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WORK, SICKNESS, EARNINGS, AND EARLY EXITS FROM THE LABOR MARKET
AN EMPIRICAL ANALYSIS USING SWEDISH LONGITUDINAL DATA

Daniela Andrén

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Abstract

This thesis contains a general overview, and five papers on the work, earnings, sickness, and early exits from the labor market of individuals in Sweden.

Using relatively reliable data for hours worked and annual earnings, Paper 1 analyses the effects of (previous) sickness on both annual earnings and hourly wages, and find that people have lower annual earnings if they have experienced long-term sickness, and there is only a very week effect on the hourly wages. Since the effect cannot be attributed to an effect on the wage rate, it has to have resulted from a reduction in time spent working. An implication for the policy is that the work alternative should always be more attractive than the alternative of disability for people who can still work. It is desirable to have programs directed to improve the social and physical work environment, and individual performance.

Analyzing "voluntary" work absence (i.e., sickness spells of seven days or less, which do not require a medical certificate) for a period with three policy regimes (i.e., two reforms), Paper 2 found that the rules clearly influenced people's decisions about when to report the beginning and ending of sickness spells. Additionally, even though economic incentives mattered, people with poorer health did not "shorten" their absences to the same extent as those with better health.

Analyzing long-term (LT) labor absence due to sickness (i.e., spells of at least 60 days), Paper 3 found that both individual and labor market characteristics had significant effects on the length of absence. To slow down or reverse the increasing trend of LT sickness, special policies could be oriented to prevent deterioration of the health status of all employees before it is too late. In this context, the involvement of employers in payment of their employees' sick pay (during the first 2, or even 4, weeks of each spell) may be well motivated, not only as an instrument for "disciplining" employees' absenteeism, but also as an indicator telling employers something about the working conditions in their organizations.

In addition to Paper 3's analysis of the duration of LT spells regardless the exit state, Paper 4 analyzed exits from long-term sickness using both duration analysis and a

multiple choice framework. This analysis was suggested by the complexity of the exit decision, which implies, in a very simplified framework, at least two aspects of the exit process: an aspect that governs the duration of sickness spell, and another that governs the type of exit. The results suggests that a greater use of the working capacity of the individuals should be made, and more lost working capacity could to a greater extent be regained, using more efficient treatment and rehabilitation measures.

Analyzing the first exit from the labor market due to disability at a certain age, conditional on the fact that people have remained in the labor force until that age, Paper 5's conclusion is that the exit decision is an extreme alternative, and is not always the best alternative for the individual. On the other hand, even supposing that it is accepted that working some hours has a positive impact on individuals with health problems, it is difficult to match individuals with available jobs on the market. In such conditions, the process of integrating these people in the labor market becomes very complex, and it requires resources allocated on both sides: training and/or vocational rehabilitation of those individuals, and the improvement of the working conditions and rethinking the job tasks in general.

Keywords: annual earnings and hourly wages, short-term, and long-term absenteeism due to sickness, disability, exits from the labor market, multiple spells, unobserved heterogeneity, duration analysis.

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To Mihai, Mircea, and Lennart,
For the initial impulse, and continuous support;

To my dear parents,
Who loved me so much to let me leave;
To my dear Thomas,
Who loved me enough to make me stay;

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Which continuously supported and inspired my work;

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That *significantly* changed my research path;
To Ed for his very generous *insurance*
That always totally covered my loss of trust;

To all of you,
From all my heart,
A simple
TACK FÖR ALLT!

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Göteborg, March 8, 2001 (i.e., International Women's Day)

Daniela Andrén

AN OVERVIEW*

1 Introduction

This thesis contains five papers on the work, earnings, sickness, and exits with disability from the labor market of individuals in Sweden. Earnings, sickness spells and early exits are analyzed against individual income losses in a context of social insurance. The focus of all five papers is on understanding the effects of health and sickness on labor market behavior.

Social insurance in Sweden is compulsory and publicly administrated, and aims at providing financial security in case of sickness or handicap, as well as for families and children, and for the elderly, by reallocating funds over periods of time and between individuals in society. Every resident of Sweden is covered. Benefits are provided partly through replacement of lost of income and partly through allowances. The social insurance sectors (sickness insurance, work injury insurance, the national basic pension, survivor's pension, partial pension, and parental insurance) are financed wholly or in part by revenue from social security charges that are collected from employers and from the self-employed, as well as from general and special pension charges. The proportion of expenditure covered by these charges varies, and has changed over the years. Some social insurance benefits are financed wholly by central government funds, such as child allowance, housing allowance, and certain other allowances for families with children, as well as a number of benefits for the disabled (such as car allowance), and housing supplement for pensioners. Other benefits, such as attendance allowance, is today partly financed by the municipalities, whereas a number of smaller public insurance plans are financed by premiums and/or the yield from

* I would like to thank Ed Palmer and Lennart Hjalmarsson for their continuous guidance and support, for the time they spent on reading, rereading, commenting and discussing my papers. The usual disclaimer applies.

funds; among these are voluntary pensions, voluntary sickness insurance, voluntary occupational health insurance, small business insurance, and seaman's pensions.

Total transfers through the social insurance system correspond to a large percent of the gross national product (about 15-21% during 1980 through 2000), and policymakers are occasionally motivated (for example, by government deficits) to reduce them. Of course, total expenditure for any particular program, such as sickness and disability insurance, depends on the average expenditure level per recipient, how long they stay in the program, and the total number of recipients. Therefore, in attempting to limit sickness and disability expenditures, policymakers could choose to limit the average daily benefit or the duration of stay, or to restrict the flow of new recipients into the program. Unfortunately, the effects of policies to limit duration of stay are uncertain, because there is not very much known about what lies behind the duration of sickness and temporary disability spells. Therefore, using the LS (Long-term Sickness) database of the National Social Insurance Board of Sweden, which provides sickness durations of employees, from January 1, 1983 to December 31,1991, this thesis mainly analyzes sickness history in connection with individual and labor market characteristics, and reports estimates of the determinants of sickness durations and transitions from sickness to other states. Even though it is almost ten years old, this is the *first* time a lot of useful information in the database has been exploited.

In the first paper, health is treated as a component of human capital that employers value, and people take with them from job to job. Therefore, in estimating earnings- and wage-equations, the focus is on individual sickness history, including the number of spells of work absence due to sickness, the duration and the diagnosis. We can expect that earnings depend on health status, but also that the effect varies with age. Therefore, regardless of investment in health at earlier ages, as one gets close to retirement, the age-earnings profile is expected to turn downwards; and it is expected to decline much more for people who have invested less in their health and life style (nutrition, exercise, etc). A decline of annual earnings close to retirement age might be explained by fewer hours worked, by less overtime with a wage bonus (and thus a lower average wage), or by some combination of these. If poor health makes people less productive, we might also expect a negative effect on their actual hourly wage, and thus on their annual earnings for a given number of hours worked. If poor health reduces working capacity by decreasing hours worked, we should find a negative effect of previous sickness history on annual earnings. Thus, if there are short-term or long-term effects of past poor health on current earnings, they should take one of the following forms: 1) unchanged hourly wages but fewer hours worked, which requires analyzing annual earnings; 2) decreased hourly wages but unchanged hours worked, which requires analyzing hourly wages; 3) decreased hourly wages and fewer hours worked, which requires analyzing both annual earnings and hourly wages. Thus, in order to estimate the effect of sickness on earnings, the first paper analyses both hourly wages and annual earnings.

The second paper analyzes short term-absences from work (i.e., periods of seven days or less) reported due to sickness during a period with two different reforms (i.e., three regimes), using a utility-maximization framework with two restrictions (time and budget constraints). Although one could report sick without actually being sick, the paper assumes that ones actual current health status could, and probably would, affect the decision to be absent, and further, that current health status might be influenced by past health status. Past health status is reflected in previous sickness history, including absences of both under and over 60 days. It is expected that people might also be tired close to the weekend, and thus take a longer weekend, not necessarily related to sickness.

The third paper analyzes underlying causes for long-tem absence due to sickness (i.e., spells of at least 60 days of compensated absence). It is assumed that employees can return to work after their sickness spell, but not necessarily to their previous jobs. If medical evaluation shows that the employee has some limitation in doing their previous job, a change of job may be the optimal alternative, even if it requires the acquisition of new skills through a vocational rehabilitation program. On the other hand, if no other alternative is offered, the duration of the sickness spell might be even longer. If medical evaluation shows that they have not yet recuperated at least partially, but it is expected that they will do so in the future, then, if it is not possible to participate in a rehabilitation program, they may "choose" to be recorded long-term sick and continue to receive sickness benefit. Medical evaluation can also conclude with a recommendation for temporary or permanent exit from the labor market with either partial or full disability pension. If no hope for total or partial recovery exists, full permanent disability exit will be recommended. In order to control for the impact of unobserved group-level heterogeneity on sickness duration, the durations are modeled using "families" of spells (i.e., spells grouped by individual, by diagnosis, and by region).

The fourth paper continues from the previous one by analyzing how individuals end long-term sickness spells. Health status may affect the labor supply decision by changing the marginal rate of substitution between leisure and consumption. Persons with lengthy sickness spells, even if they recover completely, will have lost some job experience, and perhaps some relative productivity on the job. The seriousness of this problem will depend on the length of sickness and the requirements of the job. The sickness benefit is theoretically available for an unlimited period, so that, given the medical evaluation, the patient can choose the exit alternative that maximizes their utility. Given the requirement of a medical evaluation, the patient's final decision may not appear to be a choice. Following the medical evaluation, the doctor can suggest various alternatives, but the sick employee is the one who really decides. We know that there are people who prefer to work even though offered the alternative of leaving the labor market "with pay". Given the complexity of the exit decision, with both the medical evaluation and individual choice, two aspects of the exit processes: an aspect that governs the duration of a spell prior the decision to exit, and another that governs the type of exit.

The fifth and last paper analyses first exits from the labor market due to disability, which, as just discussed, are not completely an individual decision, as they are conditional on a medical evaluation, as well as on a work capacity evaluation by a social insurance officer. Financial and psychological dependence may negatively affect employees who become disabled, and, therefore, the decision to exit with a disability pension may be difficult to accept. The goal of this paper is to analyze the individual and labor market characteristics, determining the risk that an employee would exit from the labor market at a certain age, conditional on having remained in the labor market until that age.

2 The theoretical background related to health and sickness

What consumers demand when they purchase medical and/or health services are not these services *per se* but rather *better health*. Therefore, when consumers make a decision to buy such services, they want to invest in their *health capital*, that is they want to improve their health, or they feel a need to invest in order to maintain it a level that allows a “normal” existence (e.g., being able to meet all daily biological needs without help).

Mushkin (1962), Becker (1964), and Fuchs (1966) pointed out that health capital is one component of *human capital*. According to human capital theory [Becker (1964, 1967), Ben-Porath (1967), Mincer (1974)], increases in a person’s human capital raise their productivity both in the market sector of the economy (where they produce money earnings) and in the household sector (where they produce commodities that enter their utility function). To realize potential gains in productivity, individuals have an incentive to invest in formal schooling and on-the-job training. Becker (1967) and by Ben-Porath (1967) developed models that determine the optimal quantity of such investment at any age. If increases in health capital simply increased wage rates, these models can be used with health as an additional variable that contributes to the stock of human capital. Otherwise, a model (such Grossman’s model) that assumes health capital differing from other forms of human capital should be used. Grossman (1972a,b and 1999) argued that while a person’s stock of knowledge affects their market and nonmarket *productivity*, their stock of health instead determines the total amount of *time* they can spend producing in both sectors.

Medical and health services (e.g., vaccinations and regular visits to the doctor and dentists; information about healthy diets, and the negative effects of alcohol, tobacco, and other drugs; health insurance; etc.) are one of the many inputs into the production of health as an output. Other inputs include diet, exercise, cigarette smoking, and alcohol consumption. While some of these inputs are positive investments, consumption is different in that one should either not consume them at all, or should reduce consumption to "insignificant" quantities.

Another important variable, "expected length of life", should presumably affect peoples' investments in health, although it has not been studied much in previous research on human capital. An explicit condition determining length of life is absent in Grossman's (1972) model, even though he explained later [Grossman (1999)], that it was supposed to be an endogenous variable in the model. Ried (1996, 1998) reformulated the selection of the optimal stock of health and length of life as a discrete time optimal control problem, and concluded that sufficiently *small* perturbations of the exogenous factors would not alter the length of the individual's planning horizon (this of course is somewhat unsatisfactory, given that the model assumed the length of life as endogenous).

Early work [e.g., Grossman and Benham (1974), Luft (1975), Bartel and Taubman (1979)] focused on the relationship between labor force participation and health. The results suggested that poor health in period $t - 1$ reduced both labor supply and wages in period t, with larger effects if a *simultaneous* model, which recognized the endogenous nature of the health variable in $t - 1$, was estimated. There is also evidence [e.g., Auster et al. (1969), Taubman and Rosen (1982), Kemna (1987), Berger and Leight (1989)] that schooling has an important (positive) impact on health, but Grossman (1976) and Lee (1982) have shown that this impact is substantially reduced when health and wages are estimated simultaneously. Additionally, recognizing the interdependence between work-time, wages, and health, Haveman et al. (1994) developed a simultaneous model with an error term covariance structure with few restrictions, designed to capture all the relationships involved. The results are similar to those from previous studies (e.g., education and age impacts on health limitations), but there are also some new results (e.g., the impact of job characteristics on health status).

However, none of these studies shed light on employees' sickness spells, especially given the puzzling changes during the last three decades when, while age-adjusted mortality rates have fallen, self-reports of poor health and disability in some data have increased.[1] As suggested by Fenn (1981), conventional search models used in analyzing the behavior of unemployed people would become relevant for analyzing the behavior of sick people if their employment contract were terminated, either at their own initiative, or at that of their employer. Another framework, namely a dynamic stochastic model, was used by Gilleskie (1998), who analyzed the medical care consumption and absenteeism decision of employed individuals with acute illness. Policy simulations based on her theoretical model showed substantial responses to economic incentives. Generally, medical treatment and work absenteeism appeared to be substitutes during an illness episode. For acute infections and parasitic diseases, and acute respiratory conditions, absences were 50% more common than doctor visits. With a hypothetical policy that restricted access to physicians during the first three days of illness, the average number of both doctor visits and absences fell, while the duration of absences lengthened, suggesting that medical treatment and work absenteeism might be complements.

[1] See for example, Wolfe and Haveman (1990), Chirkos(1986), and Robinson (1988).

3 The Swedish social insurance system concerning employees' sickness and disability

Every resident in Sweden is registered with a social insurance office if they are age 16 or more. If their annual earned income is at least 24% of the base amount[2] (i.e., in 2000, around SEK 8,800) they are eligible for a *sickness allowance* if they cannot work because they are sick. The sickness allowance may be full, three-quarter, half or one-quarter, depending on the extent of absence from work. They can also get a special parental allowance if they cannot go to work because their children are sick. If they have to stop working (temporarily or permanently) due to reduced working capacity, they are eligible to receive a *disability pension*.

Since 1992, people who have been employed for at least a month or have worked during a period of 14 days are entitled to *sick pay* from their employer for the first 14 days of the sickness period.[3] After 14 days, the employer must notify the social insurance office, which then, if it determines that the employee is entitled to it, provides compensation (i.e., *sickness cash benefit*) from the 15th day onwards. Employees must also notify the social insurance office, on the first day of absence from work; even if they already have a medical certificate. For periods longer than a week, a medical certificate is required. A *new* certificate is required after 14 days. The social insurance office must also decide whether employees can return to their regular job after being sick, i.e., whether their working capacity is

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[2] Many social insurance payments are linked to the so-called *base amount*, which is an amount of Swedish crowns, fixed one year at a time. The amount is appreciated in line with price changes, measured by the Retail Price Index. The amount is also used when calculating the *upper limit* (7.5 times the base amount per year), which was SEK 274,500 for 2000. One US dollar was equal to approximately 10 Swedish crowns (SEK) in December 2000.

[3] Before January 1, 1992, *all* compensation for earnings lost during sickness was paid by the social insurance system, but since then, during the *first days* of a sickness period (called the sick pay period), employees receive *sick pay* directly from their employer. From 1992 to 1996, the sick pay period was 14 days, then through March 1998, it was 28 days, and since then it has once again been 14 days.

up to that required by their job. If their employer has no other (suitable) work to offer, and if excessively long rehabilitation would be required before the employee could return to work, then their capacity for work is assessed relative to the labor market as a whole.

Self-employed people are covered by a separable system: They pay a "premium" for their sickness insurance. They can choose between having 3 and 30 waiting days (which are not covered by any sickness allowance), with a lower premium if they have a longer waiting period. People who have no income or very low income can receive tax-free *voluntary sickness allowance* from the social insurance office.[4]

As opposed to today, during the entire study period (January 1986 through December 1991) there was no employer period. Social insurance covered earnings lost due to sickness either after a single "waiting day" (i.e., the day of calling in sick)[5] before December 1987, or from the first day, thereafter. The compensation replacement rate was 90% of qualifying income until March 1991, when only 65% was paid for the first three days, followed by 80% through the 90th day, and 90% thereafter. Table 1 presents the levels of sickness cash benefit and sick pay as percent of expected earnings for the study period, but even after this.

Only full and half benefits were provided until July 1, 1990, since which 25% and 75% have also been available. These *partial* sickness benefits are received in connection with rehabilitation for persons returning to work after a long period of sickness.

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[4] Normal sick pay and sickness benefit are taxable like regular income.

[5] The compulsory sickness insurance that was implemented in **1955** stipulated a *waiting period* of three days and a limit of two years replacement in long-term sickness. In **1967** the waiting period was reduced to the day of calling in sick, and the time limit for long-term sickness was abolished (except for old-age pensioners). In **1985** some administrative changes (for state employees) implied that also the day for calling in sick and weekends were in the records, counted as sickness absence days.

Table 1 The level of *sickness benefit* and *sick pay* (% of expected daily earnings), since January 1986

	Jan 1986-Nov. 1987	Dec 1987-Feb 1991	March 1991-Dec 1991	Jan 1992-March 1993		April -June 1993		July 1993-Dec 1995		Jan-Dec 1996		Jan-Dec 1997		Jan-Mars 1998		April 1998 -	
Day of sickness spell	SCB*	SCB + AGR	SCB + AGR	Sick-pay	SCB + AGR	Sick-pay	SCB + AGR	Sick-pay	SCB + AGR	Sick -pay	SCB + AGR	Sick -pay	SCB + AGR	Sick -pay	SCB + AGR	Sick -pay	SCB + AGR
1	0	90+ 10	65+ 10	75	65+10	0	0	0	0	0	0	0	0	0	0	0	0
2-3	90	90+ 10	65+ 10	75	65+ 10	75	65	75	65	75	75	75	75	80	80	80	80
4-14	90	90+ 10	80+ 10	90	80+ 10	90	80	75	80	75	75	75	75	80	80	80	80
15-28	90	90+ 10	80+ 10	-	80+ 10	-	80+ 10	-	80+ 10	-	75+ 10	75	75	80	80+ 10	-	80+ 10
29-90	90	90+ 10	90+ 10	-	90+ 10	-	80+ 10	-	80+ 10	-	75+ 10	-	75+ 10	-	80+ 10	-	80+ 10
91-365	90	90+ 10	90+ 10	-	90	-	80	-	80	-	75	-	75	-	80	-	80
366-	90	90+ 10	90+ 10	-	90	-	80	-	80	-	75	-	75	-	80	-	80

Source: National Social Insurance Board (1993, 1997 and 1998)
Note: SCB stands for sickness cash benefit, and AGR for the negotiated wage agreement.

During the study period, employees might withdraw partially or wholly from the labor force prior to the normal pension age of 65, with a so-called *partial pension* (65% of reduced earnings, available for employees and self-employed persons 61-64 years of age who wish to work only part-time), or with a *temporary or permanent disability pension* (which could be partial or total, and was available for persons 16-64 years of age). A less attractive alternative was an *actuarially reduced old-age pension*, possible from age 60. Early retirement from age 58 is also possible for privately employed blue-collar workers, and for some other workers from various ages, depending on their *occupation*. Hence, some healthy workers can leave the labor force prior to age 60.

Both the disabled (at any age from 16 to 64) and the retired (at the mandatory age of 65) were (and are) covered by a flat-rate basic pension as well as by the income-related *ATP* benefit.[6] Only citizens are eligible for the basic pension; for nationalized Swedes or Swedes who emigrate, the benefit is prorated at 1/40 per year of employment in Sweden. Both Swedes and foreign citizens are eligible for the earnings-related *ATP* benefit, but they must have had qualifying earnings higher than the base amount for at least three years during the ages 16 to 64. This pension is based on average qualifying earnings during a person's 15 best years. In the case of disability, future earnings are imputed by assuming that present earnings would have continued into the future. Recipients of the basic pension and/or a low *ATP* benefit (as well as others with low income) may be eligible for a *housing allowance*, which is a means- and rent-tested, price-indexed benefit.

For an average industrial worker, the combined basic pension and *ATP* benefits will replace about 60% of gross pre-retirement earnings. Most Swedish workers are also covered by one of four major *occupational group insurance* plans, which entitle them to an additional benefit of around 10%.

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[6] ATP (*allmän tilläggspension*) is the national supplementary pension scheme.

4 Terminology, models and methods for duration data[7]

In analyzing absences from work due to sickness, the characteristics of sickness absences should guide both the design of data collection and the way the data is analyzed and interpreted. If we are concerned with the patterns and determinants of the *occurrence* of absence due to sickness, then we should analyze the preceding time period or "waiting time" (i.e., *duration of nonoccurrence*) in order for the work absence to be recognized as an event. If we are concerned with the patterns and correlates of the *absences themselves*, then we should analyze the duration of the absences.

The analysis of duration data can use a broad range of techniques, including some models and methods used in this thesis, as well as a specific terminology (used many times in this thesis). This section will introduce this terminology and (some of) the models and methods used in this thesis.

The basic duration data concepts are states, spells, and events. A *state* is the condition of an individual at a given point in time, with respect to circumstances (e.g., working, sick, studying or vocational training, temporarily or permanently disabled, retired) or attributes (e.g., marital status, occupation, previous sickness history).

A *spell* (also referred as an *episode, waiting time*, or *duration*) is the length of time during which a unit of analysis (here, an employee) spends in a specific state. In order to define a spell, it is therefore necessary to define the *state*, the *time of entry* to this state, and the *time of exit*. An *event* is a transition from one

[7] Other concepts, tools and models (i.e., OLS regression, Heckman selection approach, Tobit and Multinomial Logit models, etc.) referred and used in the papers are either assumed as being known, or are shortly presented in the papers.

state to another.[8] Thus, in order to define an event it is necessary to identify at least two states. For example, the event of *exiting the labor force with a* (*temporary or permanent*) *disability pension* is the transition *from* either work or being sick-listed *to* disability. In some cases, like working and being sick, transitions can occur in either direction: One can study the event of becoming sick, or the event of returning to work.

