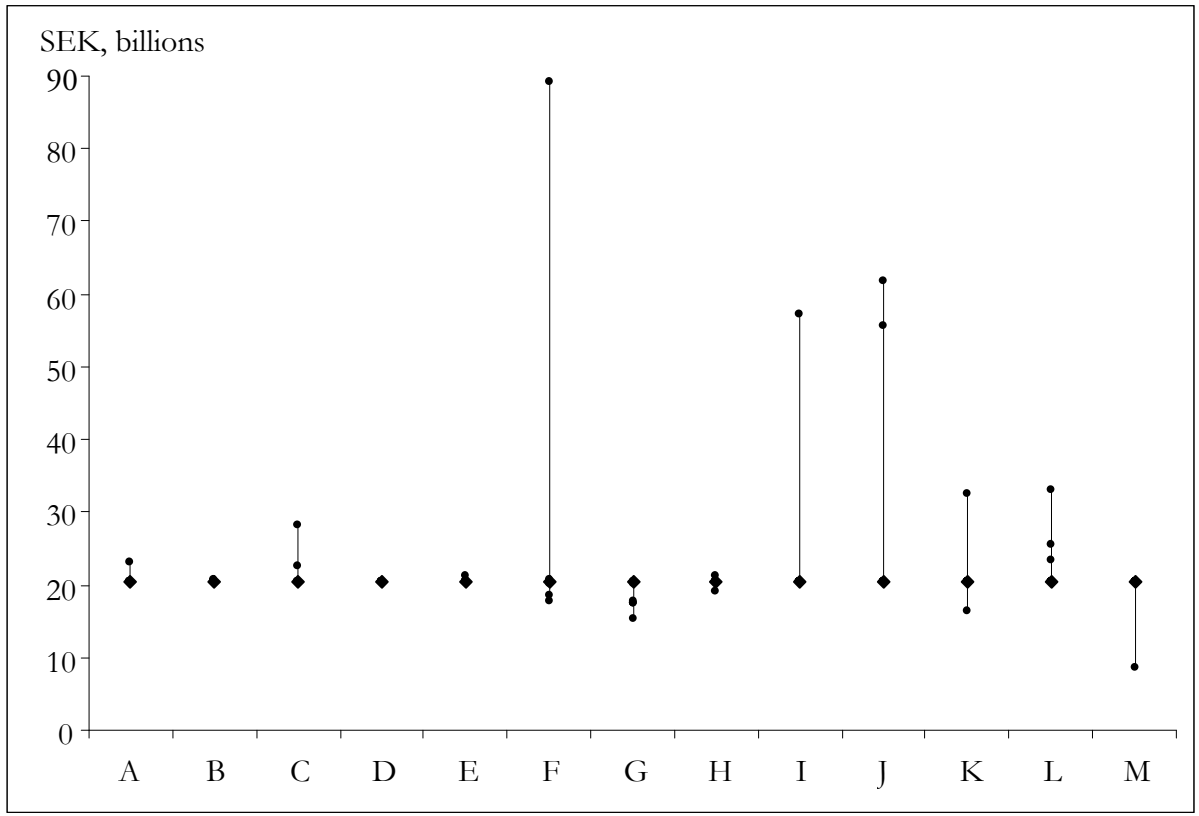
Table 9, Summary of cost of alcohol in Sweden, 2002 (SEK million)

	Net	Gross
Health care costs	2,189	3,292
Social service costs	4,364	4,364
Crime costs*	2,850	2,850
Research, policy, prevention	479	479
Productivity costs	10,447	18,394
Total costs	**20,330**	**29,379**
As % of GDP	0.89	1.29
Per capita	2,278	3,292
Per capita aged above 14	2,781	4,020

** Excluding the productivity costs among prison inmates, which is included under productivity costs.*

As outlined in Table 9, the total net cost of alcohol consumption in Sweden in 2002 is estimated as SEK 20.3 billion (29.4 billion gross). This constitutes about 0.9% of Sweden's gross domestic product (GDP), or approximately SEK 2,300 per capita. A number of different sensitivity analyses have been performed to determine the sensitivity of the results due to the assumption of methods and data. All analyses are univariate, where one assumption is changed at a time while all others are held constant. An exception to this is the last sensitivity analysis (M). Figure 1 shows the span of the sensitivity analyses compared to the base case result of SEK 20.3 billion. The largest change results from using aggregate data on sickness-related absence (F). This results in an implausible estimate totalling SEK 90 billion. Applying a frequently cited number for the alcohol-related cost to employers (3% of total wage sum) also results in an implausible estimation (I). Valuing the QALY loss in monetary terms (J) increases the base case estimate substantially. However, we prefer to only report the quality of life losses as number of QALYs lost, mainly due to a lack of consensus on the value of a QALY. Including deadweight losses due to inefficiencies of tax-financing (L) increases the cost by up to 50%. Deadweight losses are not normally included in cost-of-illness studies on substance abuse, and in order for the results of this study to be comparable, (L) is not included in the base case estimate. Also, the highest rate employed for deadweight loss, 130%, could in itself be considered implausible. Changing the prevalence of consumption (B), the valuation of inpatient care (D), and the AAF for social services (H) affects the base case result only marginally.

Figure 1, Summary of sensitivity analyses (SEK billion)



A. Age groups 0-64 years; B. Size of consumption groups; C. Disease and injury risks; D. Health care costs, data; E. Health care costs, valuation, F. Productivity costs, data; G. Productivity costs, valuation; H. Social services, data; I. Employers' costs, data; J. QALYs, valuation; K. Discount rates; L. Deadweight loss; M. Most conservative

The remaining sensitivity analyses (A, C, G, K, and M) are more interesting. The risk functions and prevalence rates among the elderly are considered less reliable than among younger individuals. Thus, an analysis excluding all individuals above 64 years of age when calculating health care and productivity costs increases the base case estimate by close to SEK 3 billion (A). This is due to the fact that most of the beneficial health effects of alcohol consumption are found among the elderly (cp. Paper II). Several analyses were performed with disease and injury risks based on alternative data sets and sources. As can be seen in (C), this has the potential to increase the results by around 50%. However, the risk functions used in the base case are considered the best choice. The effect of different discount rates was investigated in analysis (K). Increasing the discount rate to 6%, compared to the base case's 3% rate, decreased the costs by SEK 4 billion. Setting the discount rate to 0% would have increased the cost by over SEK 12 billion.

The sensitivity analysis termed (G) investigates the effect of eight different valuations of productivity losses, using five different methods (hybrid approach, friction cost method, cost in added life-years, exclusion of non-market productivity, and different valuations of non-market productivity). These different assumptions primarily change the results downwards, particularly when applying the cost in added life-years, for which alcohol-related mortality results in a net saving to society. Gender-specific productivity costs due to mortality are especially sensitive to whether non-market productivity is excluded or valued highly by market-based replacement costs. However, when adding the gender effects together, the changes tend to counteract, resulting in small changes for total mortality costs. The hybrid approach took an intermediate position between the estimates of friction costs, using 6- and 12-month friction periods. The friction cost method using a 3-month friction period results in very low alcohol-related mortality costs.

The last sensitivity analysis (M) is a process where all plausible sensitivity analyses that reduce the base case cost are included. It should therefore be considered the most conservative estimate, compared to the already conservative base case estimate of SEK 20.3 billion. This would have halved the alcohol-related total net cost, mainly due to the methodological choices of discount rate (6%) and method for estimating mortality cost (cost in added life-years). Setting aside the four highest sensitivity analyses for

the reasons discussed above, all remaining sensitivity analyses fall within a 50% range of the base case estimate.

Paper II

The aim of this paper is to investigate the effect of low alcohol consumption on health, measured as medical care costs and prevalence of alcohol-attributable diseases. As outlined in Table 10, the results show that low alcohol consumption incurred medical care costs of SEK 187 million in 2002. Low alcohol consumption is beneficial only for individuals above 80 years of age (an effect that is stronger for women than for men). The highest total cost is found for individuals 50–65 years of age, followed by 30–49 year olds. Inpatient care benefits from the protective effects of low alcohol consumption for all age groups, with the exception of men between 18 and 49 years of age. However, low alcohol consumption increases the burden on both outpatient and primary care, even for individuals above 80 years of age.

Table 10, Alcohol-related cost of medical care attributable to low-consuming adults in Sweden, 2002 (SEK millions)

			Men	
	Inpatient	Outpatient	Primary	**Total**
18-29	3.52	5.88	3.41	**12.82**
30-49	1.18	19.04	21.73	**41.95**
50-64	-38.03	24.81	58.65	**45.44**
65-79	-64.30	24.66	64.75	**25.10**
80+	-35.98	7.61	22.84	**-5.54**
Total	-133.60	82.00	171.37	**119.78**
			Women	
	Inpatient	Outpatient	Primary	**Total**
18-29	-3.86	8.19	5.09	**9.42**
30-49	-4.86	26.36	25.22	**46.72**
50-64	-3379	29.79	62.72	**58.72**
65-79	-92.71	25.06	79.02	**11.37**
80+	-112.82	10.46	43.70	**-58.66**
Total	-248.05	99.86	215.75	**67.57**

As discussed above, medical care costs might not be a perfect measure of individual health status, since diseases can be more or less costly to treat irrespective of actual health status. We therefore also report the number of health care episodes caused by low alcohol consumption as these, taken together with the costs, are considered to give a good indication of the

overall health effect of low alcohol consumption. The results (see Table 11) are about the same as for the cost calculations above. There is a net saving for inpatient care for both genders. However, the majority of the beneficial effects are attributed to individuals over 65 years of age. Outpatient and primary care show a large detrimental effect. Thus, the results of cost and episode estimates taken together show a net cost of low alcohol consumption, indicating a net detrimental health effect.

