



HAL
open science

Does drinking affect long-term sickness absence? A sample selection approach correcting for employment and accounting for drinking history

Johan Jarl, Ulf-G. Gerdtham

► **To cite this version:**

Johan Jarl, Ulf-G. Gerdtham. Does drinking affect long-term sickness absence? A sample selection approach correcting for employment and accounting for drinking history. Applied Economics, 2011, pp.1. 10.1080/00036846.2011.566206 . hal-00710925

HAL Id: hal-00710925

<https://hal.science/hal-00710925v1>

Submitted on 22 Jun 2012

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Does drinking affect long-term sickness absence? A sample selection approach correcting for employment and accounting for drinking history

Journal:	<i>Applied Economics</i>
Manuscript ID:	APE-2010-0173
Journal Selection:	Applied Economics
Date Submitted by the Author:	07-Apr-2010
Complete List of Authors:	Jarl, Johan; Lund University / Region Skåne, Center for Primary Health Care Research; Lund University, Health Economics & Management Gerdtham, Ulf-G.; Lund University / Region Skåne, Center for Primary Health Care Research; Lund University, Health Economics & Management; Lund University, Economics
JEL Code:	J21 - Labor Force and Employment, Size, and Structure < J2 - Time Allocation, Work Behavior, and Employment Determination/Creation < J - Labor and Demographic Economics, I12 - Health Production: Nutrition, Mortality, Morbidity, Disability, etc. < I1 - Health < I - Health, Education, and Welfare
Keywords:	

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



For Peer Review

1
2
3
4
5
6
7
8
9 **Does drinking affect long-term sickness absence? A sample selection approach**
10 **correcting for employment and accounting for drinking history**
11

12
13
14 Running head: Alcohol and long-term sickness absence
15
16

17 J. Jarl^{a,b,*} and U-G. Gerdtham^{a,b,c}
18
19

20
21 ^a *Health Economics & Management, Institute of Economic Research, Lund University, S-*
22 *22100 Lund, Sweden*

23 ^b *Center for Primary Health Care Research, Lund University/Region Skåne, S-20502 Malmö,*
24 *Sweden*

25 ^c *Economics Department, Lund University, S-22100 Lund, Sweden*
26
27

28
29
30 * Corresponding author: Johan Jarl, Division of Health Economics, Dept. of Clinical Science,
31 Lund University, Malmö University Hospital, SE-205 02 Malmö, Sweden, E-mail:
32 johan.jarl@med.lu.se
33
34

35
36 This article studies the effect of alcohol consumption on the probability of long-term sickness-
37 related absenteeism for women. Using Swedish matched survey and register data, we apply
38 sample selection models to correct for non-random sampling into paid employment. There are
39 three main findings of the study. First, diverging from the most prevalent consumption group
40 (long-term light drinkers) is associated with an increased probability of long-term sickness,
41 ranging from 10% for long-term heavy drinkers to 18% for former drinkers. Second,
42 controlling for former consumption errors (especially former drinker and former abstainer
43 errors) and sample selection into employment are important for unbiased, consistent
44 estimations. Third, by predicting the effect of changes in consumption on long-term sickness-
45 related absence, we find that alcohol only explains a small part of the overall picture of long-
46 term sickness-related absenteeism. Notwithstanding this fact, long-term sickness-related
47 absenteeism due to alcohol adds up to substantial productivity loss for society. Our conclusion
48 is that the commonly found U-shaped relationship between current alcohol consumption and
49 labour market outcomes remains for women, after controlling for past consumption and
50 selection effects. A change in consumption level increases probability of long-term sickness-
51 related absence, compared to individuals with constant consumption levels.
52
53
54
55
56
57
58
59
60

I. Introduction

Sweden experienced a rapid increase in sickness-related absence¹ from 1998 to 2003, and although the trend shifted in 2004, Sweden continues to experience one of the highest absence rates in Western Europe. In fact, in 2004, the rate of absences was about twice as high in Sweden as compared to the EU-15 countries (4% versus 2%) (Försäkringskassan, 2005). This was costly to Swedish society and has attracted significant attention and study regarding its causes. From an international perspective, the causes of absence have received attention in the context of efforts to reduce these rates for the purposes of improving public health and decreasing health costs (HSE, 2004). Several potential causes have been studied, including shift work (Tüchsen *et al.*, 2008), moral hazard (Johansson and Palme, 2005), contractual arrangements (Barnby *et al.*, 2004), work stress (Vasse *et al.*, 1998) and health-related behaviours (Christensen *et al.*, 2007).

Focusing on health-related behaviours in general and alcohol consumption in particular is considered important as alcohol-related absence constitutes a significant part of the societal cost of alcohol. For example did a recent Swedish study estimate alcohol-related absence to SEK 4.3 billion for the year 2002, after subtracting reductions from beneficial health effects (Jarl *et al.*, 2008). This figure constitutes over 21% of the total cost to the Swedish society from alcohol. 73% of the burden of absence is due to long-term absence (defined as longer than 14 days). Alcohol-related absence is thus a substantial burden on the society which would explain policy makers' interest in ways to reduce the absence rates.

It has been difficult to arrive at any final conclusions about the effect of alcohol on absence rates in prior research. In a review regarding absence, psychiatric disorders and alcohol,

¹ From here on only "absence".

1
2
3 Hensing and Wahlström (2004) conclude that there is insufficient evidence that alcohol
4 affects absence. The studies reviewed, however, showed that individuals diagnosed with
5 alcohol dependence or abuse suffer more and/or longer periods of absence (Hensing and
6 Wahlström, 2004). Studies focusing on high alcohol consumption did not show any
7 conclusive results, probably due to different definitions of both high alcohol consumption and
8 absence. Some studies reported that women who do not consume alcohol are at increased risk
9 of absence (Hensing and Wahlström, 2004); this result is not surprising given the negative
10 outcomes associated with abstinence that are commonly found in studies on alcohol (e.g.
11 Andréasson, 1998; Peters, 2004).
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

27 In more recent studies, there is some evidence of the effect of alcohol on absence. For
28 example, it has been shown that the risk of short-term absenteeism is increased the day after
29 alcohol consumption (McFarlin and Fals-Stewart, 2002). A Finnish study using micro-data
30 found a positive association between the level of consumption and absence (Johansson *et al.*,
31 2009). Cunradi *et al.* (2005) showed that short-term absenteeism was associated with several
32 measures of problem drinking in a sample of urban transit operators, while Tómasson *et al.*
33 (2004) found no effect of problem drinking on sick leave in a female working sample. Roche
34 *et al.* (2008) found that risky alcohol consumption (compared to low-risk), increases both self-
35 reported alcohol-related absenteeism and overall illness/injury absenteeism. The prevalence of
36 absenteeism was higher with higher risk consumption as well as more frequent, risky
37 consumption. This is the only study that incorporates pattern as well as the level of
38 consumption. Norström (2006), in a time series analysis of aggregated alcohol consumption
39 on absence, found that a one litre increase in consumption is associated with a 13% increase
40 in absence among men. No significant effects were found among women. These results were
41 later repeated in a similar study in Norway (Norström and Synnøve Moan, 2009).
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6 Two recent studies have employed alcohol groups based on the level of consumption when
7
8 studying the effect on absenteeism. Based on average weekly levels, Vahtera *et al.* (2002)
9
10 found that, compared to light drinkers, there was an increased risk of absence for former
11
12 drinkers, heavy drinkers, and those who abstain from drinking. They concluded that the U-
13
14 shaped relationship could not be explained by confounding psychosocial factors or the
15
16 “former drinker error” (i.e., including former drinkers in the abstainer group). A Danish study
17
18 investigated the effect of health behaviours on long-term sickness (Christensen *et al.* 2007).
19
20 Two analyses were conducted wherein the alcohol variable was first divided into heavy versus
21
22 non-heavy drinkers, and second into non-drinkers, moderate drinkers and heavy drinkers,
23
24 defined by weekly level. No association between alcohol and long-term absence was found. It
25
26 should be noted that although the authors controlled for former smoking in their regressions,
27
28 they did not control for former drinking.
29
30
31
32
33
34
35