Another concept specific for duration analysis is *censoring*, which means that we have incomplete information on the duration of some spells, either at the extremes of the observation period, or due to problems in collecting the data. The incompleteness of the spell can have to do with the date when the spell starts (left censoring), the date when the spell ends (right censoring), or both (interval censoring).

The central statistical concept involved in this type of analysis is *conditional probability*. For example, this could be the probability of an individual being sick on the 60th day (let's denote that A), given that he/she has been sick for 59 days (let's denote that B). Then the conditional probability that A will occur, given that B has occurred, is written $\Pr(A|B)$. A general formula for $\Pr(A|B)$ that is valid for all events A and B can be derived as follows. In order for A to occur (the individual will be sick on day x+1), it is necessary that the actual "spell of sickness" be in both A and B (i.e., in $A \cap B$, denoted AB), which means that B has occurred (say, an individual has been sick x days). Because B has already occurred, it constitutes a reduced sample space, and the probability that the event AB will occur is the probability of AB relative to B. Then, if $\Pr(B)>0$, the conditional probability $\Pr(A|B) = \Pr(AB)/\Pr(B)$. Because conditional probability is related to unconditional probability, the mathematical description of the process is

[8] The concept used here is different from that used in probability theory, where an *event* is a possible outcome of an experiment. For example, in analyzing exits from the labor market due to work accidents, both outcomes (exit and non-exit) are events in probability theory, whereas only the exit so considered here, because in the case of non-exit there was no change of state.

the same in either case. For any specification in terms of conditional probabilities, there is a mathematically equivalent specification in terms of unconditional probabilities. It is the conceptual difference that is taken into account in economic modeling of duration data.

Duration analysis requires a *time horizon*, and the focus of the analysis is related to the time when an event takes place. If we let D be the length of time until some specific event (i.e., exit from the labor market with disability pension), then D is a nonnegative random variable from a *homogenous* population, with a cumulative distribution function F and a probability density function f.[9] The *probability density* (or *probability mass*) function is the unconditional probability of the event occurring at time t. Three additional functions characterize the distribution of D, namely, the *survival* function, which is the probability of the event *not* occurring before time t; the *hazard rate* (or hazard function), which is the chance that an individual of age t experiences the event in the next instant; and the *mean residual life* at time t, which is the mean time to the event, given that the event has not occurred at time t. If we know any one of these functions, then the other three are uniquely determined.

The hazard rate[10] $h(t)$ is defined as

(1) $$h_D(t) = \frac{f_D(t)}{S_D(t)},$$

where $S(t)$ is the *survival function*, defined as:

(2) $$S_D(t) = \Pr(D \geq t) = 1 - \Pr(D < t) = 1 - F(t).$$

It is more usual, however, to deal with continuous distributions with

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[9] $F(t)$ is assumed to be differentiable and its derivative is the probability density function $f(t)$.

[10] Also called the intensity rate, failure rate, transition intensity, risk function, mortality rate, or transition rate. In economics, the hazard function is also known as the inverse of Mills' ratio.

probability density functions of the form:

(3) $$f_D(t) = -S_D^{'}(t)\,.$$

Particular forms of the distribution may be useful because they provide wider latitude for flexible empirical representation.

The hazard function can be expressed in terms of the cumulative distribution function $F(t)$ and the probability density function $f(t)$ as:

(4) $$h_D(t) = \frac{f(t)}{1 - F(t)}\,,$$

or, for continuous distributions, using the survival function

(5) $$h_D(t) = -\frac{S_D^{'}(t)}{S_D(t)}\,,$$

which can be rewritten as

(6) $$h_D(t) = -\frac{d \log S_D(t)}{dt}\,.$$

Changes in the hazard function over time give information about the duration dependence of an underlying stochastic process. If $\partial h(t)/\partial t > 0$, then the process exhibits positive duration dependence, which means that the chance of the event occurring increases over time. If $\partial h(t)/\partial t < 0$, then the process exhibits negative duration dependence, which means that the chance of the event occurring decreases over time.[11] Increasing hazard functions occur when there is natural aging, for example, while decreasing hazard functions are much less common, but occur occasionally, such as use when there is a high *early* likelihood of failure,

[11] The only restriction on $h(t)$ is that it be nonnegative.

which then declines, such as with certain types of organ transplants.

An important task in the analysis of duration data is the description of *survival curves*, which are graphical plots of survival functions, $S(t)$. They allow useful preliminary analysis, suggesting functional forms and revealing the degree of data homogeneity. Methods for estimating survival functions from a single sample of "survival" data are said to be *nonparametric* or distribution-free. *Nonparametric approaches* are useful in the absence of (relevant) theory to suggest the qualitative shape of the baseline hazard and/or the precise functional form. They yield estimates of survival functions (*Kaplan-Meier* and *life tables*) and hazard functions (life tables) without requiring a precise functional form, thus avoiding the possibility of choosing an incorrect form, and accompanying misspecification.

In many studies, there is need to compare two or more groups of duration data. If the groups are similar,[12] except for the "treatment" under study, then nonparametric methods may be used directly. More often than not, however, the subjects in the groups have some additional characteristics that may affect the outcome. For example, when analyzing exits from the labor market by type of exit, variables such as age, sex, marital status, medical diagnosis, education, sickness history and other potential risk factors, may all be used as covariates in explaining the response variables. After adjustment for these potential explanatory variables, the comparison of survival times between groups should be less biased and more precise than a simple comparison would be.

Another important problem is to predict the distribution of durations from a set of explanatory variables, which requires statistical strategies similar to those utilized in ordinary regression. We can estimate *parametric* regression models with censored survival data, known also as *accelerated failure time models*

[12] Two rank tests (the Log Rank test and the Wilcoxon test) and the Likelihood Ratio test might be used for testing the homogeneity of survival functions across various groups.

(AFT), such as

(7) $\log D_i = \beta_0 + \beta_1 X_{i1} + ... + \beta_k X_{k1} + \sigma\varepsilon_i$,

where ε_i is the random disturbance term, and $\beta_0, \beta_1, \ldots, \beta_k$ and σ are parameters to be estimated. These models are quite similar in form to an ordinary linear regression model, the basic differences being the parameter σ and the logarithmic form of the dependent variable. Another difference can be the assumption about the distribution of ε_i. In a linear regression model, it is typical to assume that ε_i has a normal distribution with mean and variance constant over *i*, and that ε_i are independent across observations. AFT models, however, also allow for other distributions (logistic, log-gamma, extreme value), and they are named for the distribution of *D* (e.g., log-normal, log-logistic, gamma, exponential, and Weibull) rather than for the distribution of ε or of log(*D*) The main reason for allowing for different distributions is the different implications for the hazard function, which might lead to different interpretations.

The relationship between survival times (durations) and the covariates is often modeled by the *proportional hazards regression model*, introduced by Cox (1972). Such a model does not require choosing some particular probability distribution to represent survival times, and therefore is called a *semiparametric* model. The conditional hazard rate at time *t* for an individual with covariate vector *x* is the product of a baseline hazard function (that depends only on *t*) and a risk factor that depends on *x*. The model can be represented as

(8) $h(t; x_i) = h_0(t)\exp(\beta x_i)$,

where $\beta = (\beta_1, \beta_2, \ldots, \beta_k)$ is a vector of *k* unknown parameters, and $h_0(t)$ is an unknown function of time. The expression $h_0(t)$, known as the *baseline hazard*, represents the hazard rate for an individual with all covariates equal to zero. The advantage of this approach is that it does not make any assumptions about the underlying distribution of completed spells (leaving $h_0(t)$ parametrically unspecified) and it also makes it relatively easy to incorporate time-dependent variables. If one assumes a parametric form for the baseline hazard function, one can base inferences on a local version of the likelihood function. Alternatively, the maximum local likelihood estimator can be obtained by estimating the baseline hazard function and the hazard regression function until convergence is obtained. But if one assumes a nonparametric baseline hazard, one can base inferences on a local version of the partial likelihood function, which yields the maximum local partial likelihood estimator.

Until now we devoted attention only to the exit (single risk) without referring at its type. The data can indicate various exit types; for example, various types of early withdrawal from the labor force. Then, the exit decision can be estimated within a duration framework using both *single risk* (analyzing the probability of exit regardless the type) and *competing risks* models (analyzing the probability of exit, by exit type). It could also be the case that we would not need to estimate models for all event types, and would therefore only estimate models for the exit type of interest, treating all other types of exit as censoring. "Competing risks" is a term used to describe duration models in which an individual spell may terminate via more than one outcome. Competing risks must be mutually exclusive and collectively exhaustive for the models to be transition specific.[13] The extension of the standard single risk model to two or more independent exit types, i.e., the independent competing risks model (Lancaster, 1990), implies that the log-likelihood can be split into the sum of its risk-specific hazards. In such a model, observations that exit differently (e.g., 1/2 or 2/3 disability pension) from the analyzed exit (i.e., full disability pension) are treated as censored.

Although it is a bit unusual, there is nothing to prevent choosing a different model for each type of exit, as for example, exponential for return to work, Weibull for both full and partial disability exits, and a proportional hazards model

[13] The risks must be completely different from one another so that, if there are two, either one or the other can happen, but not both at the same time.

for “other” exits.

Often it is not possible to control for all relevant risk factors in a hazard model. Suppose that, for two individuals with identical measured characteristics, we could measure the actual risk of exit, we might find that one individual has a higher exit risk than the other, due to *unmeasured* characteristics. Unmeasured (including unobserved or neglected) sources of variation are known collectively as *unobserved heterogeneity* or *frailty*. We can control for unobserved heterogeneity in hazard rate models in a number of ways, although current literature is undecided about the extent to which it is possible to control for individual-level heterogeneity. In controlling for unobserved heterogeneity that is common to clustered observations (e.g., within families, neighborhoods, communities, firms, etc.), random effects models provide a natural way to extent hazard models. The Expectation Maximization (EM) algorithm is one method for modeling unobserved heterogeneity for individuals, and can be used to break a complicated estimation procedure into a set of simpler estimation problems. Given the data, the algorithm finds a frailty estimate for each group. The frailty distribution parameter is estimated in one step, and is then used to estimate each group's frailty. The estimated frailty is substituted for the frailty term, and this process is repeated until the difference in successive estimates is negligible.

The terminology, the models and methods presented in this section are used in this thesis.

5 The data

The LS (Long-term Sickness) database of the National Social Insurance Board of Sweden, used in all papers of this thesis, was created to describe sickness history and early exits from the labor market, and to analyze the causes of sickness and early exits from the labor market due to disability, as well as the effects of the social insurance system, including rehabilitation activities, on individuals and society. The database focuses on the factors that seem to affect the length of work absences due to sickness, the decisions of long-term sick people to go back to work, exits from the labor market due to disability, etc. It includes *exact* dates when sickness spells began and ended, as well as the states before and after sickness (work, education, unemployment, temporary or permanent disability, etc.). It also contains information on individual characteristics (such as age, marital status, citizenship, etc.), plus sickness and rehabilitation history, and earnings, for the about 4500 individuals covered.

The database represents all residents of Sweden who were registered with the social insurance office during the observation period from January 1986, through December 1991, and who were born on the 25th day of the month sometime during 1926-1966. Sickness history actually starts from January 1983, and for those who exited into disability earlier (i.e., all dates of exits with disability pension were included). When the information varies with time, new information was recorded at the beginning of each sickness spell.

The LS database actually consists of two independent random samples:

- A national random sample of 2,000 people (called the **IP** or "insured population" sample) selected from entire population of Sweden recorded in the Swedish social insurance system during the period January 1, 1986 - December 31, 1989, and who were born on the 25th day of the month during the period 1926-1966.
- A national random sample of 3,000 people (called the **LSIP** or "long-term sick insured population" sample) selected from the long-term sick insured population. This sample, in addition to the previous selection criteria, requires people to have at least one sickness spell of at least 60 days during the period 1986-1989. Ongoing spells at the beginning and/or end of this period were also included in the sample.

The LSIP sample was thus selected from the same overall population as the IP sample, *but* limited to people (mostly employees) who had at least one "recent" long-term sickness spell. Because of the common selection criteria, 42 people fell into both samples, so the LS-database initially contained 4,958 individuals. This number decreased to 4,493 when people with a wrong address were excluded, as well as people who refused to participate in the present studies

The five papers in the thesis analyze either one of the samples or the two samples separately; but because the papers focus on different questions, there is no overlap of the data sets across papers. Tables 2-4 give an overview of the papers and the samples.

Table 2 Description of data sets, all papers

Paper	Sample	Selection	Characteristics	Dependent variable(s)	Covariates
1	IP	People not LT sick in 1988	1 observation per person	Annual earnings Hourly wage	Individual characteristics in 1988 Sickness history
2	IP and LSIP	Spells of maximum 7 days of sickness during 1986-1991	1-108 observations per person	Duration |censoring	Spell related characteristics
3	LSIP	Spells of minimum 60 days of sickness during 1986-1991	1-10 observations per person 1-610 observations per diagnosis-group* 1-774 observations per region-group	Duration |censoring	Spell related characteristics
4	LSIP	The first spell of LT-sickness during 1986-1991	1 observation per person	Duration |censoring Exit from sickness	Individual characteristics at the date of exit
5	IP and LSIP	No first exit into disability before 1983	1 observation per person	Age |censoring	Individual characteristics at the date of exit Sickness history

Note: *Diagnoses are grouped according to ICD9 (International classification of diseases 9th revision). Major categories and examples from LS-database are presented in Table A1 in the Appendix.

Table 3 IP sample

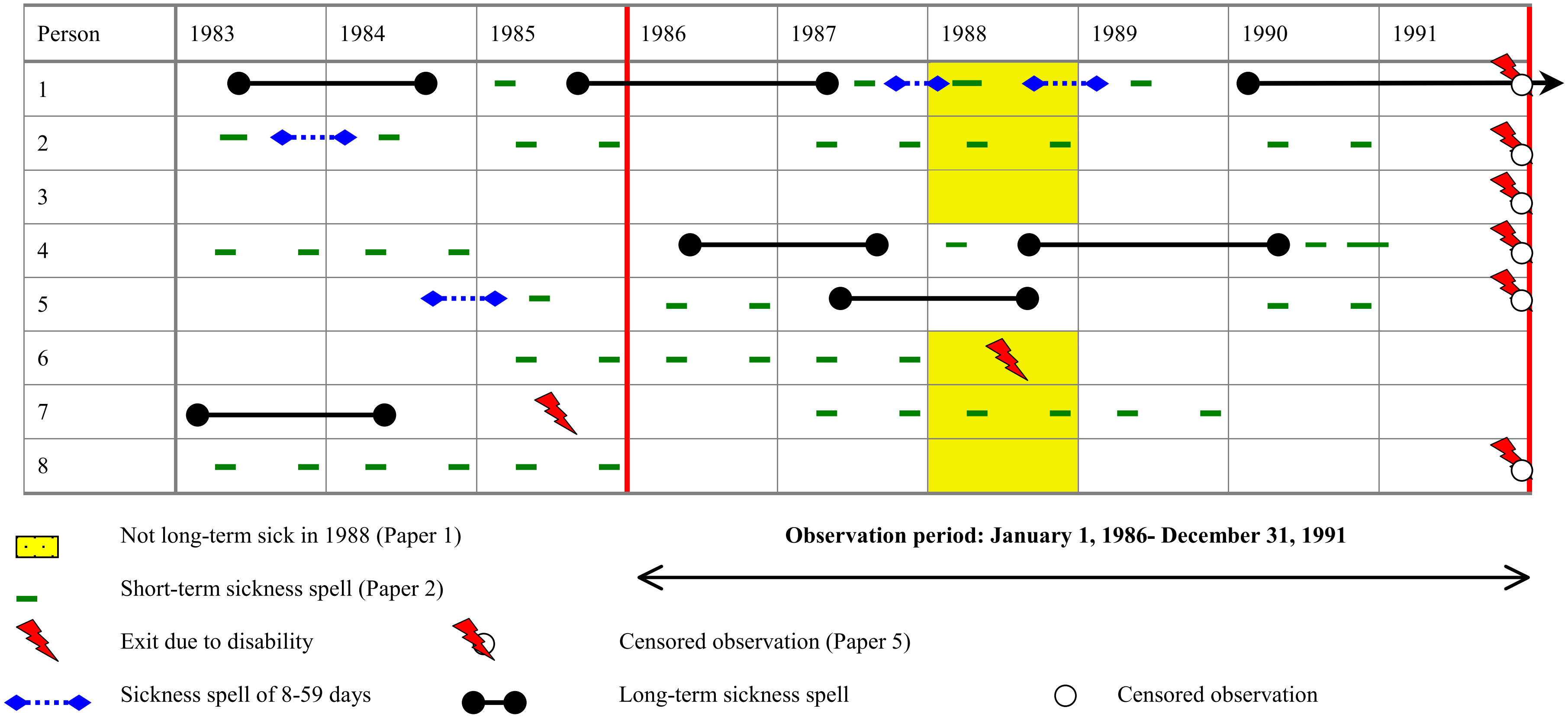
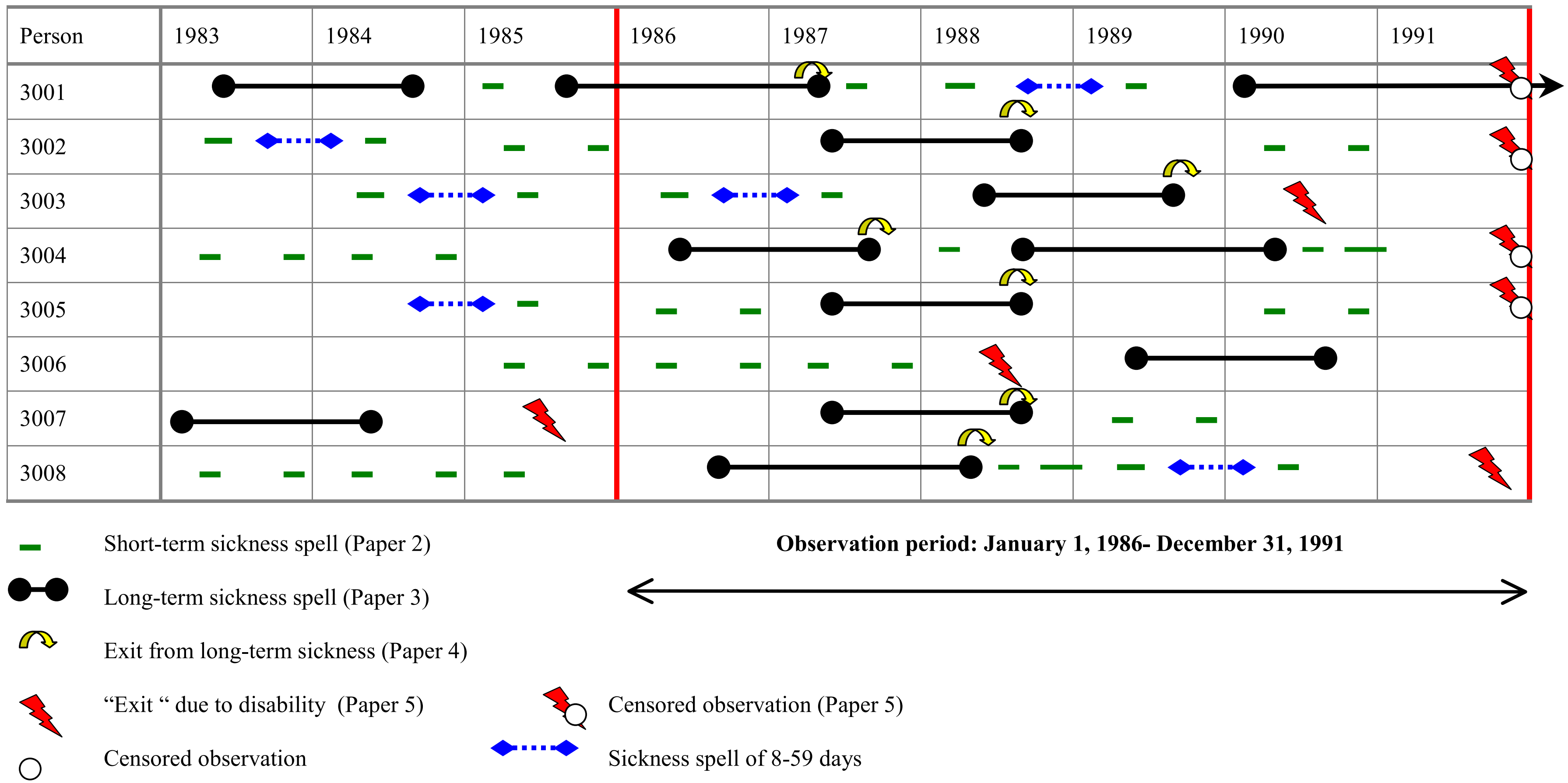


Table 4 LSIP sample



6 Results, discussion, and conclusions

This thesis analyzes the effects of sickness history on earnings, short-term and long-term absences, and exits from the labor market. All five papers in this thesis focus on understanding the effects of health and sickness on labor market behavior, using a Swedish longitudinal database that follows individuals over a relatively long period of time (from 1983 through 1991).

Using relatively reliable data for hours worked and annual earnings, Paper 1 confirms the usual effects of education and experience on both annual earnings and hourly wages. It also shows that it can be reasonable to model and estimate annual earnings directly, rather than the hourly wage and hours of work separately. Which approach fits better for analyzing some effects of sickness on earnings depends in general on the design and quality of the data. The results show that people have lower annual earnings if they have experienced long-term sickness, and there is only a very week effect on the hourly wages. The decrease in annual earnings for people after long-term sickness is due mainly to a reduction in the working time after their sickness spell.