Table 11, Number of alcohol-related care episodes attributable to low-consuming adults in Sweden, 2002

	Men			Women		
	Inpatient	Outpatient	Primary	Inpatient	Outpatient	Primary
18-29	129	2,756	2,296	-112	3,836	3,426
30-49	233	8,916	14,626	-8	12,345	16,974
50-64	-239	11,620	39,478	-232	13,951	42,214
65-79	-693	11,548	43,578	-898	11,737	53,189
80+	-567	3,563	15,370	-1 751	4,898	29,416
All	-1 137	38,403	115,348	-3 000	46,767	145,218

Paper III

This paper studies the potential heterogeneity within commonly pooled alcohol consumption groups, with special focus on the alcohol-wage relationship. The marginal effects of the main model, calculated at the mean of the independent variables, are shown in Table 12. A number of variables are significant and show different associations between alcohol consumption groups. For example, the variable for exercising at work or during spare time is associated negatively with being a lifelong abstainer (4.3%) and positively with being a lifelong light drinker (4.5%).

For the purposes of this study, however, it is more interesting to study the odds ratios between frequently pooled subgroups of alcohol consumption. The three suggested errors (and pairs used as comparisons) are lifelong abstainers (LA) and former drinkers (FD); lifelong light drinkers (LLD) and former abstainers (FA); and lifelong light drinkers and current light but former heavy drinkers (CLFHD). All three comparisons strongly reject a Wald test for combining alternatives, where the null hypothesis is that the compared subgroups are indistinguishable with respect to the included variables (see Table 13). In other words, the tests indicate that there is heterogeneity within commonly pooled subgroups.

Table 12, Marginal effects after robust multinomial logit regression

	LA	FD	FA	LLD	CLFHD	LHD
Male 26–39 yrs	-0.018	-0.028 ***	-0.031 ***	0.052 **	0.013	0.012
Male 40–54 yrs	-0.003	-0.017 ***	-0.039 ***	0.062 ***	0.003	-0.006
Male 55–69 yrs	0.022	-0.008	-0.035 ***	0.027	0.003	-0.009
Male 70+ yrs	0.068 *	-0.002	-0.030 ***	-0.019	0.005	-0.022 ***
Female 40–54 yrs	0.037 *	-0.014 **	-0.026 ***	0.008	0.003	-0.008
Female 55–69 yrs	0.102 ***	-0.004	-0.020 **	-0.072 *	0.014	-0.020 ***
Female 70+ yrs	0.119 **	0.022	-0.020 *	-0.107 **	0.008	-0.022 ***
Alone	0.018 **	0.018 ***	0.018 **	-0.068 ***	0.000	0.014 **
Immigrant	-0.014	0.015	0.032 **	-0.005	-0.001	-0.026 ***
PWC	-0.016	-0.017 ***	0.001	0.033 **	0.003	-0.004
PE	0.018 **	-0.008 *	0.017 **	-0.027 **	-0.003	0.003
Education 2	-0.023 ***	-0.011 **	0.001	0.032 **	0.002	-0.002
Education 3	-0.007	-0.006	-0.004	0.019	0.002	-0.004
Education 4	-0.023 **	-0.018 ***	-0.014	0.049 ***	0.002	0.004
Lnfinc	-0.017 ***	-0.008 ***	-0.012 ***	0.027 **	-0.002	0.012 **
Children	0.006	0.001	0.002	-0.005	-0.002	-0.002
Friend	-0.008	-0.005	-0.015 *	0.029 **	-0.005 *	0.005
Relative	-0.021 **	-0.001	-0.007	0.036 **	0.000	-0.007
Health	-0.003 ***	-0.002 ***	-0.002 *	0.007 ***	0.001 ***	-0.001
Smoker	-0.048 ***	-0.007	-0.023 ***	0.059 ***	0.005 *	0.014 **
Overweight	0.000	-0.008 *	0.007	-0.008	0.001	0.008
Obese	0.028 **	-0.006	0.009	-0.043 **	0.004	0.008
Exercise	-0.043 ***	-0.011	0.012	0.045 **	0.003	-0.006
Self-employed	-0.030 **	-0.013	-0.005	0.025	0.004	0.019
Econ. Inactive	0.026	0.061 ***	0.024	-0.117 ***	0.007	-0.001
Retired	0.033 *	0.014	0.027	-0.074 **	-0.005	0.005

Being female and 26–39 years old, from blue-collar parents, education 1, normal weight, and employed is baseline in the model. LA = lifelong abstainer; FD = former drinker; FA = former abstainer; LLD = lifelong light drinker; CLFHD = current light but former heavy drinker; LHD = lifelong heavy drinker. Significance noted on 1 (***), 5 (**) and 10 (*) percent levels.

This is also obvious when studying the individual variables included in the estimation. Looking first at the pooled group of abstainers (LA–FD), being obese or having a parent in the social group of entrepreneurs is associated with an increase in the probability of being a lifelong abstainer, which is also the case for the interaction effects between gender and age. Likewise, economically inactivity, smoking and being an immigrant are associated

with an increase in the probability of being a former drinker, as compared to lifelong abstainers.

Table 13, Odds ratios of robust multinomial logit estimation

	LA–FD		FA–LLD		LLD–CLFHD	
Male 26–39 yrs	2.820	**	0.367	***	0.319	*
Male 40–54 yrs	1.863		0.269	***	0.743	
Male 55–69 yrs	1.748		0.287	***	0.700	
Male 70+ yrs	2.245		0.377	**	0.541	
Female 40–54 yrs	2.786	***	0.472	***	0.698	
Female 55–69 yrs	3.078	***	0.626		0.258	*
Female 70+ yrs	1.713		0.651		0.366	
Alone	0.779		1.571	***	0.877	
Immigrant	0.529	**	1.765	**	1.141	
PWC	1.458		0.987		0.724	
PE	1.699	***	1.482	**	1.633	
Education 2	0.997		0.979		0.735	
Education 3	1.110		0.901		0.804	
Education 4	1.343		0.673	*	0.790	
Lnfinc	1.025		0.746	***	1.357	*
Children	1.070		1.062		1.349	*
Friend	1.043		0.704	**	1.971	**
Relative	0.770		0.816		1.075	
Health	1.253		0.568	**	0.197	***
Smoker	0.511	***	0.498	***	0.552	*
Overweight	1.326		1.166		0.820	
Obese	1.781	**	1.279		0.577	
Exercise	0.801		1.278		0.619	
Self-employed	0.950		0.852		0.643	
Econ. Inactive	0.440	***	1.817	**	0.389	*
Retired	1.028		1.845		2.590	
Test for combining alternatives						
χ^2	62.57		124.09		73.26	
$P>\chi^2$	0.00		0.00		0.00	

LA = lifelong abstainer; FD = former drinker; FA = former abstainer; LLD = lifelong drinker; CLFHD = current light but former heavy drinker. Significance noted on 1 (***), 5 (**) and 10 (*) percent levels.

The comparison between two current light drinking groups, former abstainers and lifelong light drinkers also shows a number of significant differences. On the one hand, being a former abstainer is primarily associated with living alone, being an immigrant and economically inactive.

On the other hand, a unit increase in full income and health is associated with increased probability of lifelong light drinking, which is also true for smoking. The interaction effects of gender and age show strong significance compared to the baseline, in favour of lifelong drinking.

The third comparison, between lifelong light drinkers and current light but former heavy drinkers show only two effects significant at the 5% level, although six more effects are significant at the 10% level. This is due to low power resulting from few observations in the current light but former heavy consumption group. However, having a close friend is positively associated with lifelong light drinking while health, surprisingly, is associated with current light but former heavy drinking.

Table 14, OLS illustration of coefficient effects following pooling of alcohol consumption groups in a log wage equation

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Abstainers	-0.168	***						
LA			-0.116	**	-0.123	**	-0.125	**
FD			-0.288	***	-0.295	***	-0.297	***
FA					-0.179	***	-0.180	***
CLFHD							-0.117	
LHD	0.050		0.050		0.042		0.041	
Constant	4.242	***	4.248	***	4.264	***	4.264	***
R^2 Adj	0.043		0.043		0.046		0.046	
N	2788		2788		2788		2788	

** Age, education and smoking are controlled for in the model and LLD is baseline.*

A replication of the initial OLS model in van Ours (2004) is performed in order to provide an empirical illustration of the bias created by heterogeneous pooled consumption groups (see Table 14). Only pooled consumption groups are included in the first model. Abstaining shows the expected negative association with wage, compared with the baseline light drinking. In model two, the former drinker error is controlled for (i.e., current abstainers) and divided into the subgroups lifelong abstainers and former drinkers. The negative effect on wages from former drinkers is much larger than for lifelong abstainers. When also controlling for the former abstainer and former heavy drinker errors, i.e., changing the baseline to lifelong light drinking (model four), the negative effects of both abstainer subgroups increase somewhat. This is due to former abstainers being significantly different from lifelong light drinkers, and pooling those

subgroups results in a biased estimate for light drinking. It would thus appear that the heterogeneity caused by pooling consumption groups without controlling for drinking history causes bias in wage estimations, especially by overestimating the negative effect of lifelong abstention and underestimating the protective effect of lifelong light drinking.