36 This article analyses the effect of alcohol consumption on sickness absence. There are several
37
38 significant contributions of the study. First, focus is on the rarely studied long-term absence,
39
40 which is due to the fact that many of the detrimental health effects associated with alcohol are
41
42 chronic and have relatively long recovery processes. Also, long-term absence was shown in
43
44 the recent Swedish cost of alcohol study to amount to 73% of the total absence cost (Jarl *et*
45
46 *al.*, 2008). Second, the effect of drinking history is controlled for, as it is expected to play a
47
48 key role in long-term absenteeism, i.e. the long-term effect of alcohol consumption. Third, a
49
50 sample selection model is used that correct for the effect of alcohol consumption on
51
52 employment probability. In the study we focus attention on woman’s absenteeism and the
53
54 results for men are only reported briefly. The reasons for this are discussed below.
55
56
57
58
59
60

1
2
3 The study indicates that long-term, light alcohol consumption has a protective effect on the
4 probability of long-term absence, while abstention and heavy drinking have a detrimental
5 effect. However, the detrimental effect is highest for women who have changed their
6 consumption to and from abstention. Hence, controlling for drinking history (and thereby
7 avoiding the former drinking and former abstainer errors) is important. We also find that
8 controlling for the selection effect into employment is important and that a conventional
9 probit model generally understates the effects of alcohol. In a simple model simulating
10 changes in the prevalence of consumption, we find that although alcohol on average only
11 explains a small part of individual long-term absence, the total societal effect is considerable.
12 The results for men are generally insignificant. Next, we address methods and data, followed
13 by the results of the regressions and the simulation model in subsequent sections. The results
14 will then be discussed and some concluding remarks will be shared.
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

35 **II. Estimation Method**

36
37 To model the effects of alcohol on absenteeism, we use the micro-economic data set described
38 in Section 3 below. The basic idea of the analysis is that alcohol, by causing increased
39 prevalence of certain diseases and injuries (Dave and Kaestner, 2002; Jarl *et al.*, 2009),
40 increases the prevalence of absenteeism. It is expected that the level of consumption is more
41 closely related to absence in the long run, while the pattern (e.g. binge drinking) is more
42 closely related to absence in the short run (Roche *et al.*, 2008). The short-term effects of
43 alcohol (e.g. hangovers) are also thought to increase work absenteeism.
44
45
46
47
48
49
50
51
52
53
54
55

56 *Methodological considerations*

57
58 There are three key methodological issues that need to be considered in the modelling. First,
59 there are individuals that, for different reasons, are not employed. Earlier research has
60

1
2
3 demonstrated that male abstainers have a reduced probability of employment, which is almost
4 entirely due to abstainers being diagnosed as alcohol dependant (Johansson *et al.*, 2006).

5
6
7 Problem drinking has also been found to reduce the probability of employment (Mullahy and
8 Sindelar, 1993; 1996; MacDonald and Shields, 2004), while other studies have found no such
9 relationship (e.g. Feng *et al.*, 2001). In a Russian sample, Tekin (2002) concludes that when
10 controlling for unobserved heterogeneity, alcohol has no effect on employment for men and a
11 small positive effect for women. Although previous studies have produced vastly different
12 results, one hypothesis is that individual health status is a determinant in the employment
13 equation, and that alcohol affects health status. This implies that we might face a selection
14 effect, in other words, absenteeism might not be observed for those with sufficiently
15 detrimental drinking. This is dealt with below by using a Heckman model, where the selection
16 equation is the employment function, a method not previously employed in the alcohol-
17 absence literature.
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33

34
35
36 The second methodological issue is that alcohol affects health over both the short and long
37 term; in other words, drinking history may be as important as current level of alcohol
38 consumption. In addition, changes in alcohol consumption over time may be considered a
39 proxy for (alcohol) problems. Earlier studies have shown that former drinkers who are now
40 abstainers are, in many aspects, different from long-term abstainers (Fillmore *et al.*, 1998).
41 This is also true for other consumption groups such as former abstainers that are now light
42 drinkers and long-term light drinkers (Jarl and Gerdtham, 2010). Failure to control for past
43 consumption may result in biased estimates (Sharper *et al.*, 1988; Jarl and Gerdtham, 2010). It
44 is interesting to note that, with the exception of one study that controls for the former drinker
45 error (Vahtera *et al.*, 2002), no prior studies consider the possibility of bias due to individuals
46 with the same current consumption level faces different outcomes based on their consumption
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 history. We address this by constructing alcohol variables that control for drinking history and
4
5 any possible change (see Section 3 below).
6
7
8
9

10 Third, there is an alternate theory for explaining the relationship between alcohol and
11
12 absenteeism: that absenteeism increases alcohol consumption through, for example, self-
13
14 medication or reduced social control when spending time at home (e.g., Aira *et al.*, 2008; Suh
15
16 *et al.*, 2008). The relationship between alcohol and absenteeism is difficult to disentangle and
17
18 normally is only association estimated. The alcohol variables in this study, constituting both
19
20 current and past consumption, can be interpreted as the change in consumption. As this
21
22 change has taken place in between the waves, the causality is stronger than in most prior
23
24 studies. However, it can be debated if the time between the change and the observation is long
25
26 enough to control for reversed causality.
27
28
29
30
31
32
33

34 We model the effect of alcohol on the likelihood of an episode of absenteeism using a probit
35
36 equation:
37

$$38 \quad y_{1i} = \mathbf{r}_i\beta_1 + \mathbf{x}_i\beta_2 + u \quad (1)$$

39
40 where y_1 is equal to 1 if absent from work for i^{th} individual, 0 otherwise, \mathbf{r} is a set of alcohol
41
42 variables that incorporates both current and past consumption, \mathbf{x} is a set of control variables
43
44 including health and u is the error term. Our main hypothesis is that $\beta_1 > 0$. If this holds, then
45
46 productivity losses may be avoided if current and past alcohol consumption could be reduced.
47
48
49
50
51
52

53 However, information on absenteeism is limited to a sample of the working population. Thus,
54
55 absence is observed contingent on the likelihood of employment, which may be modelled as:
56

$$57 \quad y_{2i} = \mathbf{r}_i\gamma_1 + \mathbf{z}_i\gamma_2 + v \quad (2)$$

1
2
3 where y_2 is equal to 1 if employed for i^{th} individual, 0 otherwise, \mathbf{z} is a set of control variables,
4
5 and v is the error term. It may be expected that $\gamma_1 < 0$. If there is a non-zero correlation between
6
7 u (1) and v (2), $E[u|v] = \rho v$, the absenteeism model may be specified as:

$$10 \quad y_{1i} = \mathbf{r}_i\beta_1 + \mathbf{x}_i\beta_2 + \rho v \quad (3)$$

11
12 Failure to allowance for non-random sampling when estimating (3) results in biased
13
14 estimations. In this case, \mathbf{z} in equation (2) must be a superset of \mathbf{x} in equation (1) (Baum,
15
16 2006; Wooldridge, 2003). We estimate β , γ and ρ jointly using a full maximum-likelihood
17
18 procedure (Baum, 2006). For this we use Stata software and the `heckprob` command (Stata
19
20 Corp., 2005). We employ robust cluster estimation and to facilitate interpretation, and
21
22 calculate average marginal effects using the Stata `margeff` command (Bartus, 2005, version
23
24 2.1.8). The possibility of unobserved heterogeneity in the absenteeism model is dealt with by
25
26 including the health lag.
27
28
29
30
31
32
33

34 The estimated model is used to predict the probability of individuals experiencing long-term
35
36 absenteeism, conditioned on them being both employed and non-employed, but had they been
37
38 employed. We multiplied the predicted probability with the average number of long-term sick
39
40 days for those who had at least one long-term spell of absence, which gives the expected
41
42 number of long-term absence days per individual. By simulating a change in the prevalence of
43
44 alcohol consumption and re-predicting the probability of absenteeism, we can calculate the
45
46 difference in number of expected long-term sick days. These prevalence changes can be seen
47
48 as effective interventions. Four such hypothetical interventions/prevalence changes will be
49
50 simulated:
51
52
53

- 54 • To *stop* alcohol consumption among heavy drinkers and thereby turn them into former
55
56 drinkers (short-term simulation);
57
58
59
60

- To *reduce* alcohol consumption among heavy drinkers and thereby turn them into current light but formerly heavy drinkers (short-term simulation);
- To *prevent* heavy drinkers from becoming heavy drinkers, and thereby turn them into light drinkers (long-term simulation);
- To *prevent* any individual from ending up in any of the drinking group save the group that is most beneficial based on the results of the model above (long-term simulation).