Analyzing “voluntary” work absence (i.e., sickness spells of seven days or less, which do not require a medical certificate) for a period with three policy regimes (i.e., two reforms), Paper 2 found that demographic characteristics and “sickness history” affected the hazard of ending short-term sickness. Women’s “voluntary” absences were likely to be shorter than men’s, as were younger employees’ absences compared to older ones. It was also found that the 1991 reform (which lowered the replacement rate) had a stronger effect on the hazard of ending short-term absences than did the 1987 reform (which eliminated the previous unpaid “waiting day”, while restricting remuneration to only those days when people were scheduled to work). Additionally, after the 1987 reform, the closer the beginning of the absence was to the end of the week, the shorter it was. After the 1987 reform, fewer absences started on the weekend, and more on Monday, which might be explained by the elimination of the waiting day. On the other hand, most now ended on Friday, which can be explained by the restriction of coverage to only scheduled workdays. Thus the rules seem to have influenced people's decisions about *when* to report the beginning and ending of sickness spells. These results were not unexpected, given that we assume that employees maximize their utility functions. If (at least some) absences were *voluntary*, these results also suggest that (some) employees will choose absence instead of work as long as this increases their expected utility. If people think about their lost earnings due to sickness, they may be able to "plan" their absence, either closer to the end of the week, or immediately after the weekend, in order to have a longer recovery break. Finally, the results show that even though economic incentives mattered, people with *poorer* health did not "shorten" their absences in the same extent as those with *better* health.

Analyzing long-term labor absence due to sickness (i.e., spells of at least 60 days) during 1986-1991, Paper 3 found that both individual and labor market characteristics had significant effects on the *length* of absence. Women had a higher hazard to exit than did men, which might be, at least partially, explained by women's exits into disability more often (and easier) than men. The older people were, the lower was the hazard of exit from LT sickness. This suggests that policy initiatives to change work environment, work tasks, and vocational direction for younger persons may have long-term beneficial effects. The hazard of exit from LT sickness was lower for naturalized Swedes compared to Swedish natives. Many naturalized Swedes came to Sweden as labor migration during the 1960s and early 1970s, often to jobs requiring hard physical effort, and which were more likely to have difficult working environment. Many may also have worked many overtime hours as well, hoping to return home "wealthy".

Loss of earnings due to sickness considerably decreased the length of the spell. On the other hand, the pressure of high regional unemployment seemed to increase the length of spells (perhaps due to anxiety about the uncertain job situation). All these findings suggest the possibility of designing (perhaps complex) policies to reduce long-term sickness. To slow down or reverse the increasing trend of LT sickness, special policies could be oriented to prevent deterioration of the health status of *all* employees before it is too late. It might be important to pay more attention both to working conditions, and to hours of work. Being active in a "well-balanced" way has a positive impact on health, especially in the long run, in the sense that over using working capacity today might cause health problems in the future. Improving working conditions and designing the tasks of each job so as to prevent an *overuse* of individuals' working capacity might be higher priorities for employers. Thus, the involvement of employers in payment of their employees' sick pay (during the first 2, or even 4, weeks of each spell) may be well motivated, not only as an instrument for "disciplining" employees' absenteeism, but also as an indicator telling employers something about the working conditions in their organizations. Therefore, employers' contributions to social insurance should also be redesigned. Nonetheless, the *medical examination* is clearly a very important element in this whole process, and it should be very well done. Additionally, flexible programs connected to it, can help the individual's health and wealth, and society too.

In addition to Paper 3's analysis of the duration of long-term sickness spells regardless the exit state, when analyzing *exit types* from long-term sickness (using *duration analysis*), Paper 4 found that women generally had shorter spells of sickness than did men before returning to work or exiting into *full* disability. The gender effect was not significant by conventional criteria for exits into *partial* disability. Older employees had longer spells than did younger employees for all exit types except for partial disability, for which they had shorter spells. Except for "other exits", before which foreign-born people had shorter sickness spells than did people born in Sweden, citizenship dummies were not significant by the conventional criteria. For those who returned to work, people with medium and higher education had shorter spells than did those with less education. Except for exits into disability, a higher regional unemployment rate correlated with longer spells. It was also found (using a *multinomial logit model*) that the probability of not returning to work increased with age and by duration of the sickness spell, and decreased by year examined. The latter was perhaps the result of a steadily improving labor market during the period studied Foreign-born people were more likely than were people born in Sweden to exit into full disability or to have an "other exit", instead of returning to work. Compared to those with musculoskeletal diagnoses, it was more likely that people with mental diagnoses would exit into full disability instead of returning to work.

Putting together the results of Paper 4 with the previous findings and theoretical foundation, it seems that *a greater use of the working capacity* of the individuals should be made, and more lost working capacity could to a greater extent be regained, using more efficient treatment and rehabilitation measures.

Analyzing the first exit from the labor market due to disability at a certain age, conditional on the fact that people have remained in the labor force until that age, Paper 5 found that women who were long-term sick exited into disability much faster than did men. The hazard of early exit was lower for married people than for singles (including widowed and divorced), while naturalized Swedes and other foreign born were more likely to exit early than were Swedish born persons. Those who participated in a vocational rehabilitation program were three times more likely to exit with a partial disability pension (and about 1.3 times more likely to exit with a full disability pension), than those who did not participate, which could indicate that rehabilitation was in a way efficient (since many people remained in the labor market, at least partially). The fact that participation in rehabilitation had a positive effect on exits with a part-time disability benefit seems a satisfactory outcome, but the long run effect is not known. It might be that those people who participated in a rehabilitation program and exited with a full disability benefit have (or will have) better health and are (or will be) less dependent on the health care system (later on) than their colleagues who exited with a part-time benefit.

Reducing incidence and severity of disability in a population involves changes in the social and physical environment of work, including changed attitudes towards what is required of especially older workers and what individuals should require of themselves in society, as well as changes in individual performance (by improving physical capacity, learning new skills, being flexible enough to change tasks/jobs, etc.). Therefore, the health and educational systems should be developed in such a way as to facilitate the achievement of human and health capital that would allow individuals to reach their desired level of welfare. The development of strategies to reduce "disability dependence" thus requires a detailed understanding of the underlying systems for rehabilitation and financial support, including the structure of the support and service system, the routes by which one enters it, and those by which one can exit, as well as the characteristics of the worker who becomes disabled. Therefore, one obvious proposal is that more resources should be allocated towards preventing long-term sickness in general, and that programs oriented towards prevention and rehabilitation should be designed more specifically to the characteristics (and needs) of the sick employees, including with different alternatives for men and women. A greater use should be made of the working capacity of individuals, and more lost working capacity should be regained. Making the *return to work* alternative more attractive would both reduce the economic burden on society and improve the quality of life and self-esteem of many who otherwise might become permanently disabled.

Even supposing that it is accepted that working some hours has a positive impact on individuals with health problems, it is difficult to match such individuals to available jobs in the market. The process of integrating these people into the labor market is thus very complex, and requires resources allocated on both sides: training and/or vocational rehabilitation of those individuals, and improvement of working conditions and rethinking of job tasks in general. Even with these improvements, disability will always be a very complex phenomenon that requires dynamic and flexible policies aimed at improving well being of the individuals themselves, and of society in general.

Overall, considering the employees covered by the sickness insurance, who were studied in these five papers, there appears to be two broad groups: One group is generally younger, healthier, better educated, with higher earnings, and more likely to return to work even after a long-term sickness spell. The second group is generally older, less healthy, less educated, with lower earnings, and less likely to return to work after a long-term sickness spell. These two groups may need different policies. For the healthier group, social insurance programs could encourage (more) work at older ages, while for the less healthy group, the level of income support may need improvement.

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Table A1 Groups of diagnoses, based on ICD9;[14] some examples from LS-data

Major Categories o and some selected components	LS-data (%) All spells (n=49950)	 LT spells (n=5080)
Infectious and Parasitic Diseases		
o Viral and chlamydial infection in conditions classified elsewhere and of symptoms	0.08	0.59
o Other and unspecified infectious and parasitic diseases	0.18	0.18
Neoplasms		
o Malignant neoplasm of female breast	0.08	0.53
Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders		
o Diabetes mellitus	0.32	0.53
Diseases of the Blood and Blood-Forming Organs		
o Other and unspecified anemias	0.06	0.20
Mental Disorders		
o Neurotic disorders	2.61	9.49
o Adjustment reaction	0.23	0.51
o Depressive disorder, not elsewhere classified	0.58	2.11
Diseases of the Nervous System and Sense Organs		
o Migraine	1.41	0.14
o Nerve root and plexus disorders	0.17	0.94
o Mononeuritis of upper limb and mononeuritis multiplex	0.12	0.51
o Other disorders of eye	0.45	0.16
Diseases of the Circulatory System		
o Essential hypertension	0.38	1.10
o Angina pectoris	0.17	0.81
o Ill-defined descriptions & complications of heart disease	0.13	0.37
Diseases of the Respiratory System		
o Acute nasopharyngitis [*common cold*]	16.54	0.14
o Acute pharyngitis	2.44	0.06
o Acute upper respiratory infections…	1.80	0.37
o Chronic sinusitis	1.17	0.20
o Influenza	7.94	0.12
o Asthma	0.78	0.67
Diseases of the Digestive System		
o Gastritis and duodenitis	1.19	0.67
o Disorders of function of stomach	2.58	0.31
o Other disorders of stomach and duodenum	3.34	0.10
o Other noninfectious gastroenteritis and colitis	4.55	0.26
Diseases of the Genitourinary System		
o Other disorders of female genital organs	1.01	0.77

[14] International classification of diseases 9th revision, clinical modification ICD-9-CM, Washington, D.C. U.S. Public Health Service, Health Care Financing Administration, 1980.

Complications of Pregnancy, Childbirth, and the Puerperium		
o Other complications of pregnancy, not elsewhere classified	0.51	2.42
o Other current conditions in the mother classifiable elsewhere, but complicating pregnancy, childbirth, or the the puerperium	0.30	1.71
Diseases of the Skin and Subcutaneous Tissue		
o Contact dermatitis and other eczema	0.46	1.16
Congenital Anomalies		
Diseases of the Musculoskeletal System and Connective Tissue		
o Osteoarthrosis and allied disorders	0.32	2.17
o Other and unspecified disorders of joint	1.72	2.78
o Other disorders of cervical region	1.93	4.57
o Other and unspecified disorders of back	8.83	13.43
o Peripheral enthesopathies and allied syndromes	1.25	4.27
o Other disorders of soft tissues	3.53	7.42
Certain Conditions Originating in the Perinatal Period		
Symptoms, Signs, and Ill-Defined Conditions		
o General symptoms	4.00	1.16
o Symptoms involving head and neck	2.30	0.43
o Symptoms involving digestive system	1.97	0.39
o Other ill-defined and unknown causes of morbidity	2.29	2.09
Injury and Poisoning		
o Fracture of radius and ulna	0.15	0.87
o Fracture of ankle	0.12	0.94
o Sprains and strains of knee and leg	0.21	0.41
o Sprains and strains of ankle and foot	0.61	0.65
o Injury, other and unspecified	1.90	2.09
o Certain adverse effects not elsewhere classified	0.41	0.22

Paper I

THE EFFECT OF SICKNESS ON EARNINGS*

Daniela Andrén[α] and Edward Palmer[β]

Abstract

The question addressed in this paper is whether sickness history affects annual earnings and hourly wages in Sweden. If poor health makes people less productive, we expect to find a negative effect of previous health history on hourly wages. If, instead, poor health reduces people's working capacity, but not their productivity, this implies only a decrease in hours worked. Using a longitudinal database for individual sickness, we estimate both (annual) earnings and (hourly) wage equations, and find that people who are healthy in the current year, but have long-term sickness in the previous five years have lower earnings than persons without long-term sickness.

Key words: human capital model, age-earnings profiles, earnings, and wage equations, sickness spells, health variables.

JEL Classification: I10, I12, J24, J28.

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1 Introduction

The human capital approach was built on the analysis of costs and returns to investments in human capital through the computation of earnings differentials. The main results of the human capital model show that earnings depend on investments in individual education and training, but also that the effect on earnings of a given investment in human capital may decline with age. Training and experience will have a positive effect on earnings profiles, but as people approach the end of working life, profiles typically turn downwards. The shapes of an individual's earnings profile and wage profile are not necessarily the same. For example, a decline in annual earnings close to retirement age can be explained by either a decrease in hours worked, or by less overtime with a wage bonus, or by a combination of these. In this study we are interested in the effect of health on annual earnings.

If there are short-term or long-term effects of past poor health on current earnings, we expect that they would take one of the following forms: 1) unchanged hourly wages and fewer hours worked; 2) decreased hourly wages; 3) decreased hourly wages *and* fewer hours of work (per year). This is why, *in examining the effect of health on earnings*, one should analyze *both* annual earnings *and* hourly wages. By studying hourly wages and annual earnings, we can discern whether an effect on earnings is derivable from an effect on hourly wages, or if not, attributable to a change in hours worked. People with a poor previous health history may simply have to face wage discrimination, in spite of unchanged productivity, however this possible effect is not analyzed here.

In general, the investment-earnings relation is a reduced form of two simultaneous structural equations: a demand function relating individual investments to their marginal rates of return, and a supply function relating the obtainable funds for such investments to their marginal costs. *Investments in health* (including a nutritional diet, exercising, environmental quality, etc.) help improve or maintain productivity. If poor health makes people less productive, we expect to find a negative effect of their previous health history on their hourly wages. If poor health reduces working capacity, leading to a decrease in hours worked, we expect to find a negative effect of previous health history on annual earnings. We would expect that while the investments in health keep working capacity from deteriorating and enable people to maintain a normal level of hours worked (and better annual earnings), it would not necessarily increase their hourly wages. This is another reason why, *in examining the effect of health on earnings*, one should analyze *both* annual earnings *and* hourly wages.

In studies of annual earnings and hourly wages, the most common approach is *not* to control for health status. When health status has entered studies, two approaches have been taken. It is either formulated as a binary exogenous variable or it is used as a stratification criterion for obtaining samples of "healthy" and "unhealthy" men and women, black and whites, etc. In this study, we are able to specify health status using information about days of sickness during five previous years, the year when the first spell of long-term sickness was recorded, and the diagnosis. Using these variables, we analyze the annual earnings and hourly wages for a sample of insured people, and various subsamples as well.

Another aspect of "health status" is the *quality* of this variable, which depends on the source of the information (individual interviews and/or register information). We use variables for health status that do not rely on an individual's self-evaluation, which might give a biased measure of health. Our source of data (administrative registers) enables us to use reliable information on compensated days of sickness, sickness diagnosis, and also relatively reliable information on earnings during 1985-1990, and for hours worked, and hence hourly wages for 1988.

This paper adds health related variables to the human capital model in order to analyze the effects of previous poor health on actual hourly wages and annual earnings. In Section 2 we will review literature on human capital and labor supply, considering health. Section 3 outlines a model of earnings, wages, and health, which is followed, in Section 4, by data description, and earnings and wage profiles in Section 5. In Section 6 we present the econometric specification, with the empirical results in Section 7, and the conclusions in Section 8.

2 Previous studies

The "human capital" literature has expanded rapidly since its inception in the late 1950s. Research leading toward a theory of human capital was pioneered by Theodore Schultz,[15] whose work primarily concentrated on a number of strategic questions related to conditions for efficiency in the employment of production resources, attaching crucial importance to vocational skills, schooling, research, and its application. Schultz and his students showed that, for a long time, there was a considerably higher yield on "human capital" than on physical capital in the American economy, and that this tension resulted in a much faster expansion of educational investments than in other investments.

Mincer (1958) formulated the first schooling model. With their seminal papers, Mincer (1958, 1962) and Becker (1962) stimulated a large amount of research on human investment decision. There is little economic research on the effects of health investments, compared to education and training, however.

In earlier work, Becker (1962) mentioned medical care and vitamin consumption as ways of investing in human capital. Furthermore, he referred to investment in mental and physical health that can be made within the firm (medical examinations, luncheons, protection against accidents) and outside firms by individuals. In theory, a firm would be willing to compensate employees for individual costs leading to improve human capital if it could benefit from a resulting increase in productivity. Mushkin (1962) analyzed health as an investment. Her paper dealt with capital formation through health care and with returns to investment in health. Becker (1964) and Fuchs (1966) emphasized that health capital is one component of the stock of human capital, and Grossman (1972a, 1972b) constructed the first model of the demand for health capital itself. According to Grossman (1999), if increases in the stock of health simply increased wage rates, one could apply Becker and Ben-Porath's models to study the decision to invest in health. He argued that health capital differs from other forms of human capital. While the personal stock of knowledge affects both the market and the

[15] From "Human Capital and Modern Labor Economics: The Early Days", Gary Becker' s talk to the First EALE/SOLE World Conference, Milan 2000.

non-market productivity of people, health status also determines the total amount of working time. He used the household production function model of consumer behavior to account for the gap between health as an output and medical care as one of the many inputs into its production. The model also emphasized the equally important difference between health capital and other forms of human capital. It provides a theoretical framework for making predictions about the impacts of many variables on health, and an empirical framework for testing those predictions.

Finally, it is important to recall that annual earnings and earnings profiles of men and women of different ages have always been a subject of interest for economists. Mincer's original study began with the observation that these profiles differ. Fase (1970) notes the historical interest of economists and members of other professions, especially insurance actuaries, in age-income profiles. Normally, economists focus on lifetime income and its distribution over the life cycle. Many researchers have worked with statistical models of earnings profiles to determine differences between groups, e.g., occupational groups. For Sweden, Klevmarken's (1972 and 1992) studies are still the most comprehensive.

Poor health is traditionally associated with a loss of earnings capacity mainly associated with withdrawal from the labor market. The Grossman model of the demand for health (1972 a, b) identified the complex interrelation among work-time, wages, and health. Following the 1972 studies by Grosssman, a lot of studies (mainly done on US data), focused on work, wages and health.

Variables used are the *hourly wage* [e.g., Luft (1975), and Mitchell and Burkhauser (1990)], *log of hourly wages* [e.g., Lee (1982), Johnson and Lambrinos (1985), and Baldwin and Johnson (1994)], *log real hourly wages*, computed dividing annual earnings by annual hours [e.g., Haveman et al.(1994)], *log annual wages* [e.g., Berkovec and Stern, 1991], *annual earnings* [e.g., Mitchell and Burkhauser (1990)], *log annual earnings* [e.g., Luft (1975), Bartel and Taubman (1979), Chirikos and Nestel (1985)], and *log personal annual income* [e.g., Mullahy and Sindelar (1991, 1993, 1995)]. Hours worked have also been analyzed in some of the mentioned earlier studies as hours per week [e.g., Luft (1975)], as log of hours per week [e.g., Bartel and Taubman (1979)], or as annual hours [e.g., Chirikos and Nestel (1985), Mitchell and Burkhauser (1990), Haveman et al.(1994)].

Grossman and Benham (1974) used the household production model to examine the effect of health on wages (weekly wage) and on weeks worked, treating health as an endogenous variable. The estimated structural equations for wage determination and labor supply indicated that good health had a positive effect on these two components of earnings.

Luft (1975) investigated several aspects of the impact of health status on earnings, including the computation of the overall loss of earnings to the economy in a year. He measured the effects of health status by comparing the different components of earnings (labor force participation, hourly wage, and hours worked per week) of persons who were well with those of persons who were disabled. By analyzing out subsamples of men and women, and blacks and whites, he estimates different ways in which disability affects different groups. His results suggested that there are different ways in which poor health may affect different groups. For example black males are more likely to drop out of the labor force or work fewer weeks than white males, while the latter take larger cuts in hourly wages and annual earnings.

Bartel and Taubman (1979) estimated the effect of specific diseases (physician diagnosed) on wage rates and hours worked to try to determine which diseases have bigger effects on current earnings, and how long the effects exist. They analyzed both earnings and wage rate equations, and explained the different effects using labor supply equations. They found negative effects on both wages and annual earnings given by heart disease/hypertension, psychoses/neuroses, arthritis and bronchitis/asthma.

Chirikos and Nestel (1985) examined the effect of health histories over the preceding ten-year period on current economic welfare, using a two-equation model. First, health history effects on wage rates adjusted for sample selectivity bias were estimated, and then the influence of health history and wages on annual hours of work are evaluated using Tobit regressions. Analyzing people grouped by gender, race, and health status, they found that health problems in the past (up to 10 years) adversely affected current earnings.

Johnson and Lambrinos (1985) used a national sample from the 1972 Social Security Survey of Disabled and Non-Disabled Adults to estimate wage discrimination against handicapped workers. The samples were further partitioned by gender, and four earnings functions were estimated. Their results showed (through three different experience variables) that discrimination had occurred. Handicapped women were also subject to discrimination based on gender. Discrimination accounted for about 33% of offer wage differentials between not handicapped and handicapped men and 40% for women.

Mitchell and Burkhauser (1990) developed a procedure for examining the separate impact of arthritis on wages and hours worked, and these results are translated into earnings. They found that hours worked tended to be considerably more affected by arthritis than were wage rates, although this was more pronounced for men and younger women than for older women.

Mullahy and Sindelar (1991) determined the structure of gender differences in labor market responses to alcoholism. The results indicate that the effects may depend on the control variables, the age distribution of the sample, and the choice between examining participation and income. The effects of alcoholism were greater on household income for women, but it reduced personal income for both men and women. The effect of alcoholism was found to be stronger on labor market participation than on income.

Mullahy and Sindelar (1993) found that inferences about the effects of alcoholism on income depended critically on the age group being studied. Their results also support the proposition that alcoholism has a more significant impact on the likelihood of working than it does on how much is earned when working.

Haveman et al. (1994) studied white males using longitudinal data. They specified a 3-equation simultaneous model, designed to capture interrelationships among work-time, wages and health, which is estimated using Hansen's (1982) generalized method of moments' technique. Simpler models were then estimated with more restrictive assumptions, and substantial differences were found between these estimates and those from the simultaneous model (e.g., the positive relationship between work time and health disappeared when the relevant simultaneities were considered). The implicit demand for health function is the only available estimate that accounted for the interrelationships among health, work time, and wages.

Baldwin and Johnson (1994) analyzed the extent of labor market discrimination against men and women with disabilities in US using the 1984 panel of the Survey of Income and Program Participation. Using a two-stage estimation of a quasireduced system of wages and health, they found large differences in employment rates and hourly wages between disabled and not disabled men.

Mullahy and Sindelar (1995) expanded the standard approach to the welfare analysis of health-related economic costs by accounting for risk aversion and the variance in income that depends on health status. Their results suggest that an evaluation of alcoholism's welfare costs in terms of productivity differentials alone may significantly understate such costs.

Muller et al. (1996), using multivariate analysis based on US pooled cross-sectional time-series data, estimated the probability that a recipient of a Supplemental Security Income disability benefit would perform work. They also estimated the annual earnings equation. They used distinct groups, based on their diagnoses, and found that patterns of work and earnings varied over time. Changes in the probability of work of disabled and in the level of earnings, seemed to mirror economic trends, as measured by the unemployment rate.

Thomas et al. (1997) investigated the impact of four indicators of health on wages of urban workers in Brazil, finding that health yielded a substantial return, at least in the market wage sector. The indicators used (height, body mass index, *per capita* calorie intake, and *per capita* protein intake) do not fully capture health, but they measure various dimensions of it.