Paper IV

This paper analyses the effect of alcohol consumption on the likelihood of being absent from employment for women while controlling for sample selection into employment and the individual's drinking history. The result shows that diverging from the most prevalent consumption group (long-term light drinking) increases the probability of long-term sickness-related absence, as shown in Table 15. An exception to this is the group current light but former heavy drinkers where no significant effect is found compared to long-term light drinkers. This might be a result of having few observations in this group. Former drinkers and former abstainers in particular are associated with an increased probability of long-term sickness-related absence (18% and 15%, respectively), compared to the baseline. Following Wald tests, no significant difference can be found between those consumption groups with regard to an increased probability of absenteeism.

The effect of other variables is generally as expected. Age has a U-shaped relationship, while income and education reduces the probability of absence, although the point estimate for theoretical secondary school (education 3) is somewhat higher than for higher education (education 4). Experiencing poor health or personal unemployment, as well as ever having been obese or a smoker increases the probability of long-term sickness-related absence.

Rho, which is the correlation between the error terms in the main and selection equations, is significantly different from zero. This indicates that ignoring the selection effect into (non-) employment will result in biased and inconsistent estimations. The fact that rho is negative indicates a negative relation between employment and long-term sickness-related absence (Henneberger & Sousa-Poza 1998).

The results for men show no relationship between alcohol consumption groups and long-term sickness-related absenteeism; this might be an effect of too few cases of long-term sickness-related absence. We therefore expect the results for men to be highly sensitive to both data and method and will not be further commented on.

The simulations of changes in long-term sickness-related absence following changes in alcohol prevalence are reported in Tables 16 and 17. This is done for two subsets: employed individuals and non-employed, had they been working. In the sample, the conditional probability (the probability of at least one spell of long-term sickness-related absence adjusted for employment effects) is 0.134 among employed and 0.256 among unemployed, had they been working.

Comparing the original sample in terms of prevalence with the most beneficial counterfactual scenario (i.e., everyone being long-term light drinkers), shows that the influence of alcohol consumption on long-term sick days is rather limited for the working population. However, the societal effect, due to the large number of individuals in employment, adds up to a substantial burden each year (7,000 productive working years, or SEK 1.4 billion). The alcohol effect in terms of sick days per individual and year is larger among the non-employed although, since the group is smaller, the societal effect is less pronounced (see Table 17).

Table 15 Probability of long-term sickness-related absence among women, and average marginal effects

	Heckprob		**Average marginal effects**	
	Long-term sickness			
Long-term abstainer	0.279	***	0.105	**
Former drinker	0.477	***	0.181	***
Former abstainer	0.384	***	0.145	***
Current light but former heavy drinker	0.080		0.029	
Long-term heavy drinker	0.260	***	0.098	***
Age0	-0.178	***	-0.059	***
Agesquare0	0.002	***	0.001	***
Income lag	-2.5E-06		-8.3E-07	
In-between health lag	0.464	***	0.169	***
Poor health lag	0.996	***	0.360	***
Education 2	-0.275	***	-0.095	***
Education 3	-0.505	***	-0.178	***
Education 4	-0.416	***	-0.140	***
Eversmoke	0.106	**	0.039	**
Everobese	0.249	***	0.091	***
Unemployment lag	0.290	***	0.109	***
Constant	0.194	*		
	Employment			
Long-term abstainer	-0.410	***	-0.139	***
Former drinker	-0.466	***	-0.156	***
Former abstainer	-0.335	***	-0.110	***
Current light but former heavy drinker	-0.087		-0.027	
Long-term heavy drinker	-0.323	***	-0.107	***
Age0	0.244	***	0.066	***
Agesquare0	-0.003	***	-0.001	***
Income lag	6.60E-06	*	1.74E-06	*
In-between health lag	-0.341	***	-0.103	***
Poor health lag	-1.072	***	-0.319	***
Education 2	0.302	***	0.083	***
Education 3	0.484	***	0.135	***
Education 4	0.374	***	0.106	***
Eversmoke	-0.096	*	-0.028	
Everobese	-0.191	**	-0.059	**
Unemployment lag	-0.420	***	-0.135	***
Small child	-0.016		0.000	
Unemployment rate	-0.050	***	-0.015	***
Constant	0.194			
Rho	-0.990	***		

Table 16, Simulation of an intervention abolishing heavy drinking, among the employed

	Original sample	**FD (lhd=>fd)**	**CLFHD (lhd=>clfhd)**	**LLD (lhd=>lld)**	**All light drinkers**
Conditional probability of long-term sickness spell	0.135	0.139	0.135	0.134	0.128
Average sick days, given long-term absence	98.87	98.87	98.87	98.87	98.87
Expected sick days per individual	13.35	13.74	13.35	13.25	12.66
Difference in expected sick days per individual		0.39 (2.92%)	0 (0%)	-0.1 (-0.75%)	-0.69 (-5.17%)
Number employed (2005)*		2,038,000	2,038,000	2,038,000	2,038,000
Expected change in number of productive days**		-794,820 (-3,957 yrs)	0	203,800 (1,015 yrs)	1,406,220 (7,000 yrs)
Value of gained production*** (million SEK)		-798.4	0	204.7	1,412.6

** Labour Force Survey, Statistics Sweden (www.scb.se), figures for 2005.*

*** Actual yearly working time is used; 1,607 hours for Sweden in 2005 (OECD 2008).*

**** Based on a monthly average pay for women of SEK 22,100 and 22 working days per month.*

Table 17, Simulation of an intervention abolishing heavy drinking, among the unemployed

	Original sample	FD (lhd=>fd)	CLFHD (lhd=>clfhd)	LLD (lhd=>lld)	All light drinkers
Conditional probability of long-term sickness spell	0.256	0.259	0.251	0.249	0.226
Average sick days, given long-term absence	98.87	98.87	98.87	98.87	98.87
Expected sick days per individual	25.31	25.61	24.82	24.62	22.34
Difference in expected sick days per individual		0.3 (1.19%)	-0.49 (-1.94%)	-0.69 (-2.73%)	-2.97 (-11.73%)
Number employed (2005)*		167,500	167,500	167,500	167,500
Expected change in number of productive days**		-50,250 (-250 yrs)	82,075 (409 yrs)	115,575 (575 yrs)	497,475 (2,477 yrs)
Value of gained production*** (million SEK)		-50.5	82.4	116.1	499.7

** Labour Force Survey, Statistics Sweden (www.scb.se), figures for 2005.*
*** Actual yearly working time is used; 1,607 hours for Sweden in 2005 (OECD 2008).*
**** Based on a monthly average pay for women of SEK 22,100 and 22 working days per month.*

Discussion

This section will first discuss important points raised in each of the included papers. This is followed by a synthesis, in which the results of the different papers are discussed in relation to each other. The latter section could be considered the result of the thesis, as opposed to the specific discussion, which is the result of the individual papers.

Specific discussion

Paper I

The net cost of alcohol consumption to Swedish society in 2002 is estimated to be SEK 20.3 billion—approximately SEK 2,300 per capita or 0.9% of GDP. It is important to be aware of the variability of the point estimates. The base case estimate is a result of numerous methodological and data choices, all of which would change the result if done differently. Primarily, the choice of calculating the gross cost of alcohol would increase the point estimate to SEK 29.4 billion. Aside from this, other defendable methodological and data choices could also change the result up or down by around 50%, as was shown in the sensitivity analyses. Although the base case estimate is considered the best possible estimate at the time of the study, it should not be viewed as an exact figure, and should be interpreted in connection to the sensitivity analyses. However, the most conservative sensitivity analysis still result in a net societal cost, leading to the conclusion that current level of alcohol consumption in Sweden is detrimental. The cost would undoubtedly have been higher if certain cost components excluded from the analysis had been possible to estimate. For example, neither reduced on-the-job productivity nor most costs related to anticipation of crime have been included. However, as most of the major cost components are estimated, the expected increase in cost from non-estimated components is not large, especially not relative to the sensitivity of the base case estimate.

There are a number of international studies on the societal cost of alcohol, to which this study can be compared (see Table 18). The estimates of the current study are within the range of international studies for both net[6] and gross costs, although at the low end. There are several reasons for the differing results. Different studies include different cost components and use different methods and discount rates, particularly for the calculation of productivity costs. Different countries have differences in consumption, disease structures and societal norms and values, as well as different institutional systems, which affects treatment practices, the classification of diseases and relative prices. All this should affect COA studies; trying to achieve the same cost estimate as in other countries is counterproductive. It is thus difficult to perform cross-country comparisons, and is sometimes even with questionably relevance. Table 18 should therefore be interpreted with care.

Table 18, Cost-of-alcohol studies, cost per capita in US$

Study	Total
	Net
Australia (Collins & Lapsley 2002)	344
Canada (Rehm et al. 2006)	386
Sweden (Johansson et al. 2006)	249*
	Gross
Canada (Single et al. 1998)	282
Scotland (Scottish Executive 2001)	357
United States (NIDA 2002)	757
England &Wales (UK Strategy Unit 2003)	593–642
Norway (Gjelsvik 2004)	456–498
Sweden (Johansson et al. 2006)	360*

** Intangible costs are estimated to 121,791 OALYs (net) and 145,356 QALYs (gross), corresponding to 507 and 605 PPP, in 2003 US$ per capita, respectively (although this is not included in the base case).*

On the one hand, Sweden has a relatively hazardous alcohol consumption pattern (Rehm et al. 2004), which is expected to increase costs to Swedish

[6] The Australian net estimate includes a monetary value of intangible costs. If these are excluded, as in the current study, the estimates are about the same.

society in comparison with the other countries in Table 18. On the other hand, the relatively strong Swedish alcohol policies (Karlsson & Österberg 2001) are expected to be especially effective in reducing problems among marginalised heavy users (Room 2002), a group that incurs a disproportionally large part of the alcohol-related costs. This, together with protective popular sentiments and behaviours (e.g., high compliance with alcohol-free driving) and historically low alcohol consumption, are considered plausible explanations for the relatively low cost of alcohol consumption in Sweden.