These simulations indicate the attributable fraction of alcohol on long-term absence, and indicate the maximum productivity gains in value terms from the assumed interventions under different scenarios.

Instruments

Variables included in \mathbf{x} and \mathbf{z} above are variables that are normally controlled for in estimates of labour market outcomes (see below). In order to identify the Heckman model in practical applications, we need \mathbf{z} to be a superset of \mathbf{x} ; in other words, \mathbf{z} should include the determinants of \mathbf{x} but also some determinants specific to \mathbf{z} , commonly termed instruments.

Unemployment rates affect the probability of being in paid employment. However, it has also been shown that it also affects sickness absence rates. Although some studies have shown this also for Sweden (Knutsson and Goine, 1998; Berggren *et al.*, 2002), the effect is uncertain. A common suggested explanation of the relationship between unemployment and absence rates is that reduced perceived job security that follows from economic slow downs with high unemployment reduces shirking and/or increases presenteeism (working while sick). It has indeed been shown that perceived job security affects sickness absence in Sweden, although this mostly affects short-term absence. Interestingly, there is only a weak effect on long-term absence (measured as longer than 7 days) (Khan and Rehnberg, 2009). Likewise has Olsson

1
2
3 (2007) shown that a change in the Swedish labour legislation in 2001 that reduced the job
4 security of employees affected short-term much stronger than long-term absence. This is also
5
6 connected to the issue of moral hazard which is expected to be more related to short-term than
7
8 long-term absence as a medical certificate is required after the first 7 days. Considering that
9
10 long-term absence in the current study is measured as longer than 28 days, we argue that the
11
12 effect of perceived job security is negligible. Another Swedish study investigated the effect of
13
14 unemployment rates and occupation as predictors for long term sickness absence defined as
15
16 longer than 29 days (Knutsson and Goine, 1998). They found, when controlling for
17
18 occupation, no effect of unemployment rates for women and an inversed relationship for men.
19
20 Interesting to note is that without controlling for occupation, their results showed a positive
21
22 relationship between unemployment rate and long-term sickness absence for both men and
23
24 women. A suggested explanation for the gender differences in results is that a greater
25
26 proportion of women compared to men are employed by public employers that are less
27
28 sensitive to business cycles (Knutsson and Goine, 1998). Information from comparable,
29
30 neighbouring countries is conflicting. A study in Norway on one hand showed that increased
31
32 job insecurity due to increased unemployment reduced long term sickness absence, measured
33
34 as longer than 15 days (Askildsen *et al.*, 2005). On the other hand did a Finish study of the
35
36 effect of alcohol consumption on sickness absence show a positive effect of regional
37
38 unemployment on sickness absence, i.e. increased sickness absence in regions with high
39
40 unemployment (Johansson *et al.*, 2009). Johansson and Palme (2002), studying policy
41
42 changes in Sweden 1990-91 that coincided with rising unemployment levels found that it was
43
44 the increased cost of being on sick leave following policy changes that pulled the absence
45
46 rates down rather than the increasing unemployment rates. The conclusion for the current
47
48 study based on prior research is that unemployment rates mainly affects short-term absence
49
50 and potentially mostly men's sickness absence. Given that the current study investigates long-
51
52
53
54
55
56
57
58
59
60

1
2
3 term absence among women (although the results for men also are presented), unemployment
4
5 rate appears to be an appropriate instrument.
6
7
8
9

10 From a legislative perspective, the Swedish labour legislation (LAS 1982:80) strongly
11
12 protects the employee from unreasonable discharge. Disease, sickness absence or parental
13
14 leave are not reasonable grounds for dismissal. Even in the extreme cases where the disease
15
16 makes it impossible for the employee to perform his/her work tasks in the long run, it falls on
17
18 the employer to, if possible, find other assignments for the employee. The union to which the
19
20 employee belongs has the same rights to be informed and to act instead of the employee to
21
22 contest dismissals. All this can also be taken as an additional argument that the employee
23
24 should not fear discharge due to sickness absence, no matter in what business cycle phase the
25
26 country currently finds itself.
27
28
29
30
31
32
33

34 Two instruments connected to unemployment are tested in the current study, the yearly
35
36 national unemployment rate and the yearly municipality unemployment rate. The former
37
38 should capture the business-cycle effect beyond the pure time effect, thus affecting the
39
40 probability of employment. The latter is expected to also capture differences in employment
41
42 possibilities beyond the business-cycle effect, such as differences within the country at a
43
44 certain time point. We will also try to capture this with a third instrument - homogeneous
45
46 regions. Statistics Sweden divides the country based on municipalities into 7 regions with
47
48 respect to population basis (Statistics Sweden, 2003), see 3.2 below. The rationale behind this
49
50 instrument is that regions have different supply of potential employers and thus employment
51
52 possibilities and that this is correlated to the population density. That is, individuals living in
53
54 for example Stockholm has a much larger supply of employment possibilities than individuals
55
56
57
58
59
60

1
2
3 living in a rural municipal in Northern Sweden. This should thus affect the probability of
4 employment although not being connected to sickness absence.
5
6
7
8
9

10 The fourth instrument that will be employed is whether the individual has any small children.
11 Having a small child is considered to affect the probability of paid employment, especially
12 among women as they take larger responsibility for children compared to men. However, it is
13 not expected to affect the probability of sickness absence as absence due to care of a sick
14 child is registered specifically as “temporary parental benefit”. The temporary parental benefit
15 is generally higher than sick pay/benefit why possible moral hazard issues could be expected
16 to reduce sickness absence and increase absence due to a sick child. However, this should
17 mostly affect short-term absence. All four instruments will be tested individually and in
18 different combinations and their appropriateness will be discussed after the results have been
19 presented.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

37 **III. Data**

38 In terms of compensation, absence in Sweden is divided into two different periods. During the
39 first period, the employee receives sick pay from the employer. In the second period, the
40 employee receives sickness benefits from the Social Insurance Agency. Given this division of
41 responsibility, no national register data exists for sick pay, while data on sickness benefits is
42 of good quality. In this study, therefore, we define long-term absence as absenteeism long
43 enough to be covered by sickness benefits.
44
45
46
47
48
49
50
51
52
53
54
55

56 *Participants*

57 We apply the model to data from the Swedish Survey of Living Conditions (the ULF survey)
58 from Statistics Sweden, matched to register data from the Longitudinal Integration Database
59
60

1
2
3 for Health Insurance and Labour Market Studies (LISA). Since 1975, Statistics Sweden has
4 conducted annual systematic surveys of living conditions in the form of one-hour personal
5 interviews with randomly selected 16-84 year olds. In this study we used data from 1988/89,
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

for Health Insurance and Labour Market Studies (LISA). Since 1975, Statistics Sweden has conducted annual systematic surveys of living conditions in the form of one-hour personal interviews with randomly selected 16-84 year olds. In this study we used data from 1988/89, 1996/97 and 2004/05, three two-year waves focusing on health-related issues, where the first wave is only used to control for drinking history and lags. The LISA material includes individual-specific information from the Social Insurance Agency, such as sickness benefits. The matching of survey and register data allows us to study the effect of health-related behaviours on actual labour market outcomes.