Smith (1998, 1999) noted that there are several pathways through which health may affect wealth accumulation, and referred specifically to lowered earnings and increased medical expenditures.

Currie and Madrian (1999) presented an overview of the American literature linking health, health insurance, and labor market outcomes, such as wages, earnings, employment, hours, occupational choice, job turnover, retirement, and the structure of employment. The empirical literature surveyed by them suggests that poor health reduces the capacity to work and has significant effects on wages, labor force participation, and job choice. It is difficult to conclude anything about the magnitudes of these effects, given that they are sensitive to both the choice of health measures and to identification assumptions.

The literature on this subject in Sweden includes studies of the effect of time out of labor force on subsequent wages that give contradictory results. Gustafsson (1981) used an OLS cross-sectional regression, and estimated the effect of absenteeism on monthly salaries in 1974 for women aged 30-44 years (from a random sample of white-collar workers). She found a negative effect of time spent out of work on monthly salaries. Edin and Nynabb (1992) used a restricted sample of persons employed during the interview week in 1984, with no internal missing values, and reinterviewed in 1986. They found a positive effect on (log) hourly earnings of time out for women and no significant effect for men. Stafford and Sundstrom (1996) used OLS cross-sectional regressions and found negative effects (significant at the 10 % level only for men) of time spent out of work on wages. Sundberg (1996) using basically the same model as the one used by Haveman et al. (1994), where *ill health* is a self-assessed variable, found that poor health affected wages negatively.

Albrecht et al. (1998) examined the effects of career interruption on subsequent wages by estimating cross-sectional and fixed-effects specifications of earnings functions that included time-out of labor force variables, using month-by-month event history data for individuals over their entire work life merged with employer-reported Swesish wage data. They estimated separately the effect of total time, and (disaggregate) time out (parental leave, household time, other time out, diverse leave, unemployment and military service). In the cross section, the total time out had a significant effect on both women’s and men’s wages. Parental leave had no effect on women’s wages, but had a significant negative effect on men’s wages.

Skogman Thoursie (1999), for the first time, estimated of the extent of unexplained wage differentials between disabled and nondisabled workers in Sweden, using data from the Swedish Level of Living Survey for 1981 and for 1991. He found that the unexplained component due to differences in returns on wage determinants is insignificant in the 1981 case but is highly significant in 1991, constituting around 50-60% of the average log wage differential.

None of these studies analyzed specifically time out due to sickness. Hansen (2000) uses information about short-term absence among Swedish employees to investigate the potential wage loss attributed to absence, and finds that women's wages were significantly reduced by work absence due to their own sickness, while absence to care for a sick child had no significant wage effect. He also finds that the distribution of the gender wage gap depends to a large extent on work absence.

3 The model

Our point of departure is the human capital model. Central to human capital theory is the assumption that an individual can, by forgoing earnings, spend time on education or training and thereby, augment the quality and the value of his/her labor services. Schultz' (1960) focus on education as a key to raising productivity led to the modern emphasis on "human capital" as a factor in production. Indeed, his work paved the way for Becker's analysis of human skills as a source of productivity growth, which relates hourly earnings to the effects of schooling, on-the-job training and work experience. This is typically expressed as

(1) $$\ln y = \beta_0 + \beta_1 s + \beta_2 \exp + \beta_3 \exp^2 + u$$

where the schooling coefficient (β_1) provides an estimate of the individual return to education (s), and e*xp* is experience.

The typically observed concave profile for lifetime earnings is captured by the experience variable, measured by years of work or approximated by age, and the quadratic of experience, with positive and negative expected values of β_2 and β_3, respectively. Typically, schooling occurs prior to entering the job market and training thereafter, although it is possible for individuals to leave the workforce and acquire more schooling. Human capital is the sum of all investments made in schooling and training in all years. The simple human capital model postulates proportionality between earnings and human capital, with the factor of proportionality being the earnings of the individual. The higher one's human capital, the greater are one's earnings, according to this theory. This model, which is the point of departure in many studies of earnings formation and differences in earnings between various groups, is our point of departure too.

Ben-Porath (1967) developed a model in which, in each year of one's life, one invests in oneself (education, qualifications, experience) in accordance with the benefits and costs of the investment at the stage of the life cycle. Polachek and Siebert (1993) derived an earnings function based on the assumption that, when actual earnings deviate from potential earnings, they do so because of investments in human capital. They introduced Mincer's expression for time equivalent investments, i.e. the fraction of potential earnings foregone in order to acquire (invest in) additional human capital. Total investments encompassed years of schooling (s) and years of post-school experience (t). Post-school training investments were assumed to increase at a decreasing rate. This means that earnings, i.e., the return on the capital stock, would also increase at a decreasing rate.

Health is similar to education and training in the sense that it is a "stock" that can be enhanced and/or maintained with investment (good nutrition, exercise, etc.) through life, although it is likely that the normal process of aging can increase the likelihood of some specific diseases. We consider the investment in health to be the same as the investment in education and/or training,[16] and try to estimate the effect of poor health on hourly wages and annual earnings. We include in the earnings function[17] (2) school-dummies, age and age-squared (using age as a proxy for the work experience), variables related to personal characteristics (X), and health, including previous health history (Z):

$$\textbf{(2)} \qquad \ln y = \beta_0 + \beta_1 s + \beta_2 age + \beta_3 age^2 + \delta X + \sigma Z + \varepsilon \, .$$

Previous studies of the relation between wages and the characteristics of individuals have focused on the estimation of an earnings function rather than a wage function, because of the lack of data on hourly wages. Willis (1986) provides a survey and exposition of the development of earnings function as an empirical tool for the analysis of determinants of wage rates.

People acquire jobs that require different amounts of health capital. People with little education (and/or training) usually get jobs requiring a lower level of professional skills, but often requiring more physical effort, poorer work environment, etc. In this

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[16] We consider that health investment is (much) easier for people to accumulate, since it does not involve or require too much effort and resources from the individual. Health is an investment for which people do not need skills in order to accumulate capital. Nevertheless, investments in health require financial, informational and labor resources.

[17] "The term *earnings function* has come to mean any regression of individual wage rates or earnings on a vector of personal, market, and environmental variables thought to influence the wage." (Willis, 1986)

case, it may be especially important for these people to have good health. In fact, many jobs (food handling, health care, day care, etc.) require good health on a daily basis.

Finally, we note that all individuals in Sweden are covered by public health care, which means that they have free access to medical care. Additionally, the state, health organizations and other institutions distribute a huge amount of information. In other words, people have access to medical and health care, and information concerning prevention and control, and therefore the *investment* is very much determined by the decision of individuals to care for themselves.

4 The data

The data employed in this study come from the Swedish National Social Insurance Board's LS-database. This is a longitudinal database covering spells of sickness during the time period January 1, 1983 to December 31, 1991 for people who are registered with the national sickness insurance scheme[18] in 1986, and are in working age, i.e. 16-64 years, during 1983-1991. We analyze a random sample, representative for insured population in working age, of 1688 individuals. We left out all persons who died or were classified as long-term sick during 1988 (i.e., 187 persons). The reason for choosing the year 1988 is that there is unique data on hours worked because of a change in the social insurance law in December 1987 that required everyone to report hours of work along with current earnings to the social insurance office. We have no information on hours of work for the preceding years, and only information with, we believe, lower quality for the years after 1988.

There are two choices for the earnings variable in our data, both of which have some problems. Since the dataset is based on the social insurance files, we have data on the level of income that was reported (earnings from work and related to work, such as sickness cash benefit during spells of sickness). Over all six years of the study period,

[18] During the analyzed period all Swedish residents were registered with a social insurance office upon reaching 16 years of age, and were entitled to a daily sickness allowance if they had an income from work of at least SEK 6,000 per year.

we have earnings data of this kind for about 72% of all year-persons. An alternative measure of earnings, taxable income that gives pension rights, which collected on a yearly basis, was used to fill in the missing values.

The level of education is another constructed variable, measured by three categories: (1) *low*, which means primary and secondary education; (2) *medium*, which includes gymnasium and post-gymnasium education, but without a university degree; and (3) high, which means at least a university degree. The information on education was collected by interview.

Table 1 presents basic descriptive statistics for the groups of men and women, not long-term sick in 1988, and stratified according to their sickness history.

Table 1 Descriptive statistics (individual characteristics) of men and women, by sickness status 1983-88

Variables	Not LT sick in 1988				Not LT sick during 1983-88				LT sick during 1983-87 & Not LT sick in 1988			
	Men (N=849)		Women (N=839)		Men (N=766)		Women (N=737)		Men (N=83)		Women (N=102)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Age	41.09	11.24	40.80	11.28	40.62	11.08	40.45	11.09	45.43	11.86	43.34	12.38
Age-groups												
16-30 years	0.22	0.42	0.22	0.42	0.23	0.42	0.23	0.42	0.13	0.34	0.19	0.39
31-45 years	0.42	0.49	0.42	0.49	0.43	0.50	0.43	0.50	0.37	0.49	0.35	0.48
46-50 years	0.11	0.31	0.12	0.32	0.11	0.32	0.12	0.32	0.08	0.28	0.10	0.30
51-55 years	0.10	0.30	0.11	0.31	0.10	0.30	0.11	0.31	0.11	0.31	0.14	0.35
56-65 years	0.14	0.35	0.13	0.34	0.12	0.33	0.12	0.32	0.30	0.46	0.23	0.42
Citizenship												
Swedish born	0.88	0.32	0.88	0.33	0.89	0.32	0.87	0.34	0.84	0.37	0.94	0.24
Foreign born	0.06	0.24	0.09	0.28	0.06	0.25	0.09	0.29	0.05	0.22	0.03	0.17
Nationalized	0.05	0.23	0.04	0.20	0.05	0.22	0.04	0.20	0.11	0.31	0.03	0.17
Education												
Low	0.51	0.50	0.47	0.50	0.49	0.50	0.45	0.50	0.69	0.47	0.62	0.49
Medium	0.35	0.48	0.34	0.47	0.36	0.48	0.35	0.48	0.27	0.44	0.26	0.44
High	0.14	0.34	0.20	0.40	0.15	0.35	0.21	0.40	0.05	0.22	0.13	0.34
Marital status												
Unmarried	0.41	0.49	0.34	0.47	0.42	0.49	0.34	0.48	0.33	0.47	0.30	0.46
Married	0.54	0.50	0.55	0.50	0.54	0.50	0.55	0.50	0.58	0.50	0.58	0.50
Divorced	0.04	0.20	0.10	0.29	0.04	0.19	0.10	0.30	0.10	0.30	0.09	0.29
Widower	0.01	0.08	0.01	0.12	0.01	0.09	0.01	0.11	0.00	0.00	0.03	0.17
Zero earnings	0.07	0.25	0.07	0.25	0.06	0.24	0.06	0.24	0.17	0.38	0.12	0.32
Annual hours w	1591	837	1287	849	1628	812	1324	838	1247	977	1025	870
Hourly wages (kr)	68	36	54	25	70	36	55	25	55	39	51	28
Earnings[*]	142	80	94	51	145	78	96	51	118	88	83	48

Note: [*]Italics indicates dummy variables. [**]Earnings have been adjusted to 1997 values using the CPI, and are expressed in thousand Swedish crowns per year.

The first two columns include all men and women in the study, while the next two sets of two columns each divide the sample into those who were not, or were, long-term (LT) sick sometime during 1983-87. The descriptive statistics are for year 1988.

A first conclusion is that those who experienced at least one long-term sickness spell during 1983-87 were generally older and had a lower level of education than those who did not. However, the proportion of older men with long-term sickness history is greater than that of women in the same age group. This could reflect the statistical fact that older women with sickness history tend to leave the labor market with full disability more often than men do[19].

Given the almost perfect gender-balance of the total sample, it is also clear that a higher proportion of women than men had a history of LT sickness. In addition, among persons younger than 30 years with long-term sickness, women occur more frequently, which could be explained by problems in conjunction with pregnancy.

Another difference has to do with citizenship. The proportion of naturalized men (i.e., foreign-born men with Swedish citizenship) is much higher among those with long-term sickness (10.8% compared with 5.4% for the total sample). This could reflect poor human capital and/or health capital of men who came to Sweden during the 1970's or earlier, and/or the likelihood that their jobs were mainly in categories requiring greater physical effort or consisting of more demanding work environments. The proportion of Swedish-born women is much higher in the group of women with previous spells of long-term sickness (94.1%, compared to 87.6% of total sample). An expected difference is related to hours worked per year (*Annual hours w*, in Table 1), hourly wages and earnings. Both men and women who had not experienced a long-term sickness spell in the preceding five years worked more hours per year, with higher hourly wages and higher annual earnings than did people who had had such long-term sickness spell. The difference in hourly wages for these groups is much higher for men than for women, which could be explained by the relatively better education of those

[19] Andrén (2000, Paper 4 of this thesis).

without long-term sickness in the preceding five years.

The variable *Zero earnings* refers to people who reported zero earnings on their tax declaration for 1988. These are people (about 7%) who declared that they had received neither salary nor any compensation for earnings loss due to an event such as unemployment, sickness, disability, or parental leave.

Table 2 presents further descriptive statistics (of health variables) for the groups of men and women, classified as in Table 1.[20] Sickness history is measured on an *individual* basis first by the number of days of sickness (*Compensated days of sickness per year*), second by sickness cohort[21] dummies (*Year* 1983 - *Year* 1987), which reflect the year of the first long-term sickness, and third by diagnosis. The average compensated days of sickness increased by year "only" for people who were not long-term sick during 1983-1988. The decrease for the other two groups during 1987 and 1988 is explained by the design of the sample: we selected only those people who were not long-term sick or disabled in 1988. This implies that we "left out" people with ongoing spells of long-term sickness in 1988 (about 80% of these spells started in 1987, and about 10% in 1986 or earlier).

We use two diagnosis variables, days of sickness with a specific diagnosis, and dummies for the occurrence of long-term sickness spells with a specific diagnosis (*musculoskeletal, cardiovascular, respiratory, mental, general symptoms, injuries and poisonin*g, and *other*). Unfortunately, the database is not large enough to enable us to use finer categories, which might more clearly reveal the true effects of the more serious diagnoses. Data on diagnoses cover the observation period 1986-1991 for both short-term and long-term spells of sickness, whereas we have information on duration of the sickness spells for the period 1983-1991. We present the descriptive for the period 1986-1988. During this period, women had on average more compensated days of sickness than men, and in fact this is generally true in Sweden, regardless of the period studied. Women also had on average more days of compensated sickness with general

[20] A more detailed analysis of the different sickness cohorts is presented in Table A1 in Appendix.

[21] A sickness cohort *j* consists of people who had their first long-term sickness in year *j*, i.e. people selected with regard to the occurrence of a first (within the window observation) long-term sickness spell.

symptoms and other diagnoses, while men had more days with injuries or poisoning.

With respect to *long-term spells*, the musculoskelatal diagnosis (usually back pain) was the most frequent for both men and women, while cardiovascular, respiratory and general symptoms were least frequent.

Table 2 Descriptive statistics (health variables) of women and men, by sickness status 1983-1988

Variable	Not LT sick in 1988				Not LT sick during 1983-1988				LT sick during 1983-1987 & not LT sick in 1988			
	Men (N=849)		Women (N=839)		Men (N=766)		Women (N=737)		Men (N=83)		Women (N=102)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Compensated days of sickness per year												
1983	6.65	15.00	8.84	18.48	5.13	10.49	6.75	11.73	20.65	32.87	23.96	39.58
1984	8.73	27.36	12.18	37.57	5.26	11.91	6.75	13.29	40.75	72.60	51.45	93.01
1985	11.97	47.53	12.54	38.54	5.85	12.08	7.69	14.16	68.48	135.7	47.54	97.23
1986	12.05	38.53	17.80	48.82	5.80	10.92	8.58	21.53	69.72	102.5	84.45	106.2
1987	9.89	26.57	15.93	40.90	6.40	13.01	8.71	16.23	42.11	67.52	68.11	93.96
1988	7.40	11.80	9.40	12.81	6.71	10.83	8.80	12.30	13.77	17.34	13.77	15.43
Sickness cohorts												
Year 1983[*]	0.02	0.13	0.03	0.16					0.17	0.38	0.23	0.42
Year 1984	0.03	0.17	0.03	0.16					0.31	0.47	0.22	0.41
Year 1985	0.02	0.15	0.03	0.16					0.23	0.42	0.23	0.42
Year 1986	0.01	0.11	0.02	0.15					0.13	0.34	0.20	0.40
Year 1987	0.02	0.12	0.02	0.13					0.16	0.37	0.14	0.35
Sickness spells by diagnosis, 1986-88												
Musculoskeletal	0.47	1.20	0.53	1.26	0.42	1.13	0.46	1.16	0.92	1.68	1.03	1.77
Cardiovascular	0.03	0.23	0.06	0.30	0.03	0.21	0.06	0.31	0.06	0.36	0.07	0.29
Respiratory	1.59	2.37	2.19	2.85	1.57	2.34	2.17	2.79	1.75	2.69	2.31	3.25
Mental	0.06	0.42	0.08	0.41	0.04	0.35	0.06	0.35	0.23	0.80	0.19	0.71
Gen. symptoms	0.35	0.90	0.58	1.21	0.33	0.88	0.57	1.17	0.61	1.05	0.68	1.48
Injuries etc.	0.26	0.72	0.19	0.49	0.23	0.68	0.16	0.45	0.58	0.95	0.36	0.73
Other	0.69	1.43	1.27	2.01	0.64	1.38	1.20	1.94	1.11	1.77	1.75	2.41
Compensated days of sickness by diagnosis, 1986-88												
Musculoskeletal	12.50	75.10	17.02	96.67	5.46	30.32	5.39	19.94	77.48	212.1	101.0	257.9
Cardiovascular	2.45	39.25	5.12	80.92	1.69	35.85	0.61	4.12	9.51	62.34	37.7	230.2
Respiratory	9.38	48.93	10.63	20.11	7.44	12.92	10.07	15.32	27.24	151.1	14.7	40.33
Mental	4.74	64.13	3.74	35.24	0.74	6.64	1.30	9.28	41.63	201.4	21.4	96.52
Gen. symptoms	2.10	11.68	4.07	25.44	1.67	5.50	2.74	7.58	6.10	33.32	13.7	69.61
Injuries	6.33	44.26	3.94	30.06	3.92	34.22	1.88	8.82	28.53	93.72	18.8	81.72
Others	6.32	29.88	12.61	39.34	4.13	12.85	8.74	27.62	26.52	85.08	40.6	79.88
LT sickness by diagnosis, 1986-87												
Musculoskeletal[*]	0.021	0.144	0.031	0.173					0.169	0.377	0.225	0.420
Cardiovascular	0.004	0.059	0.005	0.069					0.024	0.154	0.010	0.099
Respiratory	0.002	0.049	0.001	0.035					0.072	0.261	0.059	0.236
Mental	0.007	0.084	0.010	0.097					0.012	0.110	0.049	0.217
Gen. symptoms	0.001	0.034	0.007	0.084					0.145	0.354	0.069	0.254
Injuries etc.	0.018	0.132	0.011	0.103					0.096	0.297	0.206	0.406
Other	0.011	0.102	0.027	0.163					0.096	0.297	0.206	0.406

Note: [*]*Italics* indicates dummy variables.

5 Earnings and wage profiles

Since there is interest in comparison of earnings between points of time and among individuals, we have tried to distinguish between these two aspects, but at the same time to link them together, using cross sectional profiles and cohort profiles. Differences among individuals measured in cross sections are commonly interpreted as if the same differences had been observed over time. This sort of interpretation, with implicit agreement of results between cross sections and time series, cannot of course be expected to hold in general. Nevertheless, this is the best we can do, without much longer longitudinal data sets.

We analyze the age-earnings and age-wage profiles, taking into account sickness history (both diagnosis and duration of sickness). Figures 1 and 2 show the age-earnings profiles, for men, women, and combined, with and without considering persons with zero-earnings in the years when they did not work.

The difference due to gender is only reflected in the level, as the shapes are similar (which is clearer in Figure 2, where zero-earnings are excluded). The earnings increase was strongest until 30–35 years, after which earnings were relatively flat until 50-53 years, when they start to decline. Given the shape of the age-earnings profiles, we expect a positive effect of age on earnings, and a negative effect of age-squared. What we cannot determine from the age-earnings profiles is whether the later decline in earnings is solely the result of health, even if we compare the age-earnings profiles for the sickness cohorts (persons who were sick with a spell of at least 60 days) with the others. It could be that what we are seeing is really the effect of other factors, such as education, vocational training, experience and/or increasing age. The remainder of our paper is devoted to the task of going deeper into analysis.