Reduced quality of life following problematic alcohol consumption should be added to the base estimate of the Swedish cost-of-alcohol estimate. This amounts to a net estimate of 122,000 QALYs. This should be seen as a pioneering attempt to capture the intangible costs of alcohol consumption and, as such, has faced several methodological problems. For example, not all estimated QoL components are preference-based; as a result, the final estimate is not true QALYs. Based on the estimate of QoL losses for families and friends of problem drinkers, it could be termed "WHOQOL-BREF weighted life-years". The estimate of QoL loss for consumers uses an American survey, which is preference-based and includes other aspects besides health, such as values and feelings. However, the representativeness can be questioned, particularly for the Swedish context. Future studies in the field should find it quite easy to improve upon these estimates of intangible costs resulting from alcohol consumption.

The beneficial effects of alcohol consumption might be overestimated in the current study, especially with regard to the elderly. There are at least three methodological issues that might cause bias in the estimation for the elderly: 1) cause of death and disease diagnosis are less certain among the elderly compared to younger people; 2) consumption levels are estimated with less certainty for the elderly; and 3) the causal connection between alcohol consumption and chronic diseases might be different for the elderly, an issue that has not been commonly explored in the epidemiological literature. All this might lead to an overestimation of the beneficial effects among the elderly. Since about 42% of the cost savings due to alcohol consumption among women are for individuals above 80 years of age (22% for men), this is worth considering. This is done in the sensitivity analysis (A) above, which subsequently increases the net estimate by almost SEK 3 billion.

The estimates in Paper I were considered the best possible estimates given the available data, resources and timeframes of the research project. It is expected that these estimates could be improved on in coming years, perhaps mostly for the estimations of intangible and indirect costs. For example, very few of the found positive effects of low alcohol consumption on labour market outcomes are included in Paper I. This is mainly due to insecurity about effects and magnitudes and contradiction with the epidemiological literature. The other papers in this thesis will focus on indirect costs, particularly the wage effect of alcohol consumption, with the underlying purpose of enabling improved cost estimates in the future. There are many questions that need to be answered, such as establishing whether there is a direct effect of alcohol on wages or if the effect is mediated through other personal characteristics. If the latter is true, it becomes imperative to define these characteristics.

Paper II

The results of Paper II show that low alcohol consumption increases medical care costs and the number of care episodes. This is most evident for working-aged individuals; the net effect of low alcohol consumption is protective only for individual above 80 years of age.

Referring to a positive health effect from low alcohol consumption is common in order to explain a positive effect of low alcohol consumption on wages/earnings. This positive effect has been found in a number of studies, although the shape of the relationship differs. A general positive effect on wages was found by, for example, Peters (2004), van Ours (2004) and Zarkin et al. (1998), while a positive effect for moderate/low drinkers (with or without a negative effect for heavy drinkers) was found by Lee (2003), Hamilton & Hamilton (1997), Barrett (2002), Heien (1996) and French & Zarkin (1995). One of the most prevalent suggested explanations of this relationship in the alcohol-wage literature has been that low alcohol consumption has been shown to have a protective effect on certain diseases, mainly coronary heart disease (the health link argument). However, no study discusses the fact that low alcohol consumption has been shown to have detrimental effect on health through a number of other diseases.

This study indicates that the net effect of low alcohol consumption on health is detrimental for the working-aged population, which should have a negative effect on wages. We have employed epidemiological information—the same information on which the health link argument is based. However, we have applied the *full* information, contrary to the *selected* information on which the health link is based. It therefore seems as though the health link argument is severed. There are a number of other suggested factors that could potentially explain the positive wage effect, such as social networking (van Ours 2004) and endowment (Lee 2003). Despite increasing medical care costs and number of disease episodes, low alcohol consumption can have a positive effect on, for example, subjective health, quality of life and reduced number of days absent from work due to non-alcohol-related diseases and injuries. There is thus no shortage of alternative factors that could help explain the positive wage effect, although health, based on the protective effects in the epidemiological literature, is rejected.

Paper III

This paper has studied possible heterogeneity within pooled alcohol consumption groups with respect to the alcohol-wage relationship. The focus has been on whether heterogeneity can cause estimation bias in the form of misclassification and confounding. The first pooled group studied—current abstainers consisting of former drinkers and lifelong abstainers, also known as the former drinker error—was shown to be heterogeneous. A number of variables were significantly different between subgroups, and can thus be expected to be implicated as confounders if the former drinker error is committed. However, as no significant difference is found for income after controlling for the included variables (indicating that appropriate controls are included in the estimations), former drinkers and lifelong abstainers can be pooled without causing misclassification bias in the wage equation. Thus, the former drinker error seems to be mainly a confounding problem.

The results of the study also indicate that light drinkers are a heterogeneous group, consisting of lifelong light drinkers, former abstainers and current light but former heavy drinkers. The comparison between the first two shows a number of variables that can cause confounding. Most of these variables are considered to lean towards lower income among former

abstainers. Compared to lifelong light drinkers, former abstainers are, for example, more likely to be economically inactive and immigrants. The income variable is also significantly different between these two groups, even after controlling for included variables. This indicates that the former abstainer error causes misclassification bias in wage estimations, as the coefficient of the pooled group will be a weighted average of the coefficients of the subgroups. As shown above, lifelong light drinking is associated with higher income, while former drinking is associated with lower income, resulting in an underestimation of the positive (negative) effect of lifelong light drinking (former abstinence) on wages when using the pooled consumption group. The former abstainer error can thus be considered to be both a confounding and a misclassification bias problem.

The investigation of the former heavy drinker error—current light but former heavy drinkers pooled with lifelong light drinkers—suffered from low power due to few observations in the former subgroup. However, the Wald test strongly rejected the null hypothesis, suggesting that, compared to lifelong light drinkers, individuals who have reduced their alcohol consumption to light levels are different with respect to the determinants in the wage equation. It should be noted that being a current light but former heavy drinker is associated with better health compared to lifelong light drinkers, which is contrary to the argument that individuals reduce their consumption due to health problems. Income is significant at the 10% level, indicating that pooling of the two consumption subgroups might cause misclassification bias, underestimating the positive effect of lifelong light drinking compared to current light but former heavy drinking. The results therefore seem to indicate that the former heavy drinker error might cause both misclassification bias and confounding in the wage equation, although further studies are needed before any definitive conclusions can be drawn.

The replication of an OLS wage equation indicates that pooling of consumption groups without controlling for drinking history causes estimation biases. It should be noted that not all variables that were found to risk confounding in the main model have been included in the illustrative example, and that the control for drinking history is only an eight-year lag. It is thus expected that the OLS replication also suffers from both confounding and misclassification bias, although this is reduced when pooling is avoided.

Paper IV

The results section above for Paper IV shows that there is an increased risk of the probability of long-term sickness-related absence for all alcohol consumption groups, compared to being a long-term light drinker, given employment. The exception to this is the statistically insignificant group of current light but former heavy drinkers. The effect ranges from an 18% increase in probability for former drinkers to a 10% increase for long-term heavy drinkers.[7] Having changed consumption level between two waves is associated with a larger point estimate compared to those with constant consumption. An effect of this is that if the former abstainer error and/or former drinker error were conducted, the more detrimental association from consumption changes would not have been manifested in the results. Conducting the former abstainer error would have led to an underestimation of the protective effect of long-term light drinking. The former drinker error would have resulted in a point estimate of abstention of 14% increase in the probability of a long-term sickness-related absence spell—the weighted average of the estimates for former drinkers and long-term abstainers in Table 15. The latter would thus have underestimated the risk of former drinking and overestimated the risk of long-term abstention, compared to long-term light drinking. This is considered an important issue to account for whenever studying (inversed) U-shaped relationships of alcohol consumption.

Estimating the model with sample selection turns out to be important, as the estimates of a probit (shown in Paper IV) are biased due to correlation between the error terms of the employment and absence equations. The results of the probit model are interpreted as an underestimation, due to the fact that the non-employed are not absent when sick.[8] For example, the lag of poor health, which is strongly significant in the sample selection model, is insignificant in the probit model; in other words, individuals with a lag of poor health are more likely to be non-employed, and thus do not experience

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[7] There is, however, no significant difference between the effects, according to a Wald test.
[8] This is a simplification; the unemployed who are sick receive sickness benefit from the social insurance agency from the beginning of the sickness period, and are thus officially absent from the process of looking for work. However, the group of non-employed includes more than just unemployed individuals, and since the definition of long-term sickness-related absence included employment, this simplification is valid.

sickness-related absence. This is also evident in the simulation model, where it is shown that the probability of experiencing a long-term sickness-related absence spell is higher among non-employed individuals, had they been working, compared to those that are employed.

Several hypothetical changes in the prevalence of alcohol consumption are made to the simulation model in order to study the effect on sickness-related absence, for both employed and non-employed persons, provided that they had been working. These calculations are based on conditional probability; the results are adjusted for workforce effects of the hypothetical changes in alcohol consumption. First, all heavy drinkers are "turned" into former drinkers, as this is how they would be defined in the current paper following a successful intervention to eliminate heavy drinking (see Table 16). Such an intervention would, according to the model, increase the number of sick days. If they are instead "turned" into light drinkers and thus defined as current light but former heavy drinkers, there would be no effect on absence rates for employed individuals. However, for the non-employed, had they been working, the number of sick days would have been reduced by on average half a day per year (Table 17).