The working sample constitutes of 6,109 individuals based upon 15,471 observations (3,253 individuals are followed over three waves and 2,853 individuals are followed over two waves). Of these, 2,449 are women with 6,144 observations (out of which 1,246 are followed over three waves and 1,203 over two waves). Due to the use of the lag when constructing the alcohol variable, we get 3,695 ($1,246*2+1,203$) observations available for the estimations. We lose 162 observations due to missing alcohol information, leaving a sample of 3,533 observations (2,294 women, out of which 1,239 are followed over three years). We correct for missing values in other variables by using Stata's `impute` command (StataCorp., 2007) (two missing values for the lag of health, 11 for education, 54 for ever having been obese, and 47 missing values for the lag of income).

Measures

An individual is considered employed if she works full- or part-time, runs a company or a farm, or works at least one hour per day in a family business/farm. As mentioned above, long-term absenteeism is defined as receiving sickness benefit from the Social Insurance Agency. However, the length of the employer responsibility period has differed over the years. In 1997

1
2
3 the period was 28 days, in 2004 it was 21 days, and in 1996 and 2005 it was 14 days
4
5 (Försäkringskassan, 2005); as a result, the register data differs over the years. We have
6
7 therefore defined long-term absence as absences longer than 28 days, which is the longest
8
9 employer responsibility period covered by the study. In order for an individual to be
10
11 categorized as having a long-term absence during a specific year, the individual must be
12
13 employed and receive sickness benefit for at least one sickness spell longer than 28 days
14
15 during that year.
16
17
18
19
20

21
22 We constructed alcohol variables that focus on changes in consumption from the survey data.
23
24 A question asking whether the respondent had consumed any kind of alcoholic beverage
25
26 within the previous 12 months was used. In addition, questions on the level of weekly
27
28 consumption were used to differentiate between low and heavy drinking, using the cut-off
29
30 points suggested in Rehm *et al.* (2004). Hazardous and harmful consumption were combined
31
32 into heavy consumption in order to avoid too few observations in each category. The panel
33
34 information allowed us to construct six consumption groups based on current and past
35
36 consumption. Long-term abstainers were defined as abstainers in two following waves: in
37
38 1988/89 and 1996/97, or 1996/97 and 2004/05. Former drinkers were defined as alcohol
39
40 consumers during the first of two following waves and abstainers in the second wave (e.g.
41
42 consumed in 1988/89 but not in 1996/97). All other consumption categories were defined in
43
44 the same manner (see Table 1, where the proportions of observations for each consumption
45
46 group also are shown). Measurement errors in the reporting of alcohol consumption are
47
48 normally expected for several reasons, such as recall bias and fear of stigmatisation. The
49
50 alcohol variable created in the current study is considered to reduce the negative effect of
51
52 measurement errors, as it measures considerable changes (or non-changes) in consumption.
53
54
55
56
57
58
59
60

1
2
3 Although the exact level is expected to be measured with a bias, the change from, for
4
5 example, consumption to abstention is considered to be more reliable.
6
7

8
9
10 << Table 1 >>
11

12
13
14
15 The income variable is the lag of disposable income. It is converted to US dollars using the
16
17 average monthly exchange rate for 2005 (SEK 7.47 for US \$1). The prices were adjusted
18
19 using the Swedish consumer price index (CPI) before conversion. Two variables were created
20
21 to capture if the individual has smoked or been obese in the current wave or the lag.
22
23
24

25
26
27 The instrument variable homogeneous regions divides Sweden into 7 regions based on
28
29 population. The three largest cities with surroundings are their own regions, one region is
30
31 municipalities with more than 90,000 inhabitants within 30 kilometres from the municipalities
32
33 centre. The fifth region is municipalities with 27-90,000 inhabitants within 30 kilometres
34
35 from the municipality centre and 300,000 inhabitants within 100 kilometres. The sixth region
36
37 is the same as the fifth but with less than 300,000 inhabitants. The last region used is for
38
39 municipalities with less than 27,000 inhabitants within 30 kilometres (Statistics Sweden,
40
41 2003).
42
43
44
45
46
47

48
49 Most of the observations in the sample are long-term light drinkers while about 5-7% are
50
51 found in each of the other alcohol consumption groups. A total of 84% of the sample is in
52
53 good health, and about 13% of those employed have had a spell of long-term absenteeism (see
54
55 Table 2).
56
57
58

59
60 << Table 2 >>

1
2
3
4
5
6 Being employed is most common among current light drinkers (both long-term and formerly
7
8 heavy drinkers), as seen in Table 3. The lowest employment rate is found among current
9
10 abstainers, and former drinkers have somewhat lower rates than long-term abstainers. Based
11
12 on these averages, we would expect negative associations on employment probability from
13
14 being an abstainer compared to light drinkers, as has been seen in some earlier research (e.g.,
15
16 Johansson *et al.*, 2006). In examining the rate of long-term absenteeism for different alcohol
17
18 consumption groups, we see that the lowest rates are found among long-term abstainers and
19
20 long-term light drinkers. Former drinkers and former abstainers show the highest proportion
21
22 of absenteeism. We would therefore expect that the latter two consumption groups show a
23
24 positive association with absenteeism, compared to long-term light drinking, while no
25
26 association is expected for long-term abstention.
27
28
29
30
31
32
33

34 << Table 3 >>
35
36
37
38
39

40 **IV. Estimation Results**

41
42 This section reports the results of the estimations of probability of employment and long-term
43
44 absenteeism. We demonstrate the results of the conventional probit estimations first, followed
45
46 by the sample selection model. Estimates are considered significant at the 5% level.
47
48
49
50

51 *Estimating the model without taking selection into account*

52
53 The female probit model for having at least one spell of long-term absence shows few
54
55 significant estimates (see Table 4). Only former drinkers and former abstainers are significant
56
57 of the alcohol consumption groups, increasing their probability of long-term absenteeism.
58
59
60

Neither long-term abstention nor heavy drinking affects absenteeism, compared to long-term

1
2
3 light drinking. The lag of health demonstrates that being in poor health is not significant,
4
5 while being in between good and poor health increases the probability of long-term
6
7 absenteeism. Higher education indicates some protective effect and having ever been obese
8
9 shows detrimental effects.
10
11

12 13 14 15 *Estimating the selection into employment*

16
17 Estimating the probability of being employed using a probit model results in a number of
18
19 significant variables. All consumption groups are related to a decrease in employment
20
21 probability for women—with the exception of the insignificant group of current light but
22
23 formerly heavy drinkers—compared to long-term light drinkers (see Table 4). Wald tests
24
25 show no differences between the different significant alcohol consumption groups. Other
26
27 variables are as expected: age has an inversed U-shape, the lag of not being in good health
28
29 reduces employment probability, and more education increases employment probability. Both
30
31 the lag of unemployment and the national unemployment rate have negative effects with
32
33 current employment probability, although the effect of the former is much stronger. The
34
35 variable for ever having been obese has a negative relationship with employment probability.
36
37
38
39
40
41
42

43 << Table 4 >>
44
45
46
47

48 *Estimating the Heckman selection model*

49
50 Empirical testing has indicated that there are several combinations of instruments that appear
51
52 to work well. Here we will present the result using national unemployment rate and the
53
54 presences of a small child although other working combinations affect the estimates only
55
56 marginally. The results changes dramatically when applying the sample selection model of
57
58 long-term absenteeism where the selection equation is the employment probability model
59
60

1
2
3 outlined above. The effect for former abstainers and former drinkers becomes stronger both
4 economically and statistically. Long-term abstainers and long-term heavy drinkers both
5 become significant at the 1% level and show positive relationship with absenteeism. The other
6 variables also show more significance: age has a U-shaped relationship while women with a
7 lag of poor health or in between good and poor health increases absenteeism probability
8 compared to good health. More education reduces absence compared to no or only primary-
9 level education, although the negative effect of theoretical secondary school² is somewhat
10 stronger than higher education. Having experienced unemployment in the former wave
11 increases absence, which also ever having smoked or been obese does.
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

27 The average marginal effects of the selection model for women are shown in Table 5; this is
28 the average of the marginal effects calculated for each individual in the sample. Of all the
29 alcohol consumption groups, being a former drinker increases the probability of long-term
30 absence the most (18%) compared to long-term light drinkers, followed by former abstainers
31 (15%). Long-term abstainers and long-term heavy drinkers have about the same probability of
32 absenteeism (10%) given employment. The variables for ever having smoked and been obese
33 increases the probability of long-term absenteeism of around 4 and 9% respectively.
34
35
36
37
38
39
40
41
42
43
44
45

46 << Table 5 >>
47
48
49

50 There are few observations in many of the alcohol consumption groups for men who have at
51 least one spell of long-term absence,³ resulting in estimations that are sensitive to the data and
52 estimation methods. The alcohol consumption groups show no relationship to long-term
53
54
55
56
57
58

59 ² Theoretical secondary school is in preparation for university studies as opposed to practical secondary school
60 that is more focused on professional education.