Figure 1 Age-earnings profiles, considering zero-earnings

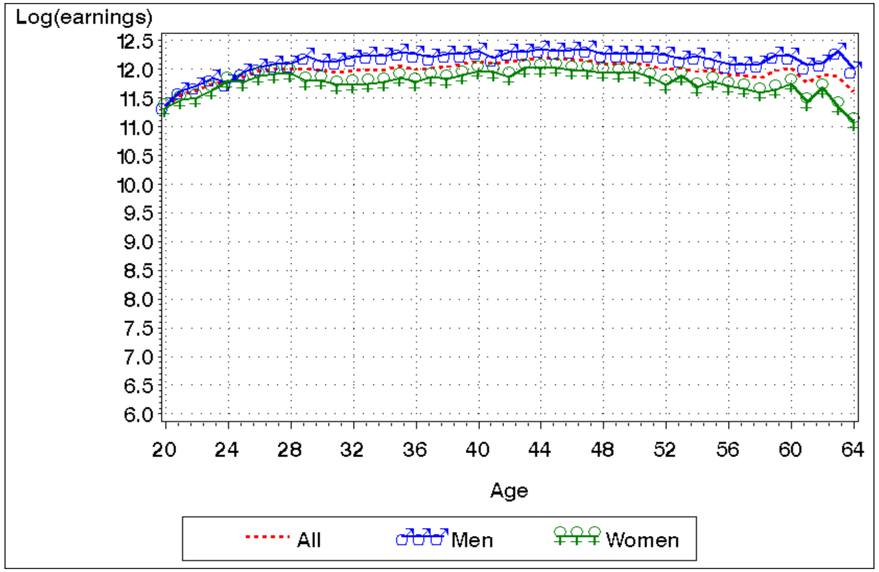

Figure 2 Age-earnings profiles, without considering zero-earnings

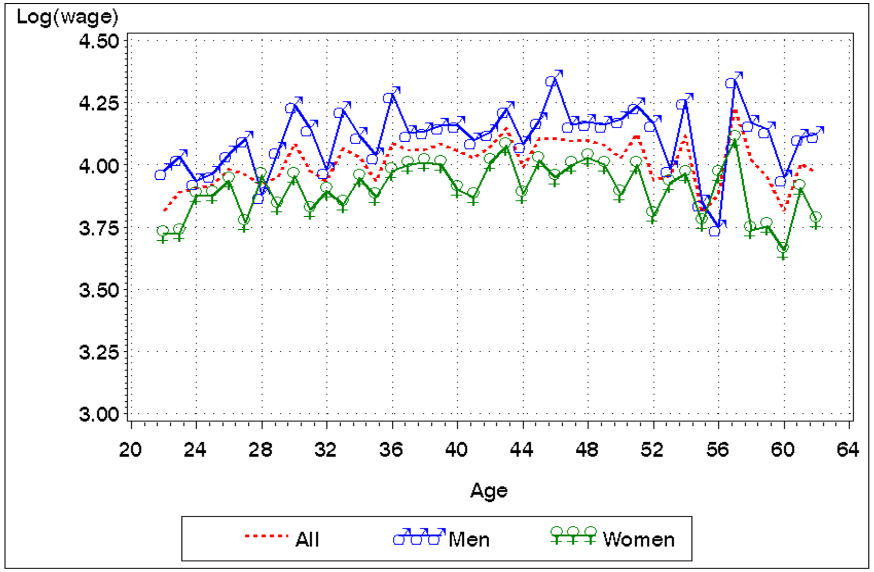

Figure 3 Age-wage profiles

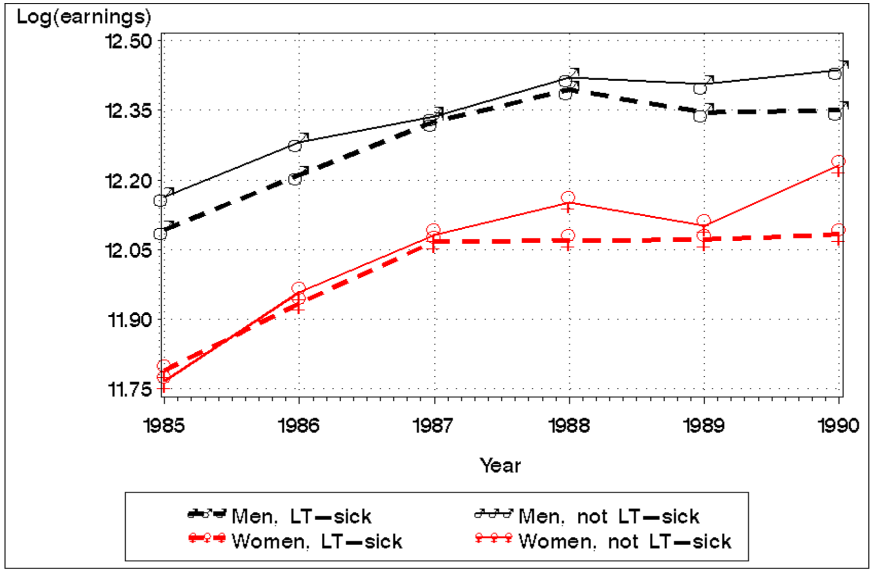

Figure 4 Earnings profiles by gender, and sickness groups

Given the lack of data, we could not get a picture of the age-wage profiles over the same period as for earnings. Figure 3 shows a picture of the age-wage profiles by gender for 1988. They are flatter than the age-earnings profiles, and as expected, women's wages were generally lower than men's.

Figure 4, which shows the earnings profiles of people who were not long-term sick in 1988, illustrates another impact of sickness on earnings. Given absenteeism from the labor market due to long-term sickness sometime during 1983-87, both women and men earned less during this period when the replacement rate was 90%, but also in 1988 and in the following years. This could imply that working capacity was not fully recovered because either people experienced new sickness spells, or returned to work for fewer hours, or both.

Figure 5 shows that earnings profiles also differ across diagnoses. The higher average earnings of people who had a musculoskeletal diagnosis could be explained by the high proportion of people aged 40-50 years with these problems, who have in average higher experience. For those with cardiovascular diagnosis the explanation could be higher education (i.e., more stressful jobs), but more likely, it reflects a tendency for persons not to be out of work until a serious cardiovascular condition occurs, and then when this occurs, they are also usually over 40.

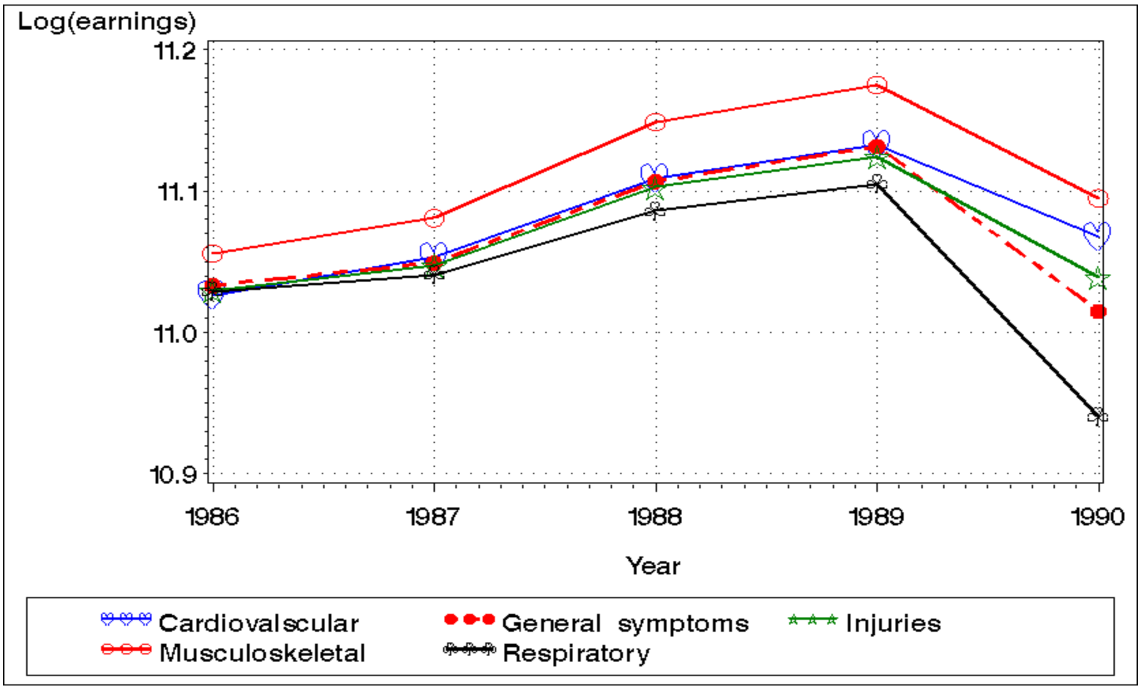

Figure 5 Earnings profiles by diagnosis

Figure 6 shows the “sickness effects” on earnings by sickness-cohort, compared to the almost constant average earnings over time for insured people who did not experience long-term sickness at all during 1983-1988. Given the short span of time and the (very low) number of observations for each cohort, it is difficult to draw conclusions about the effect of sickness on earnings in the long-run, but it seems that the average earnings of people with earlier long-term sickness spells decreased after some years, which could be explained by a full, or partial, exit from the labor market, for some period of time, or permanently.

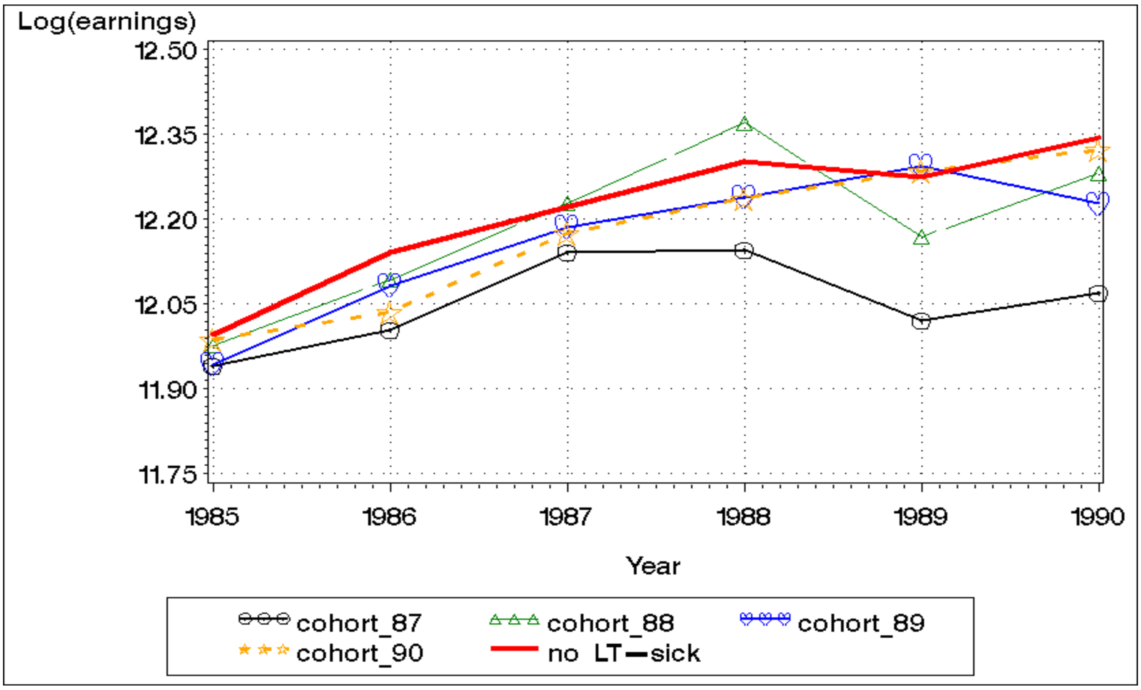

Figure 6 Age-earnings profiles for sickness cohorts

6 The econometric specification

In order to estimate the effect of sickness on earnings, we use an empirical model based on equation **(2)**, with the following form

(3) $\ln y_i = x_i^{'}\beta + u_i, \ i = 1, 2, \ldots, n$

where y_i is the earnings variable, i.e. annual earnings or hourly wage, for the individual

i, β is the parameters vector, and x_i is a vector of known constants, u_i are the residuals that are independently and normally distributed, with mean zero and a common variance σ^2.

We estimate two models that differ only by the dependent variable. In the first model we use annual earnings as a dependent variable, while in the second model we use hourly wages. An important characteristic of the data is that there are several observations where annual earnings are zero, and even more observations where the hourly wage is not observed. If the data on annual earnings have a mass-point at zero, the linearity assumption might be destroyed so that the least squares method would be inappropriate for estimating the earnings equation. If the dependent variables are limited in their range, Tobit models are the appropriate approach for estimating such regressions.

The Standard Tobit model is used for estimating the annual earnings equation. Similar to the pioneering work of Tobin (1958), who used data with several zero values for the dependent variable, we use annual earnings as the dependent variable, which has zero values when people neither worked, nor were absent from work due to sickness.[22] The Standard Tobit model is:

(4)
$$\begin{cases} y_i^* = x_i^{'}\beta + u_i \\ y_i = \begin{cases} y_i^* \text{ if } y_i^* > 0 \\ 0 \quad \text{if } y_i^* \leq 0 \end{cases} \end{cases}$$

where β is a vector of unknown parameters, x_i is a vector of known constants, and the residuals u_i are assumed to be identically and independently distributed (i.i.d.) drawings from $N(\beta, \sigma)$. It is assumed that x_i and are y_i observed for $i = 1, 2, \ldots, N$, but the y_i^* are unobserved if $y_i^* \leq 0$. If one can at least observe the exogenous variables, x_i, when $y_i^* \leq 0$ (i.e. our data used in estimating annual earnings equation), the model is known as the *censored* version of the Standard Tobit model, and has the following likelihood

[22] These people have a reservation wage greater than zero.

function:

$$\textbf{(5)}\qquad L_c = \prod_{y_i^* \le 0} \left[1 - \Phi\left(x_i'\beta / \sigma\right)\right] \prod_{y_i^* > 0} \frac{1}{\sigma} \phi\left[\left(y_i - x_i'\beta\right) / \sigma\right]$$

where Φ and ϕ are the distribution and density function, respectively, of the standard normal variable. Our problem is to estimate β and σ^2 on basis of N observations on y_i and x_i.

When the dependent variable is hourly wages, we use Heckman's full information maximum likelihood method. If y_1 is the wage offer (or market wage) and y_2 is the reservation wage, we never observe y_2 but we observe y_1 for most of people who work. If $y_1 > y_2$, we observe that the individual is in the labor force. If $y_1 < y_2$, we observe that the individual is not employed, and we do not observe either y_1 or y_2. The partitioning of the sample, for example, into employed and not employed is based on the "self-selection" of individuals into the two groups based on the relationship between wage offers and reservation wages. Selectivity is an important issue, which is often considered in the estimation of labor supply models by considering only the subsample of individuals who work. We want to estimate the wage equation **(6a)** of the following model:

$$\textbf{(6)}\qquad \begin{cases} y_{1i}^* = x_{1i}'\beta_1 + u_{1i} & \text{(a)} \\ y_{2i}^* = x_{2i}'\beta_2 + u_{2i} & \text{(b)} \\ y_{1i} = y_{1i}^* \text{ if } y_{2i}^* > 0 & \text{(c)} \\ y_{1i} = 0 \quad \text{if } y_{2i}^* \le 0. & \text{(d)} \end{cases}$$

We do not know the wages for people who do not work, and therefore we use **(6c)** and the selection equation **(6b).** Becker's wage equation **(1)** relates hourly earnings to the effect of years of school and work experience. Given the fact that people who do not work are usually those who are only able to get fairly low wages given (some of) their observed characteristics that are in both x_1- and x_2- vectors, u_1 and u_2 are expected to be positively correlated. It is assumed that u_1 and u_2 are i.i.d. drawings from a bivariate normal distribution with zero mean, variances σ_1^2 and σ_2^2, and covariance σ_{12}, that only the sign of y_{2i}^* is observed, and that y_{1i}^* are observed only when $y_{2i}^* > 0$. Given these assumptions, model **(6)** has the following likelihood function:

(7) $$L = \prod_{y_{2i}^* \le 0} \left[1 - \Phi\left(x_{2i}^{'}\beta_2 / \sigma_2\right)\right] \prod_{y_{2i}^* > 0} \Phi \left\{ \frac{x_{2i}^{'}\beta_2 + \frac{\sigma_{12}}{\sigma_1^2}\left(y_{1i} - x_{1i}^{'}\beta_1\right)}{\sqrt{\sigma_2^2 - \frac{\sigma_{12}^2}{\sigma_1^2}}} \right\} \times \frac{1}{\sigma_1} \phi\left(\frac{y_{1i} - x_{1i}^{'}\beta_1}{\sigma_1} \right)$$

Instead of using this full information maximum likelihood method, Heckman's two-step method can be used. Puhani (2000) shows that exploratory work to check for collinearity problems is strongly recommended before deciding on which estimator to apply. In the absence of collinearity problems, the full-information maximum likelihood estimator is preferable to the limited-information two-step method of Heckman, although the latter also gives reasonable results.

Under the assumption that the regression and selection models are both correctly specified, a test whether lambda[23] is significantly non-zero checks that the disturbances of the selection and regression processes are correlated. If that test is not significant, then we cannot reject the hypothesis that the selection and regression process are not correlated. If they are not correlated, selection is random. In this case, we effectively have a regression process with some data that are missing at random and OLS will produce unbiased estimates for both parameters and standard errors.

7 Results

We estimated equations for both annual earnings and the hourly wage. All equations were estimated for 1988, considering sickness records in the preceding five years.

Table 3 presents Tobit estimated coefficients of the annual earnings equation for all individuals together, and for different groups: men, women, people with no long-term sickness spell during 1983-1988, and those with at least one spell of long term sickness during 1983-87. As noted earlier (from Table 1), about 7% of observations had

[23] Lamda is the inverse Mills ratio, $\lambda_i = \phi_i / \Phi_i$, where Φ_i and ϕ_i are the distribution and density function, respectively, of a standard normal variable.

zero annual earnings. Given this, it is not surprising that the Tobit estimates are almost the same as the OLS estimates (reported in Table A2 in Appendix) in size, sign, and significance.

Table 3 Estimated parameters of the earnings equation in 1988

Variables	All Insured		Men		Women		Not long-term sick 1983-1988		Long-term sick 1983-1987	
	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.
Female	**-0.55**	0.14					**-0.60**	0.15	-0.14	0.62
Age	**0.41**	0.05	**0.40**	0.07	**0.43**	0.07	**0.43**	0.05	0.18	0.22
Age-Squared/100	**-0.52**	0.06	**-0.51**	0.08	**-0.55**	0.08	**-0.55**	0.06	-0.27	0.25
Citizeanship (CG: Swedish born)										
Foreign born	**-2.19**	0.28	**-2.42**	0.42	**-2.06**	0.36	**-2.20**	0.27	-0.48	1.57
Nationalized	**-0.61**	0.34	**-0.91**	0.45	-0.50	0.51	**-0.84**	0.35	1.03	1.22
Education (CG: low)										
Medium	**0.93**	0.17	**0.98**	0.23	0.83	0.24	**0.86**	0.17	1.07	0.77
High	**0.95**	0.21	**0.57**	0.32	1.18	0.28	**0.90**	0.21	**2.20**	1.13
Married	0.05	0.18	0.38	0.26	-0.27	0.23	0.08	0.18	-0.24	0.73
Sickness cohorts										
Year 1983	**-2.10**	0.67	**-2.61**	1.02	-0.98	0.89			-1.64	1.47
Year 1984	**-1.14**	0.52	**-1.61**	0.71	-0.85	0.74			-0.78	1.13
Year 1985	-0.21	0.51	0.26	0.76	0.10	0.68			-0.32	1.13
Year 1986	-0.13	0.61	1.49	0.99	-0.85	0.77			0.09	1.16
Year 1987	-0.54	0.63	**-1.96**	0.98	0.98	0.85				
Sickness days (1986-88), by diagnosis										
Musculoskeletal	0.002	0.001	**0.004**	0.002	-0.002	0.001	0.003	0.003	0.002	0.002
Cardiovascular	0.001	0.001	0.001	0.003	-0.001	0.001	0.001	0.003	0.000	0.002
Respiratory	0.003	0.002	0.002	0.002	0.008	0.006	**0.013**	0.006	0.001	0.003
Mental	-0.001	0.002	0.002	0.002	**-0.008**	0.003	-0.006	0.009	0.000	0.002
Gen. symptoms	0.000	0.004	**-0.021**	0.010	0.004	0.004	0.006	0.012	-0.003	0.005
Injuries	**-0.005**	0.002	0.000	0.002	**-0.014**	0.004	0.003	0.003	**-0.013**	0.004
Other	0.000	0.002	0.004	0.004	-0.002	0.003	0.002	0.004	-0.001	0.004
Compensated days of sickness, by year										
1983	**0.020**	0.005	0.006	0.008	**0.019**	0.007	0.011	0.007	0.016	0.011
1984	**-0.005**	0.003	**0.008**	0.005	**-0.012**	0.004	0.003	0.007	**-0.010**	0.004
1985	**-0.007**	0.002	**-0.012**	0.003	-0.003	0.003	0.002	0.006	**-0.009**	0.003
1986	-0.003	0.003	**-0.018**	0.005	**0.007**	0.003	0.000	0.005	-0.002	0.005
1987	0.003	0.003	**0.017**	0.006	0.000	0.003	0.004	0.006	0.000	0.005
1988	**0.051**	0.006	**0.051**	0.009	**0.048**	0.009	**0.036**	0.008	**0.070**	0.020
Intercept	**2.959**	1.022	**2.964**	1.455	**2.279**	1.395	**2.487**	1.037	7.405	4.628
Ancillary parameter	2.902	0.053	2.885	0.075	2.790	0.073	2.747	0.053	3.838	0.226
Left-censored obs.	117		59		58		91		26	
Uncensored obs.	1571		790		781		1412		159	
LR chi-squared[a]	375.47		221.22		225.17		293.360		73.51	
Log-likelihood	-4097		-2054		-2004		-3589.2		-471.8	
Pseudo-R^2	0.044		0.051		0.053		0.039		0.072	

Notes: [a]Prob >chi-squared = 0.000 for all samples. *Param.* indicates the parameter estimate in the semi-log annual earnings equation; **Bolds** indicate parameters significant at less than 5 % -level; *Italics* indicate dummy variables. CG is the comparison group.

Both the Tobit and OLS estimates show that previous sickness history (in 1983, 1984, and 1985) had a negative impact on the amount of 1998 annual earnings. The effect was higher for men. Being woman has a negative effect on the annual earnings, which is not significant for those with long-tem sickness records before 1988, however. This indicates that persons in this situation (i.e., LT-sick in the past) are not different in this respect.

Age has a significant positive impact on annual earnings. It is higher for those without recent long-term sickness than for those with, which is an indication of the sickness on earnings. Age-square's effect is negative, annual earnings increased with age at a decreasing rate, as expected.

Medium and high education had positive effects on annual earnings. The high education effect is even higher for people with recent long-term sickness than for those without. The high education effect, which is one of the few significant effects on the earnings of people with recent long-term sickness, is much higher for women than for men.

Marital status had a negative effect on women's annual earnings, while it is positive for men, but in neither case was significant at the 10% level, or less. In general, foreigners and nationalized Swedes, both men and women earned less than did Swedish born people. However, for those with recent long-tem sickness there was a positive effect (though not significant at the 10% level) for nationalized Swedes with previous long-term sickness, compared with Swedish born people.

Table 4 shows the coefficients of the wage equation estimated using Heckman full maximum likelihood. Given that we do not know the hourly wages of people who did not work during 1988, these estimates are better than the OLS estimates (presented in Table A3, in Appendix). Women had lower wages than men regardless of their previous history of sickness, but the difference was smaller when only people with recent long-term sickness were compared. As expected, the hourly wage increased with age, at a decreasing rate. Medium and high education had positive effects on hourly wages, higher for men than for women.

Foreigners had lower hourly wages than Swedish born people had, the difference being higher for women than for men, and more than double for those with recent long-term sickness, compared to those without. In fact, being a "foreigner" had the most significant negative effect on the *wage rate* of those with long-term sickness history.