It can be argued that moving heavy drinkers into the two consumption groups above is inappropriate, since one of the underlying theories of the paper is that individuals who have stopped or reduced their consumption have done so due to (alcohol) problems. The probability is calculated by applying the β-coefficients estimated in the model. Using the coefficients from the former drinker or current light but former heavy drinker groups on a group that is different in an important aspect (i.e., not having had (alcohol) problems that forced them to stop or reduce consumption) will bias the results. In the two cases above, this threatens to overestimate the number of sick days. Instead, an assumption is made that the hypothetical intervention prevents the individual from becoming a heavy drinker in the first place, and thus "turns" the heavy drinkers into long-term light drinkers. This can be interpreted as the effect of an intervention in the long run. The potential reduction in sick days, on average, is still rather small: 0.1 days annually for the employed and 0.7 days for the non-employed. However, taken together to produce a societal effect, over 2,000 productive working years would be saved annually.

A final simulation was made in order to study how much of the long-term sickness-related absence can be attributed to alcohol consumption, by assuming a counterfactual scenario where the whole Swedish population consumes alcohol as per the most beneficial consumption group, long-term light drinkers. The number of sick days in this scenario would have been reduced by 0.7 days annually for the employed and 3.0 days for the non-employed, had they been working. This translates to a reduction of 5% and 12%, respectively. The contributing effect of alcohol consumption is thus rather small compared to the combined effect of all other factors such as other health-related behaviours, work stress (Vasse et al. 1998), and contractual arrangements (Barmby et al. 2004). On a societal scale, however, the individual reduction adds up to a substantial effect. If the entire Swedish female population were long-term light drinkers, Swedish society would avoid alcohol-related productivity losses due to long-term sickness-related absence of SEK 1.4 billion annually among the employed, after adjusting for workforce effects. For the non-employed, had they been working, the corresponding figure is SEK 0.5 billion. To what extent the potential productivity gain could be realised into an actual gain can be debated, since, for example, the natural rate of unemployment is expected to be non-zero. Based on this, the method of calculation (the Human Capital Approach) might overestimate the possible productivity gain and, for example, the Friction cost method (Koopmanschap et al. 1995) might be more appropriate. However, the Human Capital Approach is used here as it allows for comparison with other estimates.[9]

[9] Comparisons should however be made with care as the conditional probability adjusts for work force effects.

Synthesis

This section will discuss the results of the four included papers in relation to each other, with special focus on how the results of Papers II, III and IV are related to Paper I. To some extent, the results will also be discussed in relation to related prior studies. For the following discussion, it is important to remember that the term (alcohol) abuse has several meanings in daily conversation. It can mean the alcohol-related disease called alcohol abuse (F10.1), problem drinking in general and, according to the economic definition, consumption that causes adverse effects. For clarity's sake, from here on *abuse* will be used to refer to the general and very broad concept of problem drinking, while *misuse* will be used for the economic definition. The disease will be followed by the ICD-10 code for the purpose of clarity.

Consumption and abuse

The Swedish cost-of-alcohol (COA) study estimates the societal cost of alcohol *consumption*, while other studies have focused on alcohol *abuse* (e.g., Single et al. 1998; NIDA 2002). *Abuse* is also the preferred term in the international guidelines (Single et al. 2003). It is argued in Paper I that it is better to use *consumption* instead of *abuse* for three reasons. First, the difference between *abuse* and *consumption* in previous research is mainly a difference in terminology and not in concept as abuse is defined as (consumption) causing adverse effects (Single et al. 2003). This is how the terms and concepts have been and are still used in many recent studies. Second, using *consumption* makes it clear from a pedagogical viewpoint that low and moderate drinking can also result in adverse effects. Third, using *abuse* would require a definition and a cut-off point between consumption and abuse that, by necessity, would be arbitrarily chosen, particularly since alcohol consumption is measured in weekly levels of alcohol consumption. Paper I considered these three arguments as sufficient justification for using the concept of *consumption* over *abuse*. The results of Paper II strengthen this decision. Low alcohol consumption, on a societal level, results in a net cost for medical health care. Health care is one of the cost categories considered to receive the most benefit from the protective

effects of alcohol consumption. In other words, on an aggregate level should both abuse and non-abuse of alcohol be considered alcohol misuse.[10] Thus, investigating the societal cost of alcohol abuse would be a completely different study with a different target population. Focusing on consumption reduces the insecurity around what is being studied, and is the correct choice based on the detrimental effects of alcohol consumption.

Alcohol, wage, and sickness-related absence

The counterfactual scenario in the Swedish COA study (the hypothetical situation to which the current situation is compared) is a situation without alcohol consumption. This is the conventional scenario for COA studies, and is best understood as a minimum gross cost scenario. It follows from the chosen counterfactual scenario that the beneficial effects of alcohol consumption should be included in the estimations. That is, as both the beneficial and detrimental effects of alcohol consumption would disappear in the counterfactual scenario, the actual effect on society would be the net effect. Connected to this is the relationship between alcohol consumption and wages, which is a potential cost component that was not included in the COA estimate in Paper I.[11] A number of studies have found a significant relationship between alcohol consumption and wages, where light/moderate drinkers normally have the best outcome while abstainers and heavy drinkers have the worst outcomes (e.g., Lee 2003; Barrett 2002). Given a direct, causal effect of alcohol consumption on wages, this should be included in COA studies. However, it is generally difficult from a theoretical perspective to explain why alcohol would have a direct effect on wages. Implicitly or explicitly, it is generally assumed that the wage effect is mediated through other characteristics. Examples of this include social networking such as extra time spent with colleagues, signalling motivation for the job (van Ours 2004), genetic endowment (Lee 2003) and health (van Ours 2004; Barrett 2002; Berger & Leigh 1988). Papers II–IV in this thesis are, in one way or another, all connected to the issue of the wage effect of alcohol consumption. Paper III shows that the wage penalty of abstention and the wage premium of light drinking can not be explained on

[10] It should be noted that these conclusions are based on aggregated level results and should not be used to assert alcohol misuse on an individual level.
[11] This was mainly due to insecure scientific evidence of effects and magnitudes.

methodological grounds (misclassification bias due to inappropriate pooling of consumption groups). Paper II rejects one suggested mediator between alcohol consumption and improved wages (objective health[12]) due to the detrimental health effect of low alcohol consumption. Paper IV, in turn, suggests a potential mediator: (long-term) sickness-related absence. It is normally assumed that absence affects wages negatively both directly (as sick pay/benefits are lower than wages) and indirectly (through reduced human capital accumulation). It is thus possible that the wage penalty that non-long-term light drinkers suffer is a consequence of increased (long-term) sickness-related absenteeism. However, the issue of whether there is a direct effect of alcohol on wages or if this effect is mediated through other characteristics remains indecisive. Future studies should attempt to disentangle the wage effect of alcohol consumption more forcefully, as this will have implications for COA studies and, by extension, economic evaluations of interventions in the alcohol field.

It should be noted that if it turns out that sickness-related absence is the sole mediator between alcohol consumption and wages (i.e., that it fully explains both the direct and indirect effects), the "wage effect" disappears and COA studies should then only include the productivity loss from sickness-related absence, which is done in Paper I. Another implication from the possibility of sickness-related absence acting as the mediator is that there should be a change in focus in terms of the research question. It is common today to ask why there is a wage premium (penalty) from light/moderate drinking (abstention). The question should perhaps be rephrased to ask why long-term abstainers are more absent from work than long-term light drinkers; this research question remains interesting even if—as is more likely—sickness-related absence explains only a part of the wage effect of alcohol consumption.

Paper II rejected objective health as the link between low alcohol consumption and improved wages. This is especially interesting in relation to the results from Paper IV (i.e., that long-term light alcohol consumption

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[12] The term objective health is meant that someone with medical training considers the individual sick, i.e. the individual receives both a diagnosis and treatment. This does not include the individual's view of his/her own health status (subjective health) or that alcohol consumption somehow affects non-alcohol-related diseases.

reduces both objective health and the probability of long-term sickness-related absence). It is obvious that something else must be influencing sickness-related absence besides objective health, such as subjective health (or quality of life). This is based on a hypothesis that long-term light drinkers considers themselves healthier and, for example, return faster to work after a sickness-related absence spell compared to individuals in other consumption groups. Subjective health might thus also serve as the mediator between low alcohol consumption and wages, since a reduced number of days absent from work should affect wages positively. The link between low alcohol consumption and sickness-related absence was tested in Paper IV with favourable results. However, it was not tested with subjective health serving as a mediator. Unfortunately, earlier research is inconclusive, since the relationship between alcohol consumption and subjective health has been found to be negatively linear (Guallar-Castillón et al 2001) as well as J-shaped (Poikolainen 1996). Studies have also failed to find consistent differences between lifelong abstainers and current drinkers or for level of consumption with regard to subjective health (e.g. Stranges 2006). Future studies should thus further investigate the relationship between alcohol consumption and subjective health in connection to its effect on sickness-related absence.

Paper IV differs from other studies in the field, as it focuses on long-term sickness-related absence and controls for drinking history and selection effect. The results, however, could generally be said to align with prior studies.[13] For example, Vahtera et al. (2002) found an increased risk of sickness-related absence for former drinkers, heavy drinkers and abstainers, as compared to light drinkers. Johansson et al. (2009) found, in the Finnish context, a positive association between alcohol consumption and sickness-related absence, and McFarlin & Fals-Steward (2002) concluded that there is an increased risk of short-term absenteeism the day after alcohol consumption. In addition, problem drinking has been shown to increase short-term absence (Cunradi et al. 2005). In the Australian context, risky alcohol consumption has been shown to increase both self-reported alcohol-related absenteeism and overall illness/injury absence (Roche et al. 2008).