³ The reason for this is unknown. One hypothesis is that men's life situation affects their alcohol consumption to a smaller extent than women's, and vice versa.

absenteeism, neither in probit nor sample selection models which could be due to the instruments being more appropriate for women. The lag of health and whether the individual ever smoked or was obese are significant in the selection model, with expected signs. Compared to long-term light drinkers, former drinkers, former abstainers and current light but formerly heavy drinkers are less likely to be employed. Age, the lag of health, smoking and the two variables for unemployment are also significant in the employment equation, with expected signs.

V. Simulation of productivity gains in terms of reduced sickness absenteeism

Given the estimations for women in the former section, it is interesting to predict and simulate the effect of assumed consumption changes on long-term absenteeism. The average probability of having at least one spell of long-term absence given employment is 0.135. The average predicted probability of one spell of long-term sickness for the non-employed subsample, had they been working, is 0.256. Table 6a and 6b outline the predictions following assumed population interventions (consumption changes). All average changes in expected long-term sick days between the original sample and after the assumed intervention are rather small—generally less than one day. However, considering the large population groups, the net societal effect is considerable, ranging between an increase in long-term sickness of 3'957 productive working years to a decrease of 7'000 years annually. The last row in Table 6 shows the potential productivity change in monetary terms, using the Human Capital Approach. This gives a range from a productivity loss of 798 million SEK to a gain of 1'412 million annually, for the employed population.

<< Table 6a + b >>

VI. Discussion

The focus of this article has been to analyse the effect of alcohol consumption on sickness absence. The results of the employment probability estimation indicate quite strong relationship between alcohol and employment. Compared to long-term light consumption, all other groups (except current light but formerly heavy consumption) have a negative effect on employment. There is no significant difference between long-term abstainers and former drinkers. Therefore, individuals who have regular, light alcohol consumption seem to have an advantage on the labour market when it comes to the probability of being employed. It is quite surprising that the negative effects on employment from the other alcohol consumption groups are about the same magnitude with variation in point estimates between 11% and 16% (average marginal effect). All other variables have expected signs, although it should be noted that the variable for ever having smoked is not significant.

The probit model for long-term absenteeism reveal some remarkable results as, for example, only former drinkers and former abstainers have a positive relationship with absenteeism and age is insignificant. These results are in line with what would be expected following results observed by Jarl and Gerdtham (2010) and Filmore *et al.* (1998)—that both former drinkers and former abstainers appear to be at a greater disadvantage than long-term abstainers and long-term light drinkers. The effect of health and education are along the lines of the Feng *et al.* (2001) study.

The results of the effect of alcohol on long-term absenteeism change drastically when we control for selection into employment. When doing so, all consumption groups except current light but formerly heavy drinkers show a significant positive effect on long-term absenteeism compared to long-term light drinkers. There is, however, no statistical difference between the

1
2
3 effects when using Wald tests. Being a former abstainer, which is commonly defined in
4 studies as a light drinker, increases the risk of long-term absenteeism by close to 15%. Had
5
6 we failed to separate this group from long-term light drinkers in this study (i.e., conducting
7
8 the “former abstainer error”), the protective effect of long-term light drinkers would have
9
10 been smaller. Thus, the increased risk of other alcohol consumption groups would also have
11
12 been smaller, underestimating the negative outcome of non-regular non-light consumption.
13
14
15
16
17

18
19
20 It is also interesting to note that the increased risk of long-term absenteeism is larger for
21
22 former drinkers (18%) than for long-term abstainers (11%). Failure to separate these two
23
24 groups is known as the “former drinker error” and would result in an estimate of a 14% (not
25
26 shown) probability reduction. That is, underestimating the risk from being a former drinker
27
28 and overestimating the risk of being a long-term abstainer, in comparison to being a long-term
29
30 light drinker.
31
32
33

34
35
36 As such, the result from the selection model indicates that long-term light alcohol
37
38 consumption reduces the probability of long-term absenteeism. Given employment, being a
39
40 long-term abstainer or heavy drinker increases the risk of absenteeism by around 10%.
41
42 Having changed consumption behaviour to or from abstention shows the highest increases in
43
44 risk of long-term absenteeism.
45
46
47
48
49

50
51 Empirical testing, as mentioned above, showed different working combinations of
52
53 instruments. Which of these combinations is used only affect the results marginally. The
54
55 presented results are the estimations with yearly national unemployment rate and having a
56
57 small child as instruments. The unemployment rate is a predictor of selection but insignificant
58
59 in the absenteeism equation while having a small child does approach significance. The latter
60

1
2
3 is however included due to its theoretical validity although unemployment rate works on its
4
5 own. Unemployment on a municipality level could be used instead of on a national level
6
7 (significant at the 10% level), although it requires controlling for both having a small child
8
9 and population homogeneous regions.
10
11

12
13
14
15 The most important instrument in these regressions is thus unemployment, either on a national
16
17 or municipal level. It has been shown in prior research that business-cycle and unemployment
18
19 rates are connected to absence rates, i.e. when unemployment increases absence rates
20
21 decreases (Berggren *et al.*, 2002; Askildsen *et al.*, 2005). This is normally explained by
22
23 insecurity regarding possible dismissal. The empirical testing done within the current study
24
25 showed that unemployment rate is not connected to probability of long term absence for
26
27 women in Sweden, when controlling for selection effects into employment. One reason for
28
29 this might be the strong legal protection towards unreasonable dismissal (which dismissal due
30
31 to sick leave is considered to be) and the strong positions of the unions. However, this result
32
33 was not unexpected based on prior studies showing that the effect of unemployment on
34
35 sickness absence mainly targets short-term absence (Khan and Rehnberg, 2009). In addition,
36
37 women's long-term absence has been shown in a Swedish study not to be affected by
38
39 unemployment rates (Knutsson and Goine, 1998). With regard to the results of prior studies, it
40
41 might not be odd that the results for men turned out as they did in the current study. It is likely
42
43 that the employed instruments are most appropriate for Swedish women and that other
44
45 instruments are needed in order to study the effect of alcohol consumption on long-term
46
47 absence for Swedish men.
48
49
50
51
52
53
54
55
56

57 As we have discussed above, applying a sample selection model instead of a probit changes
58
59 the results with stronger and more significant associations in the sample selection model. We
60

1
2
3 interpret this as that the probit model underestimates the probabilities of absenteeism due to
4 the fact that non-employed who are sick are not absent. For example, the lag of being in poor
5 health is not significant in the probit model, but strongly significant in the sample selection
6 model. That is, individuals with a lag of poor health are more likely to be non-employed and
7 thus do not experience absenteeism. When we control for this fact, the lag of poor health
8 becomes important for explaining long-term absenteeism. This is further supported by the
9 significant ρ which indicates that ignoring the selection effect would result in biased and
10 inconsistent estimation of long-term absenteeism (Baum, 2006). The fact that the ρ is negative
11 indicates that employment and long-term absenteeism is negatively related (Henneberger and
12 Sousa-Poza, 1998).
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28