Table 4 Estimated parameters of the wage equation in 1988

Variables	All Insured		Men		Women		Not long-term Sick 1983-1988		Long-term Sick 1983-1987	
	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.
Female	**-0.21**	0.02					**-0.22**	0.02	**-0.14**	0.05
Age	**0.04**	0.01	**0.04**	0.01	**0.03**	0.01	**0.04**	0.01	**0.04**	0.02
Age-Squared/100	**-0.04**	0.01	**-0.04**	0.01	**-0.04**	0.01	**-0.04**	0.01	**-0.05**	0.02
Citizenship										
Foreign	**-0.11**	0.04	-0.06	0.06	**-0.14**	0.04	**-0.10**	0.04	**-0.24**	0.13
Nationalized	0.02	0.04	0.03	0.06	-0.01	0.06	0.05	0.05	-0.14	0.10
Education										
Medium	**0.11**	0.02	**0.20**	0.03	0.02	0.03	0.13	0.02	-0.02	0.06
High	**0.24**	0.03	**0.33**	0.04	**0.16**	0.03	0.26	0.03		
Married	0.03	0.02	**0.08**	0.03	-0.01	0.03	0.03	0.02	0.02	0.06
Sickness Cohorts										
Year 1983	0.08	0.09	0.05	0.15	0.03	0.10			-0.03	0.12
Year 1984	0.06	0.07	0.00	0.11	0.11	0.09			-0.08	0.08
Year 1985	-0.10	0.06	-0.13	0.10	-0.07	0.08			**-0.24**	0.07
Year 1986	**0.18**	0.07			**0.18**	0.08				
Year 1987	-0.04	0.08			0.00	0.10				
Sickness Days (1986-88), by diagnosis										
Musculoskeletal	-0.0002	0.0001	-0.0005	0.0003	-0.0001	0.0002	-0.0003	0.0004	-0.0002	0.0001
Cardiovascular	-0.0001	0.0002			0.0000	0.0002				
Respiratory	0.0004	0.0002	0.0003	0.0003	0.0007	0.0006	0.0009	0.0007	0.0003	0.0002
Mental	-0.0001	0.0002	-0.0001	0.0003	0.0001	0.0005	-0.0013	0.0012	0.0001	0.0002
Gen. Symptoms	0.0008	0.0005	0.0023	0.0024	0.0007	0.0004	0.0028	0.0014	0.0009	0.0004
Injuries	0.0001	0.0003	0.0002	0.0004	-0.0002	0.0006	0.0001	0.0004	**-0.0002**	0.0005
Others	-0.0002	0.0003	**-0.0011**	0.0005	0.0002	0.0003	-0.0003	0.0005	-0.0004	0.0003
Compensated days of sickness, by year										
1983	-0.0007	0.0007	-0.0017	0.0012	-0.0002	0.0008	-0.0002	0.0009	-0.0012	0.0010
1984	-0.0001	0.0004	-0.0004	0.0006	0.0001	0.0005	-0.0003	0.0008	-0.0002	0.0005
1985	-0.0002	0.0003	0.0004	0.0007	-0.0005	0.0003	-0.0003	0.0008	-0.0004	0.0003
1986	-0.0002	0.0003	0.0004	0.0006	-0.0004	0.0004	-0.0006	0.0006	0.0002	0.0003
1987	-0.0001	0.0004	0.0000	0.0007	-0.0005	0.0004	0.0006	0.0008	**-0.0007**	0.0004
1988	0.0010	0.0008	0.0001	0.0012	0.0013	0.0010			0.0015	0.0016
Intercept	**3.35**	0.13	**3.18**	0.19	**3.29**	0.16	**3.27**	0.14	**3.68**	0.37
rho	-0.39	0.10	-0.44	0.12	-0.58	0.11	-0.31	0.13	-0.42	0.28
sigma	0.34	0.01	0.37	0.01	0.31	0.01	0.35	0.01	0.29	0.02
lambda	-0.14	0.04	-0.16	0.04	-0.18	0.04	-0.11	0.05	-0.12	0.09
LR Test of independent equations (rho=0)										
Chi2(1)	11.64		11.21		12.66		4.74		1.77	
Prob >chi2	0.001		0.001		0.000		0.030		0.184	
Censored obs.	117		59		58		91		26	
Uncensored obs.	1571		790		781		1412		159	
Wald chi2	331.52		140.44		97.1		293.49		62.81	
Log likelihood	-797.64		-421.63		-274.89		-721.04		-69.10	

Notes: *Param* represents the estimates of the parameters in the semi-log hourly wage equation. The selection equation is presented in Table A4, in Appendix. **Bolds** indicate parameters significant at less than 5 % -level. *Italics* indicate dummy variables. [ ] indicates that the variable was not included in the model due to few or no observations.

In sum, excepting the sample of people with recent long-term sickness, for which a few health status variables had significant effects on the hourly wages, very few other significant effects were found. This confirms our hypothesis that recent long-term sickness in a previous period can decrease both (current) annual earnings, and (current) hourly wages.

8 Conclusions

The data for annual earnings and the hourly wage provide evidence that both are affected by a history of sickness. The earnings profiles confirm the usual paradigm of a flat concave profile, first increasing with, then tapering off, and eventually declining with age. Age-wage profiles are much flatter than earnings profiles, which is typical for the Swedish labor market. Nevertheless, there is a premium for education, according to the results. High education enhances both earnings and the hourly wage rate, suggesting that the effect goes mainly through the wage rate.

The results answer the central question of this study, what is the effects of the sickness on earnings. Persons with a history of long-term sickness have lower earnings than those without. In the multiple regression analysis, previous history of long-term sickness has a negative effect on earnings when estimated for both genders together and for men when men and women are estimated separately. Days of sickness per year entered as a separate variable have a more ambiguous effect, however.

There are also clearly observable differences between earnings profiles for different diagnosis categories, where people with musculoskeletal sickness histories have higher profiles, and people with respiratory problems notably lower profiles. The multivariate analysis did not reveal significant effects through the diagnosis when men and women were aggregated, but did reveal that men with musculosketal problems had on average a higher wage and men with general symptom diagnoses had a lower wage, whereas there was a negative effect on earnings for women for mental diagnoses and injuries. The latter was also significant in the separate equation for persons with long-term sickness.

Multivariate analysis indicates that there were only few and week effects of sickness history only on the wage rate of those with poorer health. The results also indicate that being “a foreigner” had the most significant negative effect on the wage rate of those with long-term sickness history, but had not significant effect on their annual earnings.

People who previously had a spell of long-term sickness had lower earnings in following years, even if they did not experience a new spell of long-term sickness. The conclusion of this study is that since the effect cannot be attributed to an effect on the wage rate, it has to have resulted from a reduction in time spent working. An implication for the policy is that the work alternative should always be more attractive than the alternative of disability for people who can still work. Therefore, it is desirable to have programs directed to improve the social and physical work environment, and individual performance (through training and/or vocational rehabilitation of those individuals).

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Appendix

Table A1 Descriptive statistics, by sickness history, in 1988

Variable	No LT sick 1983-1988 (N=1503)		LT sick 1983-1988 (N=185)		Sickness cohorts (SC)									
					SC1983 (N=37)		SC1984 (N=48)		SC1985 (N=42)		SC1986 (N=31)		SC1987 (N=27)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std
Gender: *Woman*=1, Men=0	0.49	0.50	0.55	0.50	0.62	0.49	0.46	0.50	0.55	0.50	0.65	0.49	0.52	0.51
Age	40.54	11.09	44.28	12.16	44.59	10.80	44.44	12.93	42.21	12.40	44.26	12.38	46.81	12.27
Age-groups														
16-30 *years*	0.23	0.42	0.16	0.37	0.08	0.28	0.19	0.39	0.24	0.43	0.16	0.37	0.11	0.32
31-45 *years*	0.43	0.50	0.36	0.48	0.46	0.51	0.31	0.47	0.36	0.49	0.39	0.50	0.30	0.47
46-50 *years*	0.12	0.32	0.09	0.29	0.11	0.32	0.06	0.25	0.12	0.33	0.10	0.30	0.07	0.27
51-55 *years*	0.10	0.31	0.12	0.33	0.14	0.35	0.13	0.33	0.10	0.30	0.10	0.30	0.19	0.40
56-65 *years*	0.12	0.32	0.26	0.44	0.22	0.42	0.31	0.47	0.19	0.40	0.26	0.45	0.33	0.48
Citizenship														
Swedish born	0.88	0.33	0.90	0.30	0.84	0.37	0.92	0.28	0.86	0.35	0.94	0.25	0.96	0.19
Foreign born	0.08	0.27	0.04	0.19	0.08	0.28	0.02	0.14	0.05	0.22	0.03	0.18	0.00	0.00
Nationalized	0.05	0.21	0.07	0.25	0.08	0.28	0.06	0.25	0.10	0.30	0.03	0.18	0.04	0.19
Education														
Low	0.47	0.50	0.65	0.48	0.81	0.40	0.73	0.45	0.60	0.50	0.52	0.51	0.52	0.51
Medium	0.36	0.48	0.26	0.44	0.11	0.32	0.23	0.43	0.31	0.47	0.26	0.45	0.44	0.51
High	0.17	0.38	0.09	0.29	0.08	0.28	0.04	0.20	0.10	0.30	0.23	0.43	0.04	0.19
Marital status														
Unmarried	0.38	0.49	0.31	0.47	0.43	0.50	0.44	0.50	0.26	0.45	0.13	0.34	0.22	0.42
Married	0.54	0.50	0.58	0.50	0.41	0.50	0.52	0.51	0.64	0.49	0.77	0.43	0.59	0.50
Divorced	0.07	0.25	0.09	0.29	0.14	0.35	0.02	0.14	0.07	0.26	0.10	0.30	0.19	0.40
Widowed	0.01	0.10	0.02	0.13	0.03	0.16	0.02	0.14	0.02	0.15	0.00	0.00	0.00	0.00
Earnings (Th. SEK)	120.70	70.60	98.70	70.60	86.20	64.60	82.30	55.70	98.70	62.60	128.90	106.10	110.10	53.00
Yearly hours work	1478.8	838.4	1124.6	923.6	789.3	941.7	1014.3	920.8	1277.6	891.2	1293.3	872.6	1348.1	916.5

Variable	No LT sick 1983-1988 (N=1503)		LT sick 1983-1988 (N=185)		Sickness cohorts (SC) SC1983 (N=37)		SC1984 (N=48)		SC1985 (N=42)		SC1986 (N=31)		SC1987 (N=27)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std
Hourly wages	62.17	31.50	52.50	33.28	42.92	27.85	47.13	27.27	48.48	18.63	74.74	55.13	55.89	25.53
Compensated days of sickness, by year														
1983	5.92	11.14	22.48	36.66	65.27	54.52	16.79	24.84	6.76	9.67	12.23	19.47	10.15	18.69
1984	5.99	12.62	46.65	84.42	104.27	151.08	74.52	60.67	15.36	24.02	12.26	16.64	6.30	10.12
1985	6.76	13.17	56.94	116.21	93.92	217.10	80.73	96.86	53.36	57.08	17.84	29.70	14.41	22.17
1986	7.16	17.02	77.84	104.57	57.92	100.13	72.23	107.67	110.69	131.93	120.94	72.24	14.56	18.48
1987	7.53	14.72	56.44	83.94	33.38	67.02	37.10	81.63	49.40	78.92	81.68	109.31	104.41	57.53
1988	7.73	11.61	13.77	16.27	8.86	13.34	12.96	15.97	17.12	17.71	15.52	16.95	14.74	16.77
1989	12.35	34.63	37.94	86.20	41.03	98.17	27.06	73.82	32.26	71.80	46.81	93.34	51.70	103.14
1990	19.93	55.26	51.89	94.16	45.49	95.42	62.71	109.08	50.67	85.24	55.35	94.80	39.33	79.69
1991	17.85	48.19	36.78	83.21	33.62	80.84	37.50	80.71	36.31	80.22	46.87	104.85	28.96	71.66
Sickness days (1986-88), by diagnosis														
Musculoskeletal	5.43	25.75	90.48	238.15	92.76	335.41	83.90	244.87	128.95	246.25	89.68	163.39	40.15	75.24
Cardiovascular	1.16	25.75	25.03	176.11	0.89	3.78	58.44	319.66	24.17	111.00	8.84	48.11	18.67	96.99
Respiratory	8.73	14.20	20.31	105.41	20.70	64.99	11.67	18.60	8.36	13.11	13.55	16.86	61.52	263.40
Mental	1.02	8.05	30.47	152.66	77.76	298.15	4.73	19.80	37.12	113.08	13.03	71.27	21.11	100.89
General Symptoms	2.19	6.62	10.29	56.29	3.49	8.40	4.31	15.43	2.93	8.09	29.32	122.74	19.85	60.54
Injuries	2.92	25.21	23.18	87.20	3.11	8.28	18.63	110.08	24.86	88.41	44.58	117.29	31.59	48.73
Others	6.39	21.52	34.28	82.33	15.03	34.83	30.60	93.73	26.88	74.36	63.29	114.68	45.41	68.83
Spells of sickness (1986-88), by diagnosis														
Musculoskeletal	0.441	1.141	0.978	1.722	0.973	2.327	0.604	0.893	1.405	2.061	0.935	1.181	1.037	1.786
Cardiovascular	0.043	0.260	0.065	0.323	0.054	0.229	0.063	0.320	0.048	0.216	0.065	0.250	0.111	0.577
Respiratory	1.866	2.586	2.059	3.015	2.270	4.107	2.188	3.589	1.548	1.941	2.097	2.119	2.296	2.447
Mental	0.053	0.349	0.205	0.753	0.351	1.086	0.083	0.347	0.357	1.055	0.065	0.250	0.148	0.456
General symptoms	0.444	1.036	0.649	1.303	0.784	2.043	0.479	0.850	0.500	1.153	0.806	1.195	0.815	1.001
Injuries	0.195	0.579	0.459	0.840	0.216	0.479	0.375	0.815	0.476	0.740	0.645	1.018	0.704	1.103
Other	0.915	1.698	1.465	2.162	1.270	1.981	1.208	2.021	1.405	1.809	2.194	3.114	1.444	1.761

Table A2 OLS estimated parameters of the (log) earnings equation in 1988 considering the sickness history 1983-1988

Variable	All Insured			Men			Women			Not long-term Sick 1983-88			Long-term Sick 1983-1987		
	Param.	Robust Std. Err.	Marginal Effect [a]	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect
Female	**-0.54**	0.14	-41.58							**-0.58**	0.14	-44.25	-0.18	0.61	-16.32
Age	**0.39**	0.06	-2.08	**0.38**	0.08	-2.33	**0.40**	0.08	-1.76	**0.41**	0.06	-1.56	0.18	0.19	-4.83
Age-Squared/100	**-0.49**	0.07		**-0.48**	0.10		**-0.52**	0.10		**-0.52**	0.07		-0.25	0.23	
Citizenship															
Foreign	**-2.06**	0.38	-87.22	**-2.26**	0.64	-89.57	**-1.95**	0.47	-85.74	**-2.08**	0.40	-87.51	-0.42	1.33	-34.33
Nationalized	-0.57	0.39	-43.67	-0.86	0.58	-57.87	-0.46	0.49	-37.00	**-0.79**	0.42	-54.75	0.89	1.14	143.71
Education															
Medium	**0.88**	0.14	139.91	**0.93**	0.19	154.19	**0.78**	0.20	118.91	**0.82**	0.14	126.87	0.97	0.60	163.37
High	**0.90**	0.17	146.03	0.56	0.30	74.96	**1.11**	0.20	204.68	**0.86**	0.18	137.15	**1.91**	0.69	574.42
Married	0.05	0.11	5.36	**0.36**	0.18	43.46	-0.25	0.15	-21.95	0.08	0.12	8.35	-0.20	0.50	-18.33
Sickness cohorts															
Year 1983	**-1.93**	0.91	-85.53	-2.38	1.78	-90.76	-0.91	0.83	-59.61				-1.41	1.86	-75.63
Year 1984	-1.09	0.70	-66.38	-1.52	0.91	-78.08	-0.86	0.96	-57.84				-0.72	1.07	-51.28
Year 1985	-0.23	0.47	-20.71	0.14	0.53	14.86	0.04	0.69	4.12				-0.33	0.83	-27.90
Year 1986	-0.13	0.43	-12.06	1.34	0.83	280.22	-0.80	0.46	-55.11				0.09	0.90	9.34
Year 1987	-0.50	0.62	-39.52	**-1.78**	0.53	-83.19	0.91	0.74	147.90						
Sickness days (1986-88), by diagnosis															
Musculoskeletal	0.002	0.001	0.173	**0.003**	0.002	0.459	-0.002	0.002	-0.143	**0.003**	0.001	0.327	0.001	0.002	0.134
Cardiovascular	0.001	0.001	0.084	0.001	0.001	0.123	-0.001	0.001	-0.085	**0.001**	0.001	0.122	0.001	0.002	0.047
Respiratory	0.002	0.002	0.284	**0.002**	0.001	0.220	**0.007**	0.004	0.685	**0.012**	0.004	1.465	0.001	0.001	0.053
Mental	-0.001	0.002	-0.082	0.001	0.002	0.192	**-0.007**	0.003	-0.642	-0.006	0.004	-0.747	0.000	0.002	-0.028
Gen. Symptoms	0.000	0.005	-0.020	**-0.018**	0.008	-2.509	**0.004**	0.001	0.351	0.005	0.005	0.654	-0.003	0.006	-0.269
Injuries	-0.004	0.004	-0.506	0.000	0.002	-0.007	**-0.013**	0.005	-1.217	**0.003**	0.001	0.305	**-0.010**	0.004	-0.954
Others	0.000	0.002	0.038	0.003	0.003	0.393	-0.002	0.003	-0.193	0.002	0.001	0.202	-0.001	0.003	-0.107
Compensated days of sickness, by year															
1983	**0.019**	0.006	2.194	0.005	0.009	0.751	**0.017**	0.006	1.606	**0.011**	0.004	1.270	0.014	0.014	1.363
1984	-0.005	0.004	-0.535	0.008	0.004	1.082	**-0.010**	0.004	-0.974	0.003	0.004	0.342	-0.008	0.006	-0.795
1985	**-0.006**	0.003	-0.732	**-0.009**	0.002	-1.329	-0.003	0.005	-0.279	0.002	0.005	0.258	**-0.007**	0.003	-0.705
1986	-0.003	0.003	-0.298	**-0.015**	0.005	-2.155	**0.006**	0.003	0.607	0.000	0.002	0.048	-0.002	0.005	-0.173
1987	0.003	0.004	0.300	**0.015**	0.005	2.127	0.000	0.003	0.040	0.004	0.003	0.483	0.000	0.004	0.006
1988	**0.048**	0.005	5.626	**0.047**	0.007	6.719	**0.046**	0.006	4.294	**0.034**	0.004	4.074	0.061	0.015	6.046
Intercept	**3.443**	1.083		**3.438**	1.542		2.778	1.553		**2.959**	1.157		7.600	3.852	
N	1688			849			839			1503			185		
R-squared	0.20			0.23			0.24			0.18			0.32		
Root MSE	2.73			2.74			2.65			2.60			3.61		

Notes: The marginal effects show the effect of a one-unit change of a continuous variable X_j on the annual earnings (in thousand Swedish crowns). **Bolds** indicate parameters significant at the 5 % level. *Italics* show dummy variables, for which the marginal effect is the percentage change on earnings when category “1” is compared to “0”.