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[13] The difference in effect between aggregated time series and microdata studies is a common result in the alcohol field, for which no satisfying explanation yet has been given (e.g. Ramsted 2001; Hemström 2001; Rehm et al. 2004).

However, there are also studies that have failed to find evidence of an effect of alcohol consumption, such as Christensen et al. (2007), as well as failed to find an effect of problem drinking on short-term absence for women, such as Tómasson et al. (2004).

Alternative alcohol-related costs of long-term absence

It is difficult on an intuitive basis to understand why light alcohol consumption in and of itself should reduce (long-term) sickness-related absence, particularly as it has been shown, based on the epidemiological literature, to increase medical care costs and episodes. It seems more likely, as discussed above, that the effect is mediated through omitted variables such as subjective health, quality of life, and/or human capital accumulation (Bray 2005). However, this has not been convincingly shown in applied research, and until that happens, the basis for discussion must be that constant light alcohol consumption is reducing the probability of long-term sickness-related absence, while abstention and heavy drinking increase the probability. Therefore, the results from Paper IV will now be used to calculate an alternative estimate to the Swedish COA study's estimate of the cost of long-term sickness-related absences due to alcohol. This can be done by calculating the probability of long-term sickness-related absence and how this changes following assumed changes in alcohol consumption on the population level.[14] The proportional change in probability from a prevalence change will be calculated and applied to the prevalence of absence for the working sample and extrapolated at the population level. A working year is assumed to consist of 260 working days, and is valued according to an average salary of SEK 27,331, including 40% in salary taxes (Statistics Sweden 2003). In order to enable comparison, these are the same assumptions as made in Paper I, but they differ from the assumptions made in Paper IV.

The motivation of this exercise is to illustrate the contradiction in effects, and subsequently costs, that occurs when applying both epidemiological (Paper I) and econometric methods (Paper IV). This type of contradiction is

[14] Please observe that this is not the same probability as calculated in Paper IV. Instead, the conditional probability from Paper IV is discussed below.

not uncommon, although it is concerning that consensus appears beyond reach at the moment.

Table 19, Simulation of long-term sickness-related absence in two counterfactual scenarios, full sample, no adjustment for selection effects

	Original sample	**All long-term abstainers**	**All long-term light drinkers**
Probability of at least one long-term sickness spell	0.350	0.415	0.320
Proportional change		18.4%	-8.7%
Prevalence of long-term sickness-related absence among employed	12.82% (336 cases)		
Simulated change in long-term sickness-related absence prevalence		15.2% (397.8 cases)	11.7% (306.2 cases)
Average days sick, given long-term sickness-related absence	98.87	98.87	98.87
Number employed (2002)	2,046,900	2,046,900	2,046,900
Expected number of productive days lost	25,944,732	30,761,305	23,678,109
Expected change in number of productive days		4,816,573	-2,266,622
Value of gained production (COA comparable), SEK million*		-6,075.8	2,859.2

** Average salary of 27,331 including salary taxes (40%) and 260 working days per year.*

The predicted probability of long-term sickness-related absence based on the Heckman model is 0.35 in the full sample, see Table 19. The predicted probability increases by 18% in the counterfactual scenario of no alcohol consumption. Increasing the prevalence of long-term absence in the working sample accordingly results in a prevalence of long-term absence of 15.2%. Using the average number of days of long-term sickness-related absence, given long-term sickness-related absence, in the data and the number of employed women in 2002 allows calculation of the productivity change following the change in alcohol prevalence. In the final row of Table 19, the productivity change is valued according to average salary for women in 2002, including salary taxes. The U-shaped relationship found in Paper IV between alcohol and long-term absence—together with the large prevalence of long-term light drinking—results in a protective effect from the current prevalence of alcohol consumption compared to the

counterfactual scenario of no alcohol consumption. In other words, an alternative society without alcohol consumption would experience over SEK 6 billion higher costs due to sickness-related absences longer than 28 days.[15]

The beneficial effect of long-term light alcohol consumption is shown in the last column in Table 19. If the whole female population were long-term light drinkers, the probability of long-term absence would be reduced, resulting in cost savings of almost SEK 2.9 billion. In Paper I, the estimated cost of alcohol consumption due to long-term sickness-related absence was estimated to be SEK 3.2 billion, compared to the current estimate of cost savings of SEK 6.1 billion. This is obviously a very large difference between estimates, and the difference should be even larger considering the different definitions of long-term absence in the two studies (>14 days in Paper I and >28 days in Paper IV).

It should be remembered that the estimates based on Paper IV are contingent on a direct effect of alcohol on long-term sickness-related absence and, although the U-shaped relationship has also been found in earlier research, the magnitude of the effect is based on only the current paper. Many more studies showing the same results would be required before conclusions can be drawn regarding effects and magnitudes, which in turn will affect the cost estimate. Moreover, as discussed elsewhere in this thesis, it is possible that omitted variables might serve as explanations for the relationship between alcohol and sickness-related absence, neutralising the direct effect. For example, long-term abstainers might have characteristics other than alcohol consumption that are different compared to long-term light drinkers that are not controlled for in Paper IV, leaving them worse off with regard to health and labour market outcomes. The estimate in Paper I is based on epidemiological information and register data on long-term sickness-related absence while the estimate based on Paper IV uses microdata and econometric methods. The conflicting results between these two approaches are not uncommon and it is generally difficult to argue for one method over the other. Therefore, the results here

[15] Note that this only concerns the cost of sickness-related absences longer than 28 days. If absences between 0-28 days were included, the estimate would change. However, it is difficult a priori to determine the direction and magnitude of the change.

should be interpreted with care, and it is far from recommended that interventions urging long-term abstainers to commence light drinking are implemented. However, the main point in calculating an alternative estimate is that, if we accept the protective outcomes of (long-term) light drinking, alcohol, as it is consumed in Sweden today, is most likely beneficial on a societal level, compared to the counterfactual scenario.[16] However, by reducing, for example, heavy drinking, more beneficial outcomes can be obtained, no matter the effect of abstention. These conflicting results should thus not be seen as an argument against alcohol interventions, but rather that these interventions should target hazardous and harmful consumption until that time that the net effect of low consumption is determined.

Conditional probability

There is yet another way to approach the results of Paper IV with regard to the alcohol-related cost of long-term sickness-related absence: the conditional probability. This is a very interesting tool for COA studies, as it allows for changes in the selection equation (employment) when calculating the probability of long-term sickness-related absence. Effects on the size of the workforce are generally difficult to capture and were not estimated in the Swedish COA study. The effect as estimated in the selection equation in Paper IV suggests an inversed U-shaped relationship for this outcome. The predicted conditional probability is defined as the probability of success in both the selection and main equation divided by the probability of success in the selection equation. It thus follows that the predicted probability of long-term sickness-related absence will also depend on changes in the probability of employment following a change in alcohol prevalence. The direction of the change in conditional probability following a consumption change is thus not obvious a priori. It is important to keep track of the changes in workforce size; otherwise, interpretations can be vastly misleading, as will be shown below.

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[16] This should be put in relation to the fact that the same estimates based on the epidemiological literature result in the opposite, i.e., a detrimental effect of current alcohol consumption.

Table 20 shows the conditional probability calculated for the employed. It should be noted that the estimates following these calculations cannot be compared to the COA estimate, as the latter do not include any changes in workforce size. The conditional probability calculations show that a counterfactual scenario of no alcohol consumption, compared to the actual situation, reduces costs associated to long-term sickness-related absence to a larger extent than if all of those employed were long-term light drinkers. In other words, the current level of alcohol consumption in the Swedish society results in a substantial net cost.[17]

Table 20, Simulation of long-term sickness-related absence in two counterfactual scenarios, among the employed

	Original sample	**All long-term abstainers**	**All long-term light drinkers**
Probability of a long-term sickness spell	0.135	0.113	0.128
Average days sick, given long-term sickness-related absence	98.87	98.87	98.87
Expected sick days per individual	13.35	11.17	12.66
Difference in expected sick days per individual		-2.18	-0.69
Number employed (2002)		2,046,900	2,046,900
Expected change in number of productive days		4,462,242 (22,219 years)	1,412,361 (7,033 years)
Value of gained production (SEK million 2005)*		4,482.5	1,418.8
Value of gained production** (SEK million 2002)		5,628.8	1,781.6

** Based on the assumptions in Paper IV (i.e. average salary of SEK 22,100 and 22 working days per month). ** Based on the assumptions in Paper I, where applicable (i.e., average salary of SEK 27,331 including salary taxes (40%), and 260 working days per year).*

At first glance, it can appear strange that the probability of a long-term sickness-related absence spell decreases among the employed if all are

[17] For reference, the cost of long-term sickness-related absence in the Swedish COA study was estimated at SEK 3.2 billion.

long-term abstainers, since the probability of long-term sickness-related absence increases for long-term abstainers compared to light drinkers (see Table 15). However, this is due to a concurrent change in the probability of employment following the change in alcohol prevalence. This effect is shown in Table 21. As the probability of employment is reduced in the counterfactual scenario of no alcohol consumption, it is expected that the workforce would be reduced by almost 254,000 individuals during in 2002. This would result in a productivity loss to society, given no replacement effects, of SEK 83.2 billion. This should be compared to the productivity gain regarding long-term absence of SEK 5.6 billion.