29 It is interesting to assess the results of this study in relation to the alcohol-wage literature that
30 commonly finds a positive effect of alcohol on wages/earnings. For example, Peters (2004)
31 and van Ours (2004) find a general wage premium from drinking while Lee (2003) and
32 Barrett (2002) find a wage premium from moderate drinking, although none of these studies
33 control for any of the former consumption errors discussed above. We would assume that
34 increased absenteeism affects wages negatively, both directly as sickness benefits are lower
35 than wages, and indirectly through reduced human capital accumulation. Increased long-term
36 absenteeism is probably not enough to explain the reduction in wages/earnings as short-term
37 absenteeism should also influence this. It is also possible (a suggested hypothesis in prior
38 research) that current abstainers miss out on work-related social activities, and are thus
39 “punished” for this by being discriminated against or by being overlooked for promotion
40 opportunities. However, given the results of the current study, increasing the probability of
41 long-term absenteeism in the 10-18% interval for non-long-term light drinkers, we expect
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 absenteeism to play a significant roll in the reduction in pay among abstainers and heavy
4
5
6 drinkers, compared to light/moderate drinkers.
7
8
9

10 The predicted probabilities of at least one long-term sickness spell among the individuals in
11
12 the sample are higher among the non-employed compared to the full sample. That is,
13
14 individuals who are not employed are more likely to experience long-term absenteeism had
15
16 they been working, compared to employed individuals. The simulation model of the effect of
17
18 changes in the prevalence of alcohol on the number of days of long-term absence show rather
19
20 substantial effects from a population perspective. We start out by turning all heavy drinkers
21
22 into former drinkers, as this is the logical step based on the modelling of alcohol consumption,
23
24 which increases the number of expected absence days per year. If we instead assume an
25
26 intervention that turns heavy drinkers into light drinkers—thereby making them current light
27
28 but formerly heavy drinkers—no effect is evident for the estimation conditioned on being
29
30 employed. For those not employed, had they been working, the intervention would have
31
32 reduced the average number of expected long-term absence days by one-half day. However, it
33
34 could be argued that the original groups of former drinkers and current light but formerly
35
36 heavy drinkers are different from heavy drinkers. The total number of sick days would then be
37
38 overestimated by applying the β -coefficient from former drinkers (clfhhd) on long-term heavy
39
40 drinkers. A more pragmatic approach might be to assume an intervention that prevented the
41
42 development of heavy drinkers and thus making them long-term light drinkers instead, which
43
44 is done in column 4 of Table 6. The change per individual is rather small for those that are
45
46 employed, although for the non-employed, had they been working, the reduction in the
47
48 average absence is 0.7 days per year. Finally, an intervention that puts the whole population
49
50 into the most beneficial consumption group (long-term light drinkers) would reduce expected
51
52 sick days over a year by 0.7 days and 3.0 days, respectively (column 5 of Table 6). The
53
54
55
56
57
58
59
60

1
2
3 remaining expected absence days of 12.6 (for those employed) and 22.3 (for the non-
4
5 employed had they been working) can be considered to be due to factors other than alcohol,
6
7 such as other health-related behaviours, health status, income or bad luck. In other words, the
8
9 effect of alcohol on long-term absenteeism is rather small compared to the combined effect of
10
11 all other factors. However, if the entire female population were long-term light consumers,
12
13 expected days lost per year due to long-term sickness would be reduced by 1.4 and 0.5 million
14
15 days for employed and non-employed respectively. This is a substantial societal effect that
16
17 translates into a productivity loss of SEK 1.4 and 0.5 billion in 2005 (US\$189 and \$67
18
19 million), using the Human Capital Approach. It should also be noted that the alcohol effect is
20
21 much larger for the non-employed than the employed, giving reason to assume that alcohol-
22
23 related problems are more common in this group and that there is a selection effect from
24
25 alcohol into (non-)employment. All estimates following the simulation are changes during a
26
27 one year period in order to be comparable with other estimates (e.g. Jarl *et al.*, 2008).
28
29 Obviously are the societal productivity gain much higher measured over a person's life-cycle,
30
31 and the gains are expected to differ at different periods of life.⁴
32
33
34
35
36
37
38
39
40

41 The discussion above assumes a causal effect between alcohol and being non-employed, and
42
43 it therefore seems intuitive that societal production could be increased by changes in the
44
45 prevalence of consumption. However, since the natural rate of unemployment is considered to
46
47 be larger than zero, the full hypothetical productivity gain among the non-employed, had they
48
49 been working, could not be realized in actual productivity. The important question is to what
50
51 extent individuals that would have been a part of the natural unemployment rate replace
52
53 individuals that leave employment due to alcohol. In any case, friction costs are expected to
54
55 occur due to the recruitment and training costs involved in replacing an employee
56
57
58
59
60

⁴ This could be estimated by taking into account age effects on the probability of absence and age-adjusted average number of days absent, plus income.

1
2
3 (Koopmanschap *et al.*, 1995). This is also the case for replacing employees due to long-term
4
5 absenteeism.
6
7
8
9

10 There are some limitations to this study. Although we have a rather large data set, the coding
11 of the alcohol variable to account for prior consumption reduces the sample size considerably.
12 Defining long-term absence as longer than 28 days reduces the variation for each
13 consumption group, which might be reflected in some insignificant estimates. Future studies
14 should investigate the effects of alcohol on short-term absenteeism, something we did not do
15 in the current study, although that would require other instruments. Due to data limitations,
16 we were unable to account for patterns of consumption. This is unfortunate, as it has been
17 shown that the pattern of consumption—especially so-called binge drinking—affects
18 outcomes (Rehm *et al.*, 2004). Future studies should endeavour to include consumption
19 patterns.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

37 **VII. Conclusions**

38 This study again demonstrates the importance of avoiding the “former drinker error” and the
39 “former abstainer error” as defined in Jarl and Gerdtham (2010). Divergence from the most
40 prevalent group of long-term light consumers increases the risk of long-term absenteeism
41 among women in Sweden when we control for the selection into employment. Controlling for
42 sample selection, and thus the non-independence of the error terms in the two equations, are
43 important. It is shown that the probability of long-term absenteeism is higher among non-
44 employed, had they been working, compared to employed. A normal probit model cannot be
45 considered as consistently estimated and generally understates the effects of alcohol on long-
46 term absenteeism. The models for predicting expected long-term sick days per individual
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 show that although the effect of alcohol is rather marginal on an average individual basis, it
4
5 has a large effect on society.
6
7
8
9

10 The commonly seen result of the protective effect of regular light consumption and the
11
12 detrimental effect of abstention and heavy drinking is repeated in the current study, despite
13
14 efforts to account for drinking history and selection effects. These results are along the lines
15
16 of earlier studies such as Vahtera *et al.* (2002) and, regarding current abstainers, as reported in
17
18 Hensing and Wahlström (2004). Applying a larger sample in future research should be
19
20 prioritized in order to statistically differentiate the detrimental effects between consumption
21
22 groups as well as to incorporate patterns of consumption in the estimations.
23
24
25
26
27
28

29 **Conflict of interest**

30
31 The authors declare that they have no competing interests.
32
33
34
35

36 **Acknowledgement**

37
38 Financial support from the Swedish Council for Working Life and Social Research (dnr 2006-
39
40 1660) is gratefully acknowledged.
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