Table A3 OLS Estimated parameters of the (log) wage equation in 1988 (same *Note* as for Table A2)

	All Insured			Men			Women			Not long-term Sick 1983-88			Long-term Sick 1983-1987		
Variable	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect	Param.	Robust Std. Err.	Marginal Effect
Female	**-0.21**	0.02	-19.11							**-0.22**	0.02	-19.96	**-0.14**	0.06	-13.19
Age	**0.04**	0.01	0.26	**0.04**	0.01	0.33	**0.04**	0.01	0.16	**0.04**	0.01	0.34	0.04	0.02	
Age-Squared/100	**-0.05**	0.01		**-0.05**	0.01		**-0.04**	0.01		**-0.05**	0.01		-0.04	0.02	
Citizenship															
Foreign	**-0.14**	0.03	-13.00	**-0.09**	0.05	-8.63	**-0.16**	0.04	-15.20	**-0.12**	0.03	-11.30	-0.25	0.13	-21.74
Nationalized	0.01	0.05	1.19	0.03	0.07	2.60	-0.02	0.06	-1.57	0.04	0.05	4.02	-0.13	0.08	-12.00
Education															
Medium	**0.12**	0.02	13.04	**0.21**	0.03	23.45	0.03	0.03	2.88	**0.13**	0.02	14.33	0.02	0.06	2.01
High	**0.25**	0.03	28.03	**0.33**	0.05	39.14	**0.17**	0.03	19.07	**0.26**	0.03	30.22	0.09	0.14	9.17
Married	0.03	0.02	3.08	**0.09**	0.03	9.03	-0.01	0.02	-1.19	0.03	0.02	3.01	0.00	0.06	0.09
Cohorts of long-term sickness															
Year 1983	0.05	0.08	5.49	0.05	0.13	5.09	0.01	0.10	1.31				0.04	0.15	
Year 1984	0.05	0.05	5.38	0.00	0.07	0.14	0.10	0.08	11.02				0.02	0.09	
Year 1985	**-0.09**	0.04	-9.00	-0.11	0.08	-10.66	-0.06	0.06	-6.22				-0.13	0.09	
Year 1986	0.17	0.09	18.70	0.16	0.19	17.34	0.17	0.10	18.79				0.16	0.13	
Year 1987	-0.04	0.06	-3.62	-0.09	0.09	-8.29	0.02	0.08	2.43						
Sickness days (1986-88), by diagnosis															
Musculoskeletal	**-0.0002**	0.0001	-0.014	**-0.0005**	0.0002	-0.034	-0.0001	0.0001	-0.007	-0.0003	0.0002	-0.021	-0.0002	0.0001	-0.010
Cardiovascular	-0.0001	0.0001	-0.007	-0.0001	0.0002	-0.005	-0.0001	0.0001	-0.003	0.0000	0.0001	0.000	-0.0001	0.0002	-0.004
Respiratory	**0.0004**	0.0001	0.025	**0.0004**	0.0001	0.027	0.0009	0.0005	0.046	0.0008	0.0006	0.051	0.0003	0.0001	0.018
Mental	-0.0001	0.0001	-0.005	-0.0001	0.0001	-0.004	0.0000	0.0004	0.000	-0.0014	0.0007	-0.090	**0.0000**	0.0002	0.002
Gen. Symptoms	0.0008	0.0004	0.048	0.0026	0.0018	0.176	**0.0008**	0.0004	0.042	0.0026	0.0019	0.163	0.0007	0.0004	0.037
Injuries	0.0000	0.0002	-0.003	0.0002	0.0001	0.016	-0.0005	0.0003	-0.027	0.0001	0.0002	0.006	**-0.0005**	0.0004	-0.026
Others	-0.0002	0.0002	-0.012	**-0.0010**	0.0003	-0.065	0.0002	0.0002	0.009	-0.0003	0.0003	-0.019	-0.0004	0.0003	-0.020
Compensated days of sickness, by year															
1983	-0.0004	0.0006	-0.025	-0.0018	0.0011	-0.122	0.0001	0.0007	0.006	-0.0001	0.0009	-0.008	-0.0010	0.0012	-0.053
1984	-0.0002	0.0003	-0.012	-0.0003	0.0005	-0.018	0.0000	0.0005	-0.001	-0.0003	0.0008	-0.020	-0.0004	0.0004	-0.018
1985	-0.0004	0.0002	-0.022	0.0004	0.0005	0.026	**-0.0005**	0.0002	-0.026	-0.0003	0.0007	-0.019	**-0.0005**	0.0002	-0.024
1986	-0.0003	0.0003	-0.015	-0.0001	0.0008	-0.006	-0.0003	0.0004	-0.015	-0.0007	0.0004	-0.041	0.0001	0.0006	0.004
1987	-0.0002	0.0004	-0.010	0.0002	0.0010	0.016	-0.0005	0.0003	-0.029	0.0006	0.0007	0.038	-0.0006	0.0004	-0.030
1988	**0.0017**	0.0008	0.102	0.0007	0.0012	0.047	0.0020	0.0011	0.109	0.0011	0.0009	0.071	0.0021	0.0017	0.110
Intercept	**3.24**	0.12		**3.09**	0.19		**3.16**	0.15		**3.17**	0.13		**3.56**	0.38	
n	1571			790			781			1412			159		
R-squared	0.19			0.16			0.13			0.19			0.32		
Root Mean Sq. Error	0.34			0.37			0.31			0.35			0.31		

Table A4 Estimated parameters of the selection equation

Variables	All Insured		Men		Women		Not long-term Sick 1983-88		Long-term Sick 1983-88	
	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.	Param.	Std.Err.
Female	-0.11	0.12					-0.14	0.13	0.24	0.38
Age	0.21	0.06	0.27	0.10	0.23	0.08	0.24	0.06	0.07	0.19
Age-Squared/100	-0.28	0.07	-0.37	0.14	-0.33	0.11	-0.32	0.08	-0.12	0.23
Citizenship										
Foreign	-0.90	0.18	-0.75	0.30	-1.00	0.28	-1.01	0.19	-0.44	0.97
Nationalized	-0.20	0.26	-0.45	0.39	-0.45	0.50	-0.36	0.28	0.77	0.84
Education										
Medium	0.66	0.17	1.09	0.32	0.63	0.26	0.64	0.18	0.69	0.64
High	0.71	0.20	0.46	0.28	1.23	0.39	0.60	0.21		
Married	0.20	0.20	1.01	0.55	0.19	0.34	0.19	0.20	0.22	0.56
Sickness Cohorts										
Year 1983	-0.84	0.51	-2.97	1.15	3.68	1.70			-0.64	0.86
Year 1984	-0.98	0.38	-2.90	1.05	-0.24	0.81			-0.91	0.75
Year 1985	0.07	0.53	0.60	1.45	1.33	1.10			-0.32	0.80
Year 1986	-0.35	0.54			-1.53	0.95				
Year 1987	0.31	0.61	-8.87	4.62	2.40	1.23			-0.29	0.87
Sickness Days (1986-88), by diagnosis										
Musculoskeletal	0.002	0.001	0.004	0.005	-0.007	0.002	0.016	0.014	0.000	0.001
Cardiovascular	0.002	0.002			-0.004	0.001				
Respiratory	0.056	0.013	0.023	0.025	0.072	0.022	0.059	0.015	0.073	0.035
Mental	0.000	0.001	-0.148	0.098	-0.014	0.007	0.016	0.021	0.000	0.001
Gen. Symptoms	-0.002	0.002	0.021	0.018	0.112	0.059	0.084	0.047	-0.002	0.002
Injuries	-0.003	0.001	0.012	0.006	-0.018	0.004	0.041	0.022	-0.004	0.002
Others	0.002	0.003	0.026	0.015	-0.008	0.003	0.072	0.028	-0.001	0.002
Compensated days of sickness, by year										
1983	0.013	0.005	0.013	0.012	0.059	0.022	0.031	0.015	0.004	0.006
1984	-0.002	0.002	0.014	0.007	-0.013	0.005	-0.003	0.010	-0.004	0.002
1985	-0.001	0.001	-0.003	0.003	-0.004	0.003	0.010	0.008	-0.002	0.001
1986	-0.002	0.002	-0.031	0.014	0.019	0.007	-0.012	0.006	0.000	0.002
1987	-0.002	0.002	0.131	0.059	-0.002	0.003	0.010	0.014	0.001	0.002
1988	0.106	0.018	22.426	19.545	0.160	0.040			0.040	0.018
"*50 plus*"	0.02	0.31	-0.10	0.60	0.35	0.44	0.12	0.32	0.17	0.93
Intercept	-2.77	1.04	-4.26	1.80	-3.05	1.62	-3.13	1.10	0.43	3.83
Censored obs.	117		59		58		91		26	
Uncensored obs.	1571		790		781		1412		159	
Wald chi2	331.52		140.44		97.10		293.49		62.81	
Log likelihood	-797.64		-421.63		-274.89		-721.04		-69.10	

Notes: *Param* represents the estimates of the parameters in the semi-log hourly wage equation.

Paper II

SHORT-TERM ABSENTEEISM DUE TO SICKNESS: THE SWEDISH EXPERIENCE, 1986 - 1991*

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Abstract

The goal of this paper is to analyze short term-absences from work (i.e., periods of seven days or less) in Sweden during a period with two different reforms. As a theoretical model we use a utility-maximization framework with two restrictions (time and budget constraints). Using multiple spell data, short-term absenteeism is analyzed for a period with three regimes, and it is found that the 1991 reform (which lowered the replacement rate) had a stronger effect on the hazard of ending short-term absenteeism than did the 1987 reform (which eliminated the previous unpaid "waiting day", while restricting the remuneration to only those days when people were scheduled to work). Even though economic incentives mattered, people with *poorer* health did not "shorten" their absences in the same extent as those with *better* health.

Key words: short-term absenteeism sickness spells, repeated events, unobserved heterogeneity.

JEL classification: I18; J22; J32; J33.

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1 Introduction

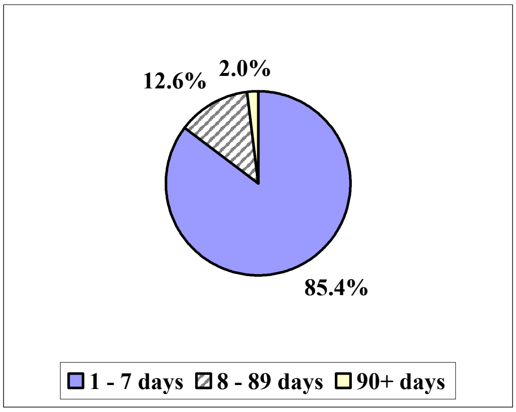
Employee absenteeism has long been an important subject of psychological, sociological, and economic research. Labor absence can be thought of as any time spent away from the workplace that is not anticipated or scheduled by the employer. The causes of work absenteeism are debated from the firm level to the macro level. People may be absent from their job because of either their own or another family member's sickness, because of death in the family, or for other strictly personal reasons. But there are also working-environment factors that determine absence from work, such as job involvement and satisfaction, a culture with strict attendance norms, etc. Persons with a high level of job satisfaction, or whose work-culture includes strict attendance norms, may seldom be away due to poor health, whereas low satisfaction, and/or lax norms, may lead to greater absenteeism. The purpose of this study is to analyze short-term absenteeism (i.e. spells of 1-7 days) due to sickness.[24] A medical certificate is required from the eighth day of sickness, so 1-7 days is a natural (short-term sickness) category. We will study the duration of these spells with regard to individual and labor market characteristics, but also with regard to characteristics related to the spells: diagnosis, the season when they occurred, and the weekday when they started.

Figures 1 a and b, and Table 1 (which motivated the interest for this study) show that about 85% of all sickness spells which ended in 1991 had a duration of 7 days or less, and accounted for about 20% of all days with a sickness benefit.[25] On the other hand, sickness spells of 90 days or more accounted for only 2% of cases, but for over 55% of compensated says. The percentage of 1-7 day cases had been substantially lower in 1986 and 1987 (Table 1). The jump in 1988 (and thereafter) appears to relate to the

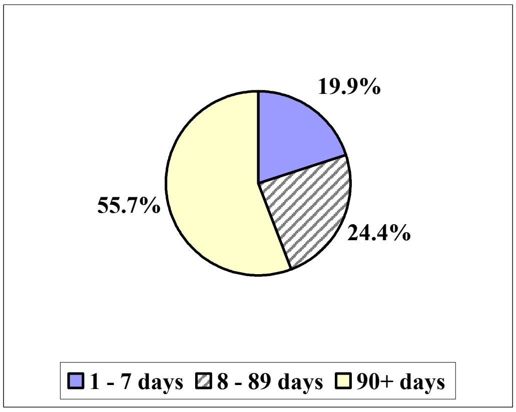
[24] Short-term sickness is an absence of 1-7 day due to sickness. It could be considered "voluntary" because a medical certificate is not required until the eighth day.

[25] In Sweden, "sickpay" is sometimes provided by the employer, and sometimes by the social insurance system. When the distinction matters, the term "sickness cash benefit" will be used for the later, and the term "sickpay" reserved for the former. During the study period, excepting one waiting day before December 1987, social insurance covered all days of employees' sickness.

fact that, from December 1987, the previous unpaid "waiting day" was eliminated, although the compensation was provided for only those days when people were scheduled to work.



a) Number of sickness spells ending in 1991 distributed by duration



b) Total number of days of sickness by spell duration

Figure 1 Duration-shares for sickness spells and for total number of benefit days,[26] by spell-duration, in 1991

Table 1 Sickness spells and the total number of sickness cash benefit days, by spell-duration, 1986-91 (%)

Year ended	Cases of sickness concluded			Days of sickness cash benefit		
	1-7* days	8-89 days	90+ days	1-7* days	8-89 days	90+ days
1986*	76.9	21.1	2.0	16.8	38.1	45.1
1987*	77.4	20.6	2.0	16.8	37.0	46.2
1988	84.4	14.0	1.6	23.8	30.3	45.9
1989	84.9	13.4	1.7	23.0	29.0	48.0
1990	85.6	12.7	1.7	22.8	27.4	49.8
1991	85.4	12.6	2.0	19.9	24.4	55.7

*Before December 1, 1987, the day when the sickness was reported was not covered by social insurance, so that the number of actual sickness cash benefit days was **1-6**, **7**-89, and 90+.

[26] The Swedish National Social Insurance Board (RFV) is the *source* of data for the entire paper, except were other sources are mentioned.

The next section reviews the literature, while Section 3 describes the institutional setting. Section 4 describes the theoretical framework used, and Section 5 the data (mostly via Appendix 2). The econometric specification, and results, are presented in Sections 6 and 7. Section 8 draws conclusions and discusses further research possibilities.

2 Literature review

Douglas (1919) was perhaps the first to analyze absenteeism, which was mentioned as "another factor in the instability of labor, which has not been given the attention that it deserves". Given the fact that during that time it was often confused with labor turnover, Douglas defined absenteeism as "absence from work at the job at which one is employed", including absence for both all-day or only partially. He examined the amount of absenteeism (i.e., the number of days and hours lost) at the plant and company level, pointing out its causes, the resulting losses, and possible methods of reducing it.

In both economic and psychological research, a common assumption is that individuals rationally allocate their labor supply by making daily decisions to attend the work or non-work setting with the highest expected utility [e.g., Winkler (1980), Chelius (1981), Youngblood (1984), Lantto (1991)]. Allen (1981a) presented a mathematical form of this model, and concluded that if absence is a normal good, then absence following a wage increase can be expected to rise as an income effect (also with respect to non-labor income), but to decline as a substitution effect. In this framework, an increase in monetary penalties for absence, such as fewer available days for future paid sick leave, would reduce absence. Additionally, Allen (1981b) argued that employees trade off wage levels against expected absences when choosing employment.

Employees may also have an incentive to be absent if the contractual hours specified by the employer exceed their optimal amount of labor supply (Brown and Sessions, 1996). Barmby et al. (1994) presented a static model in which contractual considerations played a prominent role. Building on this static model, Brown (1994) addressed two major weaknesses in the previous theory of absence behavior: the lack of demand-side considerations, and dynamics over time. Kaiser (1996) presented a model in which absence behavior was jointly determined by the employer and employees through interactive processes; first, between the absence culture of a work group and the preferences/behaviors of its individual members, and second, between the larger organization and the absence behavior of the work group. Brown (1999) used the conventional labor supply model of absence behavior, extended to multi-period analysis. Her analysis suggested again that absenteeism is primarily affected by contractual characteristics, such as the wage rate and penalties for absence. Other studies [e.g., Allen (1981a, 1981b), Barmby et al. (1991, 1995), and Johansson and Palme (1996)] have also found effects of economic incentives on individual absences.

A critical feature of the idea of *short-term choice* is that it explicitly considers the utility of both work and non-work alternatives. But sometimes the non-work alternative is more necessary, as, for example, when poor health reduces capacity to work in a given environment.

When health variables have been incorporated into absence models [e.g., Allen (1981b); Paringer (1983); and Leigh (1983, 1986, 1991)], they have usually been found to be the most important determinants of absenteeism. Other studies, however, have found that some health variables were not significant. For example, French et al. (1998) using various measures of current and lifetime drug-use, and accounting for alcohol-use co-morbidity, found no significant relationship between drug-use and either wages or absenteeism, regardless of gender.

The unemployment rate often appears to be negatively correlated with absenteeism. Some studies predicted that increased unemployment would lead to less absenteeism at the *individual* level [e.g., Larson and Fukami (1985), Leigh (1985), and Drago and Wooden (1992)], at the *plant* level [e.g., Markham and McKee, 1991], at the *industry* level [e.g., Leigh, 1985], and at the *national* level [e.g., Doherty (1979), Leigh (1985), Lantto and Lindblom (1987), and Bäckman (1998)]. Lidwall and Skogman Thoursie (2000), using official statistics produced by the Swedish National Social Insurance Board found that short-term sickness absence increases at lower levels of unemployment, and decreases at higher levels of unemployment.

Absenteeism has been found to be significantly reduced by profit sharing and employee share-ownership plans [e.g., Brown et al. (1999)].

Absenteeism has also been found to be different for women and men [e.g., Allen (1981b, 1984), Leigh (1981), Dunn and Youngblood (1986), Johansson and Palme (1996), and Vistnes (1997)]. Nevertheless, Vistnes (1997), investigating the extent and determinants of gender differences in days lost from work due to illness, found that, for both men and women, health status measures, such as self-reported health status and medical events, explained work absence more consistently than did economic incentives.

Married persons have been found to have generally lower absence rates [e.g., Keller (1983), Allen (1984), and Leigh (1986)], which might be explained by the family budget constraint, especially when only one member of the household is working and earnings replacement is well below 100%. They might also just feel better.

White-collar workers have been found to be absent less than blue-collar workers [Kenyon and Dawkins (1989)]. This may be because they are less likely to be injured at work, or work more often in occupations where it is considered acceptable to work with colds, but also easier to work with acute back pain, etc. Blue-collars workers also do more shift work, which has been associated with higher rates of absence [Drago and Wooden (1992)].

Some studies have used temporal patterns of absenteeism to make inferences about short-term absence processes, focusing on *when* an employee will be absent, rather than on *how long*. Fichman (1988, 1989) demonstrated that the daily probability of absence went up as the time since the last absence increased, but went down to the extent that fulfilling non-work events occurred (e.g., a paid holiday). Harrison and Hulin (1989) found that absence on a daily basis was uniquely associated with short-term attendance-history and with temporal variables (the weekday, and the season or month).

Some studies on absenteeism in Sweden have used day-to-day data. For example, using a sample of blue-collar workers (from the Swedish Level of Living Survey) with day-to-day data from 1991, Cassel et al. (1996) found strong economic incentive effects on absenteeism, but they also found that the sharp decrease in work absences after the 1991 reform, which lowered the replacement rate, could not be attributed solely to the higher cost of missing work. Using a linear demand function and the 1981 cross section from the Swedish Level of Living Survey, Johansson and Palme (1996) estimated absenteeism as an individual day-to-day decision. Their binomial maximum likelihood estimators were consistently estimated under the assumptions of unobserved heterogeneity and serial correlation. For the male subsample, they found a negative effect of lost earnings on work absence. Using a generalized method of moments estimator, Johansson and Brännäs (1998) empirically tested a household model for the day-to-day absenteeism decision, with similar results.

Some studies have used time-series for the average number of compensated days of sickness [e.g., Lantto and Lindblom (1987); Gustafsson and Klevmarken (1993); and Bäckman (1998)], and found a negative effect of the unemployment rate on the sickness absence rate. Except for the unemployment rate, the model specification differed across these studies. For example, Gustafsson and Klevmarken used the replacement rate as an explanatory variable; whereas Lantto and Lindblom, as well as Bäckman used dummy variables for changes in social insurance rules.

3 Sickness cash benefit in Sweden, rules and statistics

The study period for this paper is January 1986 through December 1991, during which all residents of Sweden, aged 16-64 years, and whose annual income was at least 6000 Swedish crowns (i.e., about 1100 US dollars in 1991) were eligible for a sickness cash benefit if they lost income due to sickness.[27] The National Insurance Act gives no general definition of sickness, but according to the National Social Insurance Board's recommendation, *sickness* is an abnormal physical or mental condition;[28] if it reduces normal work capacity by at least 25%, the afflicted individual can qualify for a sickness cash benefit. *Normal work capacity* is defined as either the ability to perform the same task, or the ability to earn the same income, as prior to sickness.

There were two social insurance reforms during the study period, effective December 1, 1987, and March 1, 1991. The changes that affected short-term

[27] This applied not just to employees, but also to the self-employed, who had a choice of applicable coverage, however.

[28] The sickness cash benefit is actually granted by the local social insurance offices. The National Social Insurance Board cannot set binding policy for them, but can only recommend its interpretation of law.

absenteeism due to sickness are summarized in Table 2.

Table 2 Social insurance rule changes affecting short-term absenteeism during 1986-91

Changes (in **bold**)	Regime 1 Jan 1986 – Nov 1987	Regime 2 Dec 1987 - Feb 1991	Regime 3 March 1991 – Dec 1991
Coverage	• The first day of reported sickness NOT covered. • Holidays NOT covered	• **The first day of reported sickness covered** • **Only scheduled work days are covered.**	
Replacement rate	90%	90%	**65% first 3 days** **80% day 4 - day 90** **90% day 91-**

The compulsory sickness insurance when it was implemented in 1955 stipulated a *waiting period* of three days and a limit of two years replacement in long-term sickness. In 1967 the waiting period was reduced to the day of calling in sick. In 1985 some administrative changes (for state employees) implied that also the day for calling in sick and weekends were counted as sickness absence days. In the period covered by this study, before December 1987, there was one unpaid "waiting" day before a sickness cash benefit could be claimed. For sickness spells of 7 days or less (excluding the first day), the compensation was not provided for non-working days (at most, two days).[29] Starting with December 1987, the waiting day was abolished, and a sickness cash benefit was provided from the day the sickness was reported to the social insurance office. However, a cash benefit was now only provided for scheduled workdays during the first *fourteen* days of absence. Until March 1991, the sickness cash benefit replaced 90% of lost earnings.

For most countries, including Sweden, absenteeism follows a typical pattern over the business cycle: There are more and longer absences when unemployment is low [e.g. Allen (1981a), Kenyon and Dawkins (1989), Drago and Wooden (1992), Johansson and Palme (1996)]. Figure 2 shows this inverse cyclical fluctuation of

[29] For longer spells, compensation was paid for all days, except the registration day. The self-employed could choose between waiting period of either 3 or 30 days.

absenteeism and unemployment in Sweden during the last three decades. During the economic slowdown from 1976 through 1983, the average annual number of compensated days of sickness per insured person declined from about 23 days to about 18, while unemployment reached a peak in 1983 (at the end of second OPEC recession). During the expansion of 1983 to 1989, the unemployment rate decreased, while the average number of compensated days of absenteeism due to sickness increased through 1988; and the inverse cyclical pattern then generally continued. The Swedish recession during 1991-1994 resulted in a huge increase in unemployment, from 2% to almost 10%, while absenteeism fell, reaching a low in 1997.

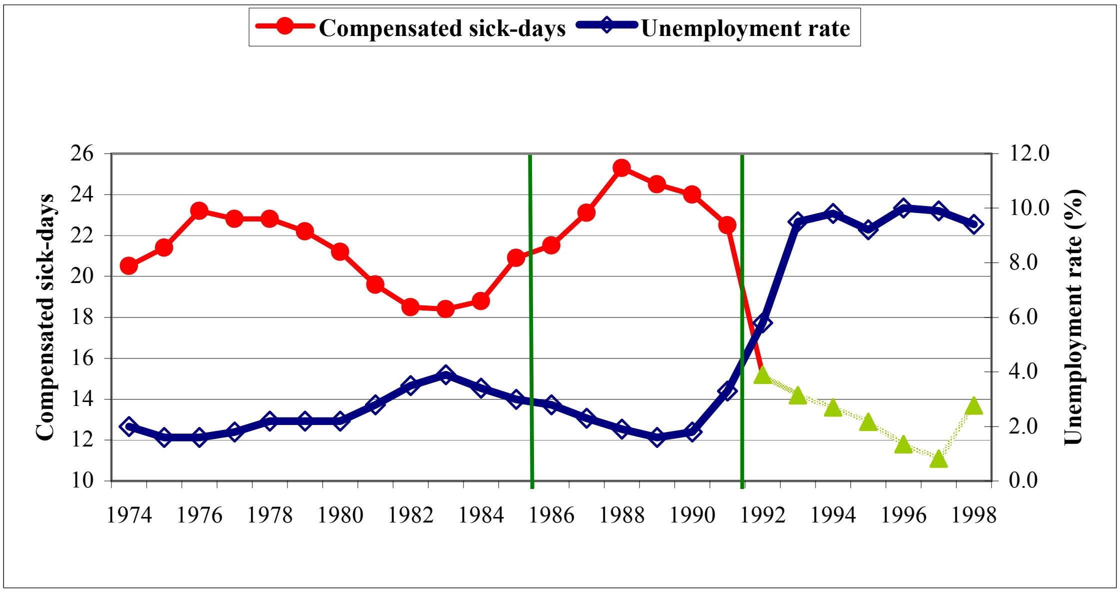


Figure 2 Average compensated sick-days per insured person[30] and the unemployment rate, 1974-1998

Economic incentives associated with the social insurance system also appear to have influenced absenteeism. After the unpaid waiting day was abolished in December 1987, there was a significant jump in the average number of compensated days of absence due to sickness, even though during the first *two* weeks, only scheduled

[30] Additionally to RFV's source, OECD Health Data 1998 is also used.

workdays were now covered. After the replacement rates were lowered (especially during the first three days) in early 1991, the absence rate fell drastically. Besides the high unemployment and lower replacement rate, the introduction of a two week "employer period" in January 1992 (represented by the "triangles" in Figure 2), contributed to a drop in average days of absence due to sickness.[31]

4 Theoretical framework

The conventional labor supply model of absenteeism focuses on contractual arrangements, assuming that the wage rate plays a central role. If markets were perfect, spot contracts would be used, and an employee who would benefit from absence on a given day would simply not go to work that day. In addition to the wage rate, however, employment contracts typically specify standard hours during which the employee is expected to work (on any given day); if these standard hours of work exceed the worker's preferred hours at the given wage, then there exists a potential utility gain from absence during the contracted hours.