Table 21, Changes in probability of employment following changes in alcohol prevalence

	Original sample	**All long-term abstainers**	**All long-term light drinkers**
Probability of being employed	0.742	0.650	0.772
Proportional change		-12.4%	4.0%
Prevalence of employment	74.19% 2621 cases		
Simulated change in employment prevalence		64.99% 2296.0 cases	77.15% 2725.8 cases
Number employed (2002)	2,046,900	2,046,900	2,046,900
Expected change in number of productive years		-253,815.6	81,876.0
Value of gained production* (SEK million 2005)		-67,311.9	21,713.5
Value of gained production** (SEK million 2002)		-83,244.4	26,853.0

** Based on the assumptions in Paper IV (i.e. average salary of SEK 22,100 and 22 working days per month). ** Based on the assumptions in Paper I, where applicable (i.e., average salary of SEK 27,331 including salary taxes (40%), and 260 working days per year).*

The result of the conditional probability should not be compared to the simulation in Table 19 above nor the COA estimate. Rather, it should be considered a practical example of how the productivity effects of alcohol consumption can be approached to include workforce effects. However, the actual estimates here should be interpreted with extreme caution, especially as the selection equation in Paper IV is estimated only with regard to

capturing the selection effect to allow for unbiased estimate of the main equation, and not for efficient and unbiased estimation of the workforce effects. The effects of alcohol consumption on employment as found in the selection equation are thus uncertain and should be furthered studied. In addition, the question of whether or not individuals who leave employment due to alcohol consumption are replaced by non-employed individuals has to be dealt with in future research. It seems likely that replacement takes place to some extent. Further discussion regarding the conditional probability is left for future research.

Strengths and Limitations

Sweden is a very appropriate country for conducting a COA study, mainly due to its richness of easily accessible data. The data material used in Papers III and IV also employs relatively rich data that allows for the investigation of interesting research questions. This has provided the opportunity to employ different approaches when studying a specific issue, such as basing cost estimates on both epidemiological and econometric methods. This is mostly pronounced in the sensitivity analyses in Paper I and, with regard to cost of alcohol-related sickness-related absence, in Paper IV and the synthesis of the thesis. The consequence of this is that the conflicting results following different approaches become unusually clear. Obviously, this is also a limitation, as no definitive conclusions can be drawn based on the results of the thesis. Rather, the current thesis suggests more questions for future research than it itself answers.

Paper I

Conducting a societal cost of alcohol study requires a number of different data sets as well as assumptions. As was shown in the sensitivity analysis, the final estimate can vary by up to 50% around the point estimate depending on what data set is used and what assumptions are made. A thorough discussion regarding all assumptions and sources of errors would be beyond the scope of this thesis. The interested reader is referred to Johansson et al. (2006).

Paper II

The cost of medical care due to low alcohol consumption is mainly driven by outpatient and primary care. Inpatient care even shows a protective

effect on costs. The data on outpatient and primary care, especially with regard to the coding of diagnoses, are of lower quality than inpatient care. If there is a serious bias in the coding of diseases in the two former health care sectors (e.g., if alcohol-related diseases are given a disease code to a lower extent than non-alcohol-related diseases), this could have a major impact on the results. However, due to social stigma it is expected that such bias is more connected to fully alcohol-related diseases, such as alcohol dependence. Since those diseases are not included in the calculations due to the methodological problem of establishing the number of cases of a fully alcohol-related disease that are attributable to a specific consumption group, the possible bias is of lesser concern. However, the exclusion of accidents and fully alcohol-related diseases surely causes an underestimation of the net cost of low alcohol consumption. For example are accidents also expected to burden the low alcohol consumption group, as alcohol consumption at the very least reduces the ability to mitigate accidents caused by others. As all excluded diagnoses are detrimental to health for all consumption groups compared to abstention, the net medical care cost of low alcohol consumption is most likely larger than estimated in the current study.

Paper III

The study suffered from low variability in the current light but former heavy drinking group, which most likely resulted in insignificant estimations in the comparison with lifelong light drinkers. Another limitation is that past alcohol consumption could only be controlled for using an eight-year lag. It is expected that longer lags also affect current alcohol-related outcomes. It would thus be of interest if both shorter and, especially, longer lags could be included to fully capture the effect of alcohol consumption on chronic diseases.

Paper IV

It has not been possible to control for pattern of consumption in Paper IV. Pattern of consumption, especially binge drinking, has been shown to affect alcohol-related outcomes such as health status (Rehm et al. 2004). Since pattern of consumption is considered more related to outcomes in the short run, while level of consumption is more related to the long run (Roche et al. 2008), this can be considered a minor limitation in the current study. However, future research should endeavour to include pattern of

consumption as well as short-term sickness-related absenteeism in order to give a full picture of the effect of alcohol consumption on sickness-related absence. Beside this, the definition of long-term absence is also a limitation in the current study. Using 28 days as the cut-off point was made out of necessity. A shorter period would increase the sample size, and it is expected that the results to some extent are sensitive to the definition. Future studies should ideally be able to choose the definition of long-term sickness-related absence based on medical or economic theory and not, as in the current paper, based on data availability.

A common concern in econometric modelling, especially focusing on effects of alcohol consumption, is the omitted variable bias. It is often assumed that "counterintuitive" relationships are due to failure to control for all relevant factors, which is also the case in the wage equation above. One method of avoiding this would be utilising the panel information in the ULF data set to perform fixed effect calculations. However, in order to do this at the same time controlling for drinking history, at least one more wave is required. Appropriate panel data sets covering this aspect should be employed in future research.

Conclusions

Specific conclusions

The net cost of alcohol consumption to the Swedish society is conservatively estimated in Paper I to SEK 20.3 billion, or 0.9% of GDP. The sensitivity range is deemed to be around 50%. However, even the most conservative estimate still results in a net cost and the conclusion is that alcohol consumption is costly to society, irrespective of applied methods and data.

The argument that low alcohol consumption increases wages through a protective effect on a few diseases appears invalid based on the results of Paper II. The net effect of low alcohol consumption on health, measured as medical care costs and prevalence of alcohol-attributable diseases, is detrimental. Using selected information from the epidemiological literature is an oversimplification of the complex relationship between alcohol consumption and wages. This has the additional drawback that other factors might be overlooked.

Paper III shows that commonly pooled consumption groups are heterogeneous with respect to the determinants of the wage equation. This might implicate confounding and misclassification bias in estimations that fail to account for drinking history. Drinking history is taken into account in many research areas, although this has not often been done in (health) economic research, particularly with respect to labour market outcomes. Individuals who have changed their consumption levels are different from individuals with constant consumption. Thus, including the lag of alcohol consumption will not be sufficient to capture this effect. The answer to the question posed in the title of Paper III—whether the wage penalty of abstinence and the wage premium of drinking are due to bias caused by pooling of drinking groups—is that misclassification and confounding are expected to cause bias in the wage equation when pooled consumption groups are used. However, the direction of the bias is both to overestimate

the negative effect of abstention and to underestimate the protective effect of light drinking. The wage penalty of abstention can thus not be explained by inappropriate pooling of consumption groups.

The effect of alcohol consumption has again turned out to be (inversed) U-shaped in Paper IV, where both abstention and heavy drinking are associated with a higher probability of long-term sickness-related absence compared to light drinking. However, individuals who have changed their consumption level in the last eight years, indicating some form of (alcohol-related) problem, are generally worse off compared to individuals who maintain their consumption level. Controlling for drinking history is thus important in order to correctly estimate the effect of alcohol consumption, especially avoiding the former drinker and the former abstainer errors. Long-term sickness-related absence attributable to alcohol is a small part of total long-term absence. However, from a societal perspective, this adds up to a substantial effect. Alcohol consumption plays a larger part in absence among the non-employed, had they been working, than among the employed, indicating selection effects into employment from alcohol consumption and its effects.

General conclusions

The general conclusion of this thesis is that alcohol consumption has a large impact on both society and individuals. The societal costs of alcohol consumption are substantial as was shown in Paper I. However, there is much room for improvement in the estimates and Papers II-IV has endeavoured to supply necessary information for future improvements with regard to the possible wage effect of alcohol consumption. Paper II rejects the possibility of a protective health effect from low alcohol consumption based on the epidemiological literature, i.e. low alcohol consumption does not improve objective health status. According to Paper III, the investigated methodological issue of inappropriate pooling of consumption groups can not explain the commonly found (inversed) U-shaped relationship between alcohol and wages. Paper IV in turn suggests that sickness-related absenteeism may serve as a mediator between alcohol consumption and wage, an issue that needs to be further investigated in future research. It has also been shown in this thesis that the results of a cost estimation are sensitive to what type of data are used. On the one hand gives epidemiological data, as used in Paper I, a detrimental effect of current

alcohol consumption compared to a counterfactual scenario without alcohol. On the other hand results the use of microdata and econometric methods in Paper IV in a cost saving of the current prevalence of consumption compared to the counterfactual. Future research must find ways to reconcile the results of these two approaches if ever credible recommendations in the alcohol field based on economic evaluations are to be made.

Policy implications

The papers in this thesis are policy relevant by increasing knowledge regarding the effects of alcohol consumption, defining the problem, and serving as a starting point for future studies. Paper I shows the effects of alcohol consumption to different societal sectors and gives a sense of the size of the problem, allowing for cautious comparison with other health-related behaviours and diseases. It also identifies areas where the potential for developing and implementing cost-effective interventions are high. It should be remembered however that the study only can identify new research and should not be used for determining where and how intervention are to be implemented.