References

- Aira, M., Hartikainen, S. & Sulkava, R. 2008 "Drinking alcohol for medicinal purposes by people aged over 75: A community-based interview study" *Family practice*, 25: 445-449
- Andréasson, S. 1998 "Alcohol and J-shaped curves, *Alcoholism: Clinical and experimental research*, 22: 359s-364s
- Askildsen, J. E., Bratberg, E. & Nilsen, Ø. A. (2005) "Unemployment, labor force composition and sickness absence: a panel data study" *Health Economics* 14: 1087-1101.
- Barmby, T., Ercolani, M. & Treble, J. (2004) "Sickness absence in the UK 1984-2002" *Swedish Economic Policy Review*, 11: 65-88
- Barrett, G. F. (2002) "The effect of alcohol consumption on earnings" *Economic Record*, 78: 79-96
- Bartus, T. 2005 "Estimation of marginal effects using margeff" *Stata journal* 5: 309-329
- Baum, C. F. (2006) *An introduction to modern econometrics using Stata*, Stata Press, College Station, TX, USA
- Berggren, S., Cohen Birman, M., Nyberg, K., Palmer, E., Skogman Thoursie, P. & Söderberg, J. (2002) *Swedish sickness absenteeism in a European perspective* [Svensk sjukfrånvaro i ett europeiskt perspektiv] The National Insurance Board Report 2002:11, Stockholm.
- Christensen, K. B., Lund, T., Labriola, M., Bültmann, U. & Villadsen, E. 2007 "The impact of health behaviour on long-term sickness absence: Results from DWECs/DREAM" *Industrial health*, 45: 348-351
- Cunradi, C. B., Greiner, B. A., Ragland, D. R. & Fisher, J. 2005 "Alcohol, stress-related factors, and short-term absenteeism among urban transit operators" *Journal of urban health*, 82: 43-57
- Dave, D., & Kaestner, R. (2002) "Alcohol taxes and labor market outcomes" *Journal of Health Economics*, 21: 357-371
- Feng, W., Zhou, W., Butler, J. S., Booth, B. M. & French, M. T. (2001) "The impact of problem drinking on employment" *Health Economics*, 10: 509-521
- Fillmore, K. M., Golding, J. M., Graves, K. L., Knip, S., Leino, E. V., Romelsjö, A., Shoemaker, C., Ager, C. R., Allebeck, P., & Ferrer, H. P. (1998) "Alcohol consumption and mortality. I. Characteristics of drinking groups" *Addiction*, 93: 183-203
- Försäkringskassan [The Social Insurance Agency] 2005 "Sjukfrånvaron in Sverige i ett Europeiskt perspektiv 1983-2004" Redovisar 2005:6 (<http://forsakringskassan.se/filer/publikationer/pdf/red0506.pdf>)
- Henneberger, F. & Sousa-Poza, A. (1998) "Estimating wage functions and wage discrimination using data from the 1995 Swiss labour force survey: a double-selectivity approach" *International Journal of Manpower*, 19: 486-506
- Hensing, G. and Wahlström, R. (2004) "Chapter 7: Sickness absence and psychiatric disorders" *Scandinavian Journal of Public Health*, 32: 152-180
- HSE 2004 "Managing sickness absence in the public sector" Health and Safety Executive (<http://www.hse.gov.uk/gse/sickness.pdf>)
- 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.
- 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* 7:17.

- 1
2
3 Jarl, J. & Gerdtham, U-G. (2010) "Wage penalty of abstinence and wage premium of
4 drinking: A misclassification bias due to pooling of drinking groups?" *Addiction*
5 *Research and Theory*, early publication online (<http://informahealthcare.com/art>).
6
7 Johansson, E., Alho, H., Kiiskinen, U. & Poikolainen, K. (2006) "Abstaining from alcohol
8 and labour market underperformance: Have we forgotten the 'dry' alcoholics?" *Alcohol*
9 *& Alcoholism*, 41: 574-579
10
11 Johansson, E., Böckerman, P. & Uutela, A. (2009) "Alcohol consumption and sickness
12 absence: Evidence from micro data" *European Journal of Public Health*, 19: 19-22
13
14 Johansson, P. & Palme, M. (2002) "Assessing the effect of public policy on worker
15 absenteeism" *Journal of Human Resources* 37:382-409.
16
17 Johansson, P. & Palme, M. (2005) "Moral hazard and sickness insurance" *Journal of Public*
18 *Economics*, 89: 1879-1890
19
20 Khan, J. & Rehnberg, C. (2009) "Perceived job security and sickness absence: a study on
21 moral hazard" *European Journal of Health Economics* 10: 421-428.
22
23 Knutsson, A. & Goine, H. (1998) "Occupation and unemployment rates as predictors of long
24 term sickness absence in two Swedish counties" *Social Science and Medicine* 47: 25-31.
25
26 Koopmanschap, M. A., Rutten, F. F. H., van Ineveld, B. M. & van Roijen, L. (1995) "The
27 friction cost method for measuring indirect costs of disease" *Journal of Health*
28 *Economics*, 14: 171-89
29
30 Lee, Y. L. (2003) "Wage effects of drinking in Australia" *Australian Economic Review*, 36:
31 265-282
32
33 MacDonald, Z. & Shields, M. A. (2004) "Does problem drinking affect employment?
34 Evidence from England" *Health Economics*, 13: 139-155
35
36 McFarlin, S. K. & Fals-Stewart, W. (2002) "Workplace absenteeism and alcohol use: A
37 sequential analysis" *Psychology of Addictive Behaviors*, 16: 17-21
38
39 Mullahy, J. & Sindelar, J. L. (1993) "Alcoholism, work, and income" *Journal of Labor*
40 *Economics*, 11: 494-520
41
42 Mullahy, J. & Sindelar, J. (1996) "Employment, unemployment, and problem drinking"
43 *Journal of Health Economics*, 15: 409-434
44
45 Nordström, T. 2006 "Per capita alcohol consumption and sickness absence" *Addiction*, 101:
46 1421-1427
47
48 Norström, T. & Synnøve Moan, I. (2009) "Per capita alcohol consumption and sickness
49 absence in Norway" *European Journal of Public Health*, advance access 090415
50
51 OECD, 2008 *OECD employment outlook 2008 – statistical annex* OECD,
52 (<http://www.oecd.org/dataoecd/54/57/40846335.pdf>)
53
54 Olsson, M. (2007) "Ökar anställningsskyddet sjukfrånvaron?" [Does employment protection
55 increase sickness absence?] *Ekonomisk Debatt* 2: 31-41.
56
57 van Ours, J. C. (2004) "A pint a day raises a man's pay; but smoking blows that gain away"
58 *Journal of Health Economics*, 23: 863-886
59
60 Peters, B. L. (2004) "Is there a wage bonus from drinking? Unobserved heterogeneity
examined" *Applied Economics*, 36: 2299-2315
Rehm, J., Room, R., Monteiro, M., Gmel, G., Graham, K., Rehn, N., Sempos, C.T., Frick, U.,
& Jernigan, D. (2004) Alcohol use. In: Ezzati, M., Lopez, A.D., Rodgers, A., & Murray
C.J.L., eds. *Comparative Quantification of Health Risks: Global and Regional Burden
of Disease Attributable to Selected Major Risk Factors. Volume 1*. Geneva: World
Health Organization, pp 959-1108
Roche, A. M., Pidd, K., Berry, J. G. & Harrison, J. E. 2008 "Workers' drinking patterns: the
impact on absenteeism in the Australian work-place" *Addiction*, 103: 738-748
Shaper, A. G., Wannamethee, G., & Walker, M. (1988) "Alcohol and mortality in British
men: explaining the U-shaped curve" *Lancet*, 2: 1267-1273

- 1
2
3 StataCorp. (2005) *Stata Statistical Software: Release 9*. College Station, TX, USA
4 StataCorp. (2007) *Data management* Stata Press, College Station, TX, USA
5
6 Statistics Sweden, 2003 *Regionala indelningar i Sverige den 1 januari 2003, del 1* [Regional
7 clasifications in Sweden the 1st of January 2003, part 1] Statistics Sweden, Stockholm
8 (<http://www.scb.se/Statistik/OV/OV9999/2003M00/X200P0301.pdf>)
9
10 Suh, J. J., Ruffins, S., Robins, C. E., Albanese, M. J. & Khantzian, E. J. 2008 “Self-
11 medication hypothesis: connecting affective experience and drug choice”
12 *Psychoanalytic psychology*, 25: 518-532
13
14 Tekin, E. (2002) “Employment, wages, and alcohol consumption in Russia” *Southern*
15 *Economic Journal*, 71: 397-417
16
17 Tómasson, K., Gunnarsdóttir, H. K., Rafnsdóttir, G. L. & Helgadóttir, B. (2004) “Correlates
18 of probable alcohol abuse among women working in nursing homes” *Scandinavian*
19 *Journal of Public Health*, 32: 47-52
20
21 Tüchsen, F., Christensen, K. B. & Lund, T. (2008) “Shift work and sickness absence”
22 *Occupational Medicine*, 58: 302-304
23
24 Vahtera, J., Poikolainen, K., Kivimäki, M., Ala-Mursula, L. & Pentti, J. 2002 “Alcohol intake
25 and sickness absence: a curvilinear relation” *American journal of epidemiology*, 156:
26 969-976
27
28 Vasse, R. M., Nijhuis, F. J. N. & Kok, G. (1998) “Associations between work stress, alcohol
29 consumption and sickness absence” *Addiction*, 93: 231-241
30
31 Wooldridge, J. M. (2003) *Introductory Econometrics* 2nd ed. Mason, Ohio, USA, South-
32 Western
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1. Alcohol consumption categories and the proportion of individuals in the employment (absenteeism) estimation