In this study, short-term absenteeism is analyzed using a utility maximization framework based on Allen (1981a), Kenyon and Dawkins (1989), and Johansson and Palme (1996, 1998). It assumes that the distribution of information between employers and employees is asymmetric, in that employers must accept their employees' word regarding their actual state of health. Thus, there is an element of moral hazard in the decision to miss work.

The potential for absenteeism is determined by the employment contract. At a given wage, an employee who wants more leisure than provided therein can choose to be absent from work, possibly with sickness compensation. For the firm, this can obviously result in lost output, but it is assumed here that employees do not consider this impact directly; they rather base their decisions on their own well-being.

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[31] The "employer period" requires the employers to pay for the first weeks of sickness. Since January 1992 there has been a two-week employer period, except the time period January 1997 up to and including March 1998 when the employer covered the first four weeks.

The model uses the theory of choice in which purchased goods are one of the inputs into the production of commodities that directly enter preferences. Preferences are assumed to be a function of an ordered set of commodities Z_1, Z_2, and Z_3, the pair-wise indifference curves of which are assumed strictly convex. Z_1 is work, Z_2 is absenteeism, and Z_3 is leisure.

Let t_w measure the time spent by an employee i in work activities, t_a measure the time spent doing other activities than those specified in the work contract during the time when the employee is supposed to realize work activities specified in the contract, and t_l measure the time spent for leisure (non-market work activities, recreation, etc.). The characteristic of absenteeism due to sickness is that the employee can do any other activity than those specified in the work contract, being entitled to a compensation for the loss of earnings during the sickness period.

We can then write the model as (1)-(3)

(1) $(\max)U = U(Z_1, Z_2, Z_3)$

(2) $t_w + t_a + t_l \equiv t$

(3) $\sum_{j=1}^{3} p_j x_j = w(t_w + \rho t_a) + V$

where $Z_1 = f_1(t_w, x_1)$, $Z_2 = f_2(t_a, x_2)$, and $Z_3 = f_3(t_l, x_3)$ are three commodities produced by the employees, combining different market goods (x_j) and time (t_j); f_j are the household production functions, where f_1 and f_2 are assumed to have the same monotonic behavior. Restriction (2) represents *the time constraint*, in which t is the analyzed time period, expressed in hours, days, weeks, etc.; it can be normalized to one. Restriction (3) represents *the budget constraint*, in which the parameter ρ ($0 \le \rho \le 1$) is the replacement rate used in computing the sickness cash benefit, w ($w > 0$) is the wage rate, and V represents other income minus taxes.

The Lagrangian expression is

(4) $L = U(Z_1, Z_2, Z_3) - \lambda\left(\sum_{j=1}^{3} p_j x_j - w(t_w + \rho t_a) - V\right) - \mu(t_w + t_a + t_l - t),$

where $\lambda > 0$ represents the marginal utility of money income, which converges towards zero as income becomes high, and μ represents the marginal utility of time.

Using equilibrium conditions for the allocation of time, and substituting (see Appendix A1), we get

(5) $$\lambda(1-\rho)w = \frac{\partial U}{\partial t_a} - \frac{\partial U}{\partial t_w}.$$

It follows that, regardless of the value of the hourly wage (w) and marginal utility of money (λ), assumed to be strictly positive, individuals would be indifferent between work and be absent (i.e., $\frac{\partial U}{\partial t_a} = \frac{\partial U}{\partial t_w}$) only if $\rho = 1$ (i.e., 100% replacement rate).

If $\frac{\partial U}{\partial t_a} > \frac{\partial U}{\partial t_w} > 0$, individuals would choose to both work and be absent only if $0 < \rho < 1$, and $\lambda > 0$. Thus, given that the marginal utility of money is positive, and that the marginal utility of being absent is greater than the marginal utility of working, the level of voluntary absenteeism is determined in the model by the replacement rate. If it is low, people will be less likely to be absent, but if it is high, they will be more likely. In this model, then, economic incentives clearly affect labor participation.

If $\frac{\partial U}{\partial t_w} > \frac{\partial U}{\partial t_a} > 0$, individuals would choose to both work and be absent only if $0 < \rho < 1$ and $\lambda < 0$. In other words, if people enjoyed work very much, they would choose to be absent only if the marginal utility of money were negative. But a negative marginal utility of money is not allowed in the model, so it cannot happen that the marginal utility of work is higher than the marginal utility of being absent. Indeed, whether work is pleasant or not cannot be ascertained easily from observed behavior, but nevertheless, we expect that people who enjoy their work and working place would choose to be absent less frequently than people who are not very happy with or devoted to their work.

In sum, the model developed here addresses some aspects of *time allocation with respect to voluntary absenteeism*. Assuming that voluntary absenteeism is possible, the model illustrates that both the marginal utility of money and the replacement rate are important for the decision to miss work. In order to increase work discipline, it might be necessary to have a restriction on absenteeism. In this paper, however, the model is used *without* this restriction, in order to match the actual historical situation in Sweden during the study period.

5 The data

The LS database used here is a longitudinal database provided by the National Social Insurance Board of Sweden. The data encompass about 4500 individuals born on the 25th day of the month sometime during 1926-1966. The observation period was January 1, 1986 through December 31, 1991, which means all the individuals we will analyze are of working age.

There are two samples: 1) **IP**, a national sample based on stratified selection of the *entire insured population* of Sweden; and 2) **LSIP**, a national sample of the *long-term sick insured population*, selected from those who had at least one sickness spell of at least 60 days during the period January 1986 to December 1989. As there could be differences between the two populations with respect to the subject of this study, both samples were examined. Descriptive statistics of these samples and their analysis are presented in Appendix A2.

6 Econometric specification

The approach taken by the majority of researchers [e.g., Allen (1981a, 1981b), Dunn and Youngblood (1986), Chaudhury and Ng (1992)] has been to explain *the amount of observed absence* (i.e., absence rates across individuals or work places) with a set of regressors, such as wages and contractual hours, using a model derived from the income-leisure framework. Another approach analyzes the *probability of being absent on a particular day*, which is likely to be dependent on whether or not the individuals were absent the day before, given that the health status of an individual on a particular day is not independent of their health status the day before. This study uses this approach to analyze the hazard of ending the spell of short-term absence.

Let D_i measure the completed duration of absence due to sickness for employee i, and $S(t)$ measure the probability that an employee would be absent from work for at least t days, where $S(t) = \Pr(D > t)$ and $t > 0$. The corresponding distribution function of

D is then $F(t) = \Pr(D < t) = 1 - S(t)$, where $t > 0$. From information on D, we want to estimate the impact of observable (p) and unobservable (u) personal characteristics on the duration of absence.

One can estimate nonparametric, semiparametric, and parametric regression models with censored survival data. The semiparametric approach has the advantage that it does not make any assumption about the underlying distribution of completed sickness spells. Assuming that the hazard function can be factored into a function of time and a function of variables related both to spell and to individual, we can model the hazard of ending short-tem absenteeism (or the hazard of returning to work) as

(6) $$h_i(t; x_i) = h_0(t)\exp(\beta x_i),$$

where (β_1, β_2,…, β_k) is a vector of unknown parameters; x_i is the vector of k covariates for employee i, which may depend on time, or not; and $h_0(t)$ is the baseline hazard function, an unknown function of time. The expression $h_0(t)$ gives the hazard function for the standard set of conditions $x = 0$, and leaves $h_0(t)$ parametrically unspecified.

The data used here have a multi-episode design, which means that we have to check if there is a significant difference between absences across observation units, i.e., whether or not the sample is heterogeneous (neglected heterogeneity between observation units can lead to incorrect conclusions). For example, there are many techniques for analyzing duration data that are based on the assumption that the durations of distinct individuals are independent of each other, but in the case of repeatable events, this assumption is questionable, especially when same individuals have many spells.

There are basically two approaches to analyzing repeated events: 1) a separate analysis for each successive event; or 2) an analysis of all spells together, treating each spell as a distinct observation. The first approach gives a biased sample of later spells (for example, only people who have already had two spells, in the analyzed period, can have a third spell), and it could be inefficient, especially if the underlying process is unchanged from one period to the next, which would result in several redundant estimates. The second approach has the potential problem of dependence among multiple observations, which can be thought of as arising from *unobserved* *heterogeneity*, leading to declined hazard functions, and coefficients that are attenuated toward zero.

There are methods [e.g., Chamberlain (1985), Wei et al. (1989), and Allison (1996)] that correct some of these problems.[32] A fixed-effects version of a Cox regression (partial likelihood) is available for data in which (at least two) repeated events are observed for each individual [Chamberlain (1985), Yamaguchi (1986), Allison (1996)].

In the applied econometric literature on the estimation of multiple-duration models, the range of different models is actually not very large. Van den Berg (2000) provides an overview of duration analysis, with an emphasis on models for multiple durations, especially on the mixed proportional hazard (MPH) model and its multivariate extensions. For the multivariate mixed proportional hazard (MMPH) model, in which the marginal duration distributions each satisfy an MPH specification, and the durations can only be dependent by way of their unobserved determinants, he discusses the dimensionality of the heterogeneity distribution, and compares the flexibility of different parametric heterogeneity distributions.

Frequently in the analysis of survival data (e.g., how long sick employees "survive" before returning to work), survival times within the same "group" are correlated due to unobserved covariates. One way these covariates can be included in the model is as *frailties*; a frailty term represents the common covariates that are not

[32] Chamberlain (1985) introduced an approach, called Fixed-Effects Partial Likelihood, which corrects for some or all of the bias in the coefficients caused by unobserved heterogeneity; however, he expressed reservation about its use when the number of intervals varies across individuals, and when spell-duration depends on the lengths of the preceding spells. Wei et al. (1989) proposed a method for getting robust estimates that allows for dependence among multiple spells, allowing the computation of efficient pooled estimates of the coefficients and their standard errors, but it does not correct for biases in the coefficients due to unobserved heterogeneity. Using Monte Carlo simulations, Allison (1996) concluded that, except in cases where the number of previous spells is included as a covariate, there is, in practice, little or no problem regarding Chamberlain's concerns.

observed or are neglected. A *frailty model* [33] is a random effects model for time variables, where the random effect (the frailty) has a multiplicative effect on the hazard. This model can be used to describe the influence of unobserved covariates in a proportional hazard model, for example with multivariate failure times generated independently given the frailty for "groups" (both for survival times for related individuals, like twins or family members, and for repeated events for the same individual). These frailty random block effects generate dependency between the survival times of the individuals that are conditionally independent given the frailty.

Here we will assume that all individual variation in the hazard function can be characterized by a finite-dimensional vector of observed explanatory variables x and an unobserved heterogeneity term u. We can thus redefine our model (6) as

(7) $h_{ij}(t; x_{ij}, u_i) = h_0(t) u_i \exp(\beta x_{ij})$, $i = 1, 2, \ldots, G$, $j = 1, 2, \ldots, n_i$.

where h_{ij} represents the hazard rate of subject j in group i; u_i (u_i=exp(σw_i) can be interpreted as a function of unobserved explanatory variables. According to Lancanster (1990), u_i may also to some extent represent measurement errors in D and x. The u_i's are assumed independent and identically distributed from a distribution with mean 1 and some unknown variance. When $u_i > 1$, employees in a given group tend to "fail" (in this case, return to work) faster than under an independence model (where $u_i = 1$). When $u_i < 1$, employees in a given group tend to "fail" slower than under an independence model. The unobserved heterogeneity term is assumed constant from one event (absence) to the next, and has a specified distribution, independent of x_{ij}.

In this study, we expect that rule changes created substantial variation in the cost of being absent from work during the period studied, and changed the pattern of short-term absences due to sickness during the study period. The longitudinal structure of the

[33] Clayton (1978) and Oakes (1982) were the first to consider frailty models for multivariate survival data, using gamma distribution for the frailty. Hougaard (1986) introduced the G-family of distributions, which includes the gamma distributions and inverse Gaussian distributions. He also used the positive stable distribution for the frailty, along with arbitrary and Weibull hazards. Lu and Bhattacharyya (1990) used the Weibull distribution to model the frailty parameter, while Whitmore and Lee (1991) studied a model with inverse gamma frailties.

data provides *multiple spells*, which makes it possible both to analyze these changes, but also requires that we deal with *unobserved heterogeneity*. Therefore, we used a frailty model in the empirical analysis.

7 Empirical Results

In the *fist* step, using nonparametric estimation, a preliminary analysis of the short-term absences due to sickness was produced for both samples. Tables 3 and 4 show the plots of the estimated survival and hazard functions, respectively, stratified by the weekday when the spells of absence began. In general, the closer was the beginning of the spell to the following weekend, the shorter was the spell, so that the most likely *ending* day was Friday. In both samples, in both survival and hazard plots, this effect is especially visible (in both of the following periods) after the 1987 reform, which restricted the coverage of the earnings lost only to scheduled work (which increased the probability of uncompensated weekends). For the survival functions, it is highlighted (with "balloons") for the LSIP sample in the period after the 1987 reform, but it remains equally visible after the 1991 reform as well. For the hazard functions, it is similarly highlighted for the IP sample, Generally speaking, for both samples and all three periods, absences which started on the weekend (especially Sunday) lasted the longest.

The hazard rates were much higher for the IP sample than for LSIP, meaning that people in the IP sample were more likely to return to work sooner, and the rates increased for both samples after the 1987 reform, and again after the 1991 reform, which indicates that in both regimes the spells of absenteeism due to sickness became shorter. This is expected after the 1991 reform, because the replacement rate was lowered, from 90% to 65% for the first 3 days, and to 80% from day 4.

Table 3 Survival functions (s) by the weekday when the short-term absences began, and by regime, and sample

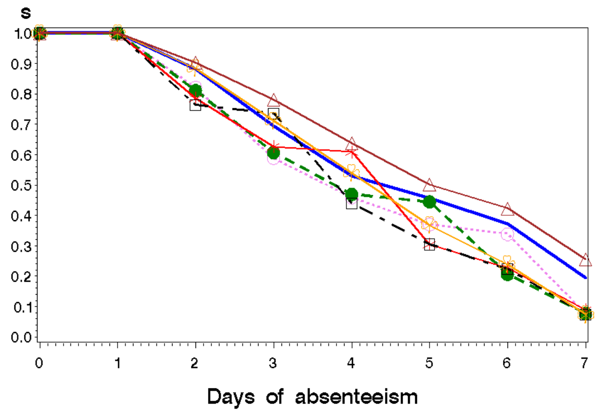
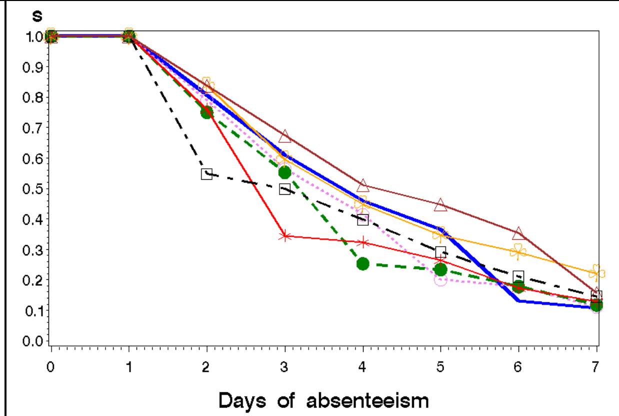
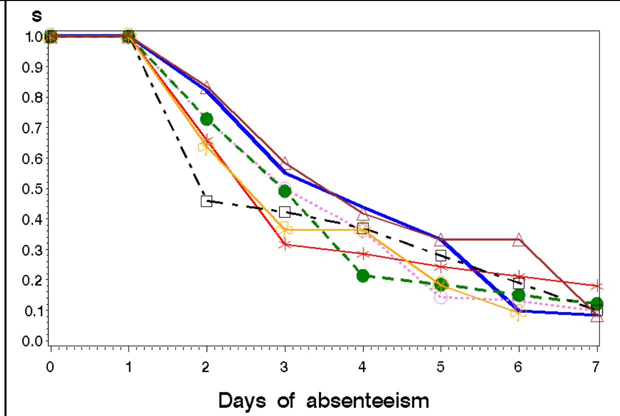
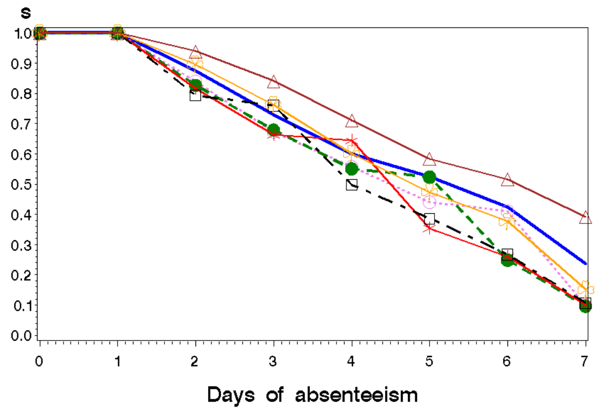
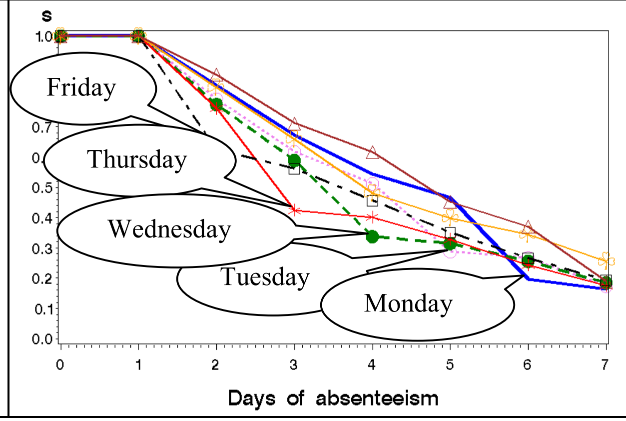
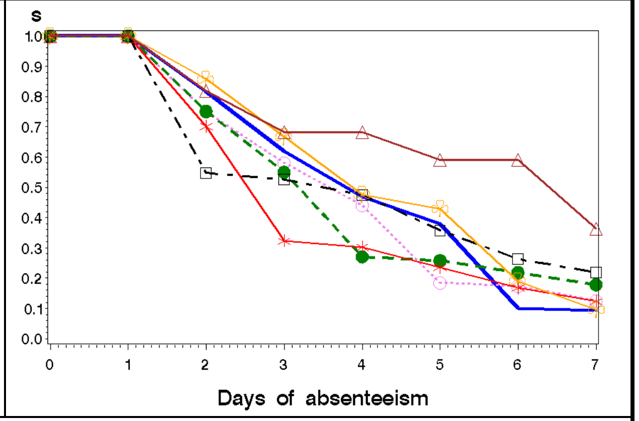
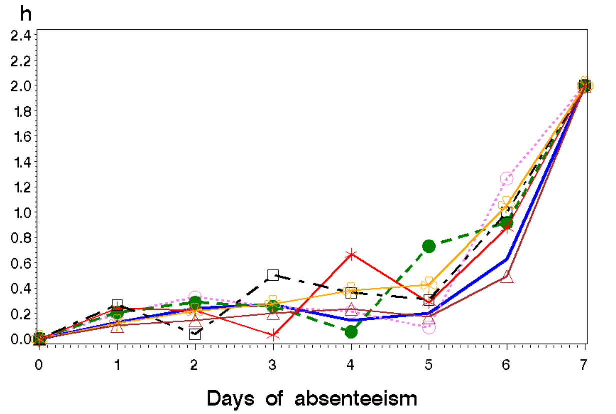
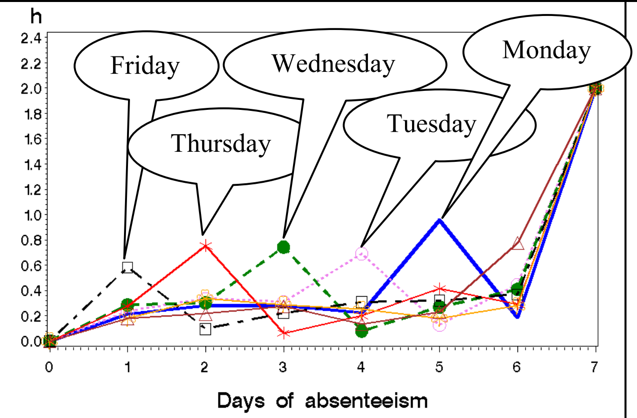
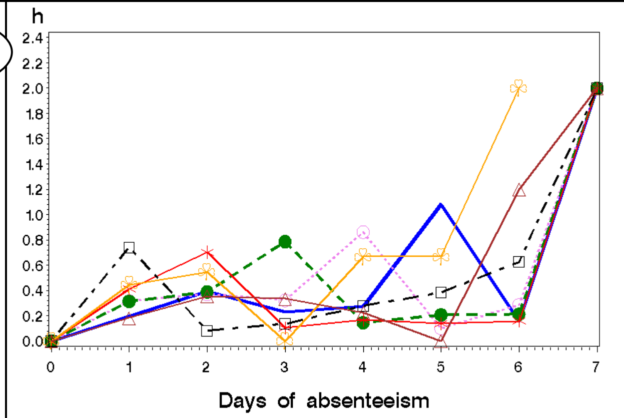