Paper II shows that, based on the epidemiological literature, low alcohol consumption is detrimental to health. From the perspective of the health care sector, this is in opposition to promoting low levels of alcohol consumption among individuals below the age of 80. However, from a societal perspective, this might not hold true as Paper IV shows that low alcohol consumption reduces the probability of long-term sickness-related absence, which is expected to more than counter the detrimental effect on objective health. Perhaps the only unambiguous information based on the current thesis is that low alcohol consumption seems not to be detrimental for individuals above 80 years of age and that future research should investigate the potential of medically prescribing alcohol to individuals in this group.

Some results of the thesis have implications for the evaluation of studies upon which policy decisions are to be based. Paper III shows that it is important to control for drinking history. Policy makers should therefore make sure that they base their decisions on studies controlling for past consumption. Policy makers should also pay special attention to what type

of data are used in studies. It has been shown in this thesis that the societal cost of long-term sickness-related absence due to alcohol consumption is sensitive to if epidemiological or microdata are used.

The papers concerning labour market outcomes following light drinking obviously has the potential to directly affect policy. If the substantial protective effect from light drinking remains, as it does despite efforts to explain it in mediating and methodological terms, current alcohol policies would have to be changed, promoting light drinking. This is despite the detrimental effect on objective health. However, as most alcohol policies in Sweden could be said to trying to reduce (heavy) drinking rather than promoting abstention, the actual policy change will be much smaller than what would be expected at first. The scientific base, however, for such a radical policy change needs to be broadened beyond the scope of the current thesis, including further investigation of the alcohol – wage relationship and mediating effects, see for example Future research section below.

All studies in this thesis have been performed with the intention to facilitate future policy relevant studies, and not in themselves produce policy recommendations. Additional studies are required before specific recommendations can be made to policy makers.

Future research

COA studies supply much information although they can only be considered a first step toward affecting policies. From the policy perspective, estimates of the avoidable cost of alcohol consumption are more relevant. Such an estimate gives the costs that could be eradicated over a certain amount of time, given a decrease in exposure. Diseases caused by current or future consumption should be considered avoidable if a plausible consumption decrease would be preventive. Unavoidable costs would then be diseases and other effects caused by prior consumption. An advantage of the avoidable cost calculations, which also has a higher requirement of information, is that time characteristics are included in the theoretical model making the estimate more plausible. For example is it necessary to know how the increased relative risk of a specific alcohol-related disease decreases over time following a reduction in exposure, and also the time characteristics of the actual consumption reduction. Besides

resulting in estimates that are considered theoretically more appropriate compared to COA estimates, information on avoidable cost is also required when evaluating the cost-effectiveness of policies and interventions, in addition to improving upon existing estimates and methods (Collins et al., 2006). Estimating the avoidable cost of alcohol consumption would also allow for a more realistic counterfactual scenario as it would represent a move away from the theoretical minimum cost scenario toward scenarios that are deemed achievable within a reasonable time horizon.

Future studies should investigate to what extent the found alcohol effect on sickness-related absence can explain the wage differences between consumption groups. The question why non-long-term light drinkers suffers from increased sickness-related absence compared to long-term light drinkers is also interesting to study in this context. This could be done by investigating the causes of absence (e.g. diagnoses and/or caring for a close relative) and how this differs between consumption groups. The possibility that subjective health might serve as a mediator between alcohol consumption and sickness-related absence should also be considered. It is imperative in all future studies to control for drinking history and, preferably, for a longer period than what was done in Paper III and IV. It is likely that more factors are involved in explaining the relationship between alcohol consumption and wages, and future studies should therefore also endeavour to identify these. The results of such studies will in particular affect future economic evaluations in the alcohol field.

Finally should more advanced alcohol consumption variables be created in order to capture the lifetime level and pattern of alcohol consumption. This measure should be based upon temporal characteristics of beneficial and detrimental effects of consumption. This would avoid inappropriate pooling of consumption groups, and thereby avoiding estimation bias, while reducing reporting bias and unexplained variation.

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Sammanfattning på svenska

Alkoholkonsumtion har omfattande samhälliga effekter och medför, till exempel, förtidig död, skydd mot vissa hjärtsjukdomar, ökning av antalet begångna brott samt individuella livskvalitetsförändringar. Från en nationalekonomisk synvinkel är de största problemen med alkohol att individen, när hon tar ett konsumtionsbeslut, inte har all information som krävs för ett väl underbyggt beslut. Detta tillsammans med konsumtionsexternaliteter och alkoholens beroendeframkallande effekt medför att olämpliga kvantiteter alkohol konsumeras i samhället där kostnaderna för konsumtion överstiger nyttan. Av denna anledning är det viktigt att studera alkoholens effekter för att öka informationsmängden samt möjliggöra interventioner och regleringar. Det övergripande målet är således att öka välfärden både på individnivå och för samhället i stort.

Syften med denna avhandling är att studera de samhälliga effekterna av alkoholkonsumtion samt att beräkna de samhälliga kostnaderna som uppstår pga. alkoholkonsumtion. Syftet är också att undersöka möjliga förbättringar i kostnadsskattningar med avseende på metoder, datamaterial och metodantagande. Fokus kring förbättringsarbetet ligger på frågor kopplade till individers utfall på arbetsmarknaden. Avhandlingen syfte täcks av fyra självständiga studier (Studie I – IV), inkluderade i appendix.

Studie I estimerar de samhälleliga kostnaderna för alkoholkonsumtion i Sverige för år 2002, vilket också inkluderar hälso- och livskvalitetseffekter. Nettokostnaden beräknas till 20,3 miljarder kronor, motsvarande 0,9% av BNP. Till denna kostnad ska kostnader för minskad livskvalitet läggas, lågt skattat till 122’000 QALYs. Känslighetsanalyser visar att rimliga alternativa skattningar kan ändra grundestimeringen med ca. 50% åt båda hållen. Dock, även den mest konservativa skattningen visar på att alkoholkonsumtion i Sverige medför kostnader för samhället.

Studie II undersöker hälsoeffekten av lågkonsumtion av alkohol. Hälsa är i det här fallet mätt som kostnader för hälsovård samt antalet

alkoholrelaterade vårdtillfällen. Resultaten visar att lågkonsumtion ökar hälsovårdskostnader och antalet vårdtillfällen, med undantag för individer över 80 år. Den skyddande hälsoeffekten från låga mängder alkohol motsvarar alltså inte den skadliga hälsoeffekten som samtidigt uppstår. Baserat på epidemiologiska data ska således lågkonsumtion av alkohol inte anses förbättra hälsan.

Studie III studerar ett metodologiskt problem i anknytning till skattningar av alkoholens påverkan på arbetsinkomst; huruvida heterogenitet uppstår då konsumtionsgrupper slås samman utan att hänsyn tas till tidigare alkoholkonsumtion vilket leder till att ekonometriska skattningar kan blir felaktiga. Genom att använda en multinomial logit-modell, visas att sammanslagna konsumtionsgrupper (nuvarande nykterister och lågkonsumenter) är heterogena vilket kan medför fel i estimeringar pga. ”confounding” och missklassificering. Slutsatsen av studien är således att hänsyn måste tas till tidigare alkoholkonsumtion när alkoholens effekter studeras, något som alltför sällan görs vid arbetsmarknadsstudier.

Studie IV analyserar hur kvinnors alkoholkonsumtion påverkar sannolikheten för långtidssjukskrivning. En Heckman-modell används där både selektionseffekter och tidigare konsumtion kontrolleras för. Kvinnor med konstant lågkonsumtion tenderar att ha lägst risk för långtidssjukskrivning. De högsta sjukskrivningsriskerna har nykterister som tidigare drack (18%) samt lågkonsumenter som tidigare var nykterister (15%). Lite överraskande är att effekten för individer med konstant högkonsumtion och långtidsnykterister är ungefär den samma (ca. 10%). En mängd simuleringar har också gjorts där effekterna av förändringar i alkoholkonsumtion på långtidssjukskrivningar undersökts, t.ex. studeras hur produktiviteten förändras om alla kvinnor hade en konstant lågkonsumtion. Simuleringen visar att nuvarande alkoholkonsumtion, i snitt, ökar långtidssjukskrivningarna marginellt men att den totala samhällseffekten är kraftig.

Den här avhandlingen visar att konsumtion av alkohol har en betydande påverkan på samhället. De samhälleliga kostnaderna skattades i Studie I, medan Studie II – IV gav ny information, med fokus på alkoholkonsumtionens möjliga arbetsinkomsteffekt, med målet att förbättra framtida skattningar. Studie II förkastar, utifrån epidemiologiska data, att den ofta funna positiva effekten av lågkonsumtion på arbetsinkomst kan

förklaras genom en skyddande hälsoeffekt. Utifrån Studie III måste hänsyn tas till tidigare alkoholkonsumtion i ekonometriska studier. Men, detta är inte förklaringen till det inverterade U-formade förhållandet mellan alkoholkonsumtion och arbetsinkomst. Slutligen, Studie IV för fram sjukfrånvaro som en möjlig förklaring till sambandet mellan alkohol och arbetsinkomst. Avhandlingen har också visat att resultaten av en kostnadsskattning beror på vilken typ av data som används. Jämfört med ett hypotetiskt samhälle utan alkohol så medför nuvarande konsumtionsnivåer en ökning av långtidssjukskrivningar om epidemiologiska data används. Om däremot mikrodata och ekonometriska metoder används syns istället en kostnadsbesparning av nuvarande konsumtion.

Appendix