Current \ Lag	Abstain	Low	Heavy
Abstain	Long-term abstainer 6 (5)%	Former drinker 5 (4)%	N/A
Low	Former abstainer 6 (5)%	Long-term light drinker 71 (75)%	Current light but formerly heavy drinker 5 (5)%
Heavy	N/A	Long-term heavy drinker 7 (6)%	

For Peer Review

Table 2. Descriptive statistics, used sample

Variable	Definition/explanation	Obs	Mean
Employed	=1 if employed	3533	0.742
Long-term absent	=1 if at least one long-term sickness spell	2621	0.128
Long-term abstainer	Long-term abstainer	3533	0.064
Former drinker	Former drinker, current abstainer	3533	0.050
Former abstainer	Former abstainer, current drinker	3533	0.061
Long-term light drinker	Long-term light drinker	3533	0.706
Current light but formerly heavy drinker	Formerly heavy drinker, current light drinker	3533	0.047
Long-term heavy drinker	Long-term heavy drinker	3533	0.071
Age0	Age where 0=24 years of age	3533	20.232
Agesquare0	The square of age0	3533	1,517
Income lag	Disposable income in US\$ (lag)	3533	17,589
Good health lag	Self assessed health good (lag)	3533	0.843
In-between health lag	Self assessed health neither good nor poor (lag)	3533	0.131
Poor health lag	Self assessed health poor (lag)	3533	0.026
Education 1	No or primary school	3533	0.155
Education 2	Practical secondary school	3533	0.348
Education 3	Theoretical secondary school	3533	0.132
Education 4	Higher education	3533	0.365
Eversmoke	Current and/or former smoker	3533	0.317
Everobese	Current and/or former obese	3533	0.092
Unemployment lag	Individual unemployment (lag)	3533	0.068
Small child	Number of children younger than 7 years of age	3533	0.282
unemployment rate	National unemployment rate	3533	6.836

Table 3. Number of employed women and number with long-term absenteeism

	Employment		Long-term absence	
	No	Yes	No	Yes
Long-term abstainer	99	128	113	15
Percent	43.61	56.39	88.28	11.72
Former drinker	81	97	76	21
Percent	45.51	54.49	78.35	21.65
Former abstainer	81	135	110	25
Percent	37.5	62.5	81.48	18.52
Long-term light drinker	533	1,961	1,726	235
Percent	21.37	78.63	88.02	11.98
Current light but formerly heavy drinker	36	130	111	19
Percent	21.69	78.31	85.38	14.62
Long-term heavy drinker	82	170	149	21
Percent	32.54	67.46	87.65	12.35
Total	912	2,621	2,285	336
Percent	25.81	74.19	87.18	12.82

Table 4. Probability of long-term absence among women

	Probit	Heckprob
<i>Long-term sickness</i>		
Long-term abstainer	-0.121	0.279 ***
Former drinker	0.330 **	0.477 ***
Former abstainer	0.302 **	0.384 ***
Current light but formerly heavy drinker	0.125	0.080
Long-term heavy drinker	0.025	0.260 ***
Age0	-0.002	-0.178 ***
Agesquare0	0.000	0.002 ***
Income lag	4.16E-06	-2.50E-06
In-between health lag	0.470 ***	0.464 ***
Poor health lag	0.479 *	0.996 ***
Education 2	-0.098	-0.275 ***
Education 3	-0.308 **	-0.505 ***
Education 4	-0.230 **	-0.416 ***
Eversmoke	0.089	0.106 **
Everobese	0.256 **	0.249 ***
Unemployment lag	0.077	0.290 ***
Constant	-1.276 ***	0.194 *
<i>Employment</i>		
Long-term abstainer	-0.414 ***	-0.410 ***
Former drinker	-0.461 ***	-0.466 ***
Former abstainer	-0.334 ***	-0.335 ***
Current light but formerly heavy drinker	-0.086	-0.087
Long-term heavy drinker	-0.324 ***	-0.323 ***
Age0	0.240 ***	0.244 ***
Agesquare0	-0.003 ***	-0.003 ***
Income lag	6.31E-06 *	6.60E-06 *
In-between health lag	-0.332 ***	-0.341 ***
Poor health lag	-1.046 ***	-1.072 ***
Education 2	0.294 ***	0.302 ***
Education 3	0.463 ***	0.484 ***
Education 4	0.385 ***	0.374 ***
Eversmoke	-0.090	-0.096 *
Everobese	-0.191 **	-0.191 **
Unemployment lag	-0.402 ***	-0.420 ***
Small child	-0.001	-0.016
Unemployment rate	-0.055 ***	-0.050 ***
Constant	0.237	0.194
Rho		-0.990 ***

Significance is shown on 1(***), 5(**), and 10(*) per cent levels.

Table 5. Average marginal effects of the probability of long-term absence among women

	<i>Long-term sickness</i>
Long-term abstainer	0.105 **
Former drinker	0.181 ***
Former abstainer	0.145 ***
Current light but formerly heavy drinker	0.029
Long-term heavy drinker	0.098 ***
Age0	-0.059 ***
Agesquare0	0.001 ***
Income lag	-0.000
In-between health lag	0.169 ***
Poor health lag	0.360 ***
Education 2	-0.095 ***
Education 3	-0.178 ***
Education 4	-0.140 ***
Eversmoke	0.039 **
Everobese	0.091 ***
Unemployment lag	0.109 ***
	<i>Employment</i>
Long-term abstainer	-0.139 ***
Former drinker	-0.156 ***
Former abstainer	-0.110 ***
Current light but formerly heavy drinker	-0.027
Long-term heavy drinker	-0.107 ***
Age0	0.066 ***
Agesquare0	-0.001 ***
Income lag	0.000 *
In-between health lag	-0.103 ***
Poor health lag	-0.319 ***
Education 2	0.083 ***
Education 3	0.135 ***
Education 4	0.106 ***
Eversmoke	-0.028
Everobese	-0.059 **
Unemployment lag	-0.135 ***
Small child	0.000
Unemployment rate	-0.015 ***

Table 6a. Simulation of an intervention abolishing heavy drinking, among the employed

	Original sample	FD (lhd=>fd)	CLFHD (lhd=>clfhd)	LLD (lhd=>lld)	All light drinkers
Probability of long-term sickness spell	0.135	0.139	0.135	0.134	0.128
Average sick days	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
Diff (original vs. change)		0.39 (2.92%)	0 (0%)	-0.1 (-0.75%)	-0.69 (-5.17%)
Number employed*		2,038,000	2,038,000	2,038,000	2,038,000
Potential days saved**		-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.

** We use actual yearly working time in 2005 of 1,607 hours for Sweden (OECD, 2008).

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

Table 6b. Simulation of an intervention abolishing heavy drinking, among the unemployed

	Original sample	FD (lhd=>fd)	CLFHD (lhd=>clfhd)	LLD (lhd=>lld)	All light drinkers
Probability of long-term sickness spell	0.256	0.259	0.251	0.249	0.226
Average sickdays	98.87	98.87	98.87	98.87	98.87
Expected sickdays per individual	25.31	25.61	24.82	24.62	22.34
Diff (original vs change)		0.3 (1.19%)	-0.49 (-1.94%)	-0.69 (-2.73%)	-2.97 (-11.73%)
Number unemployed*		167,500	167,500	167,500	167,500
Potential days saved**		-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.

** We use actual yearly working time in 2005 of 1,607 hours for Sweden (OECD, 2008).

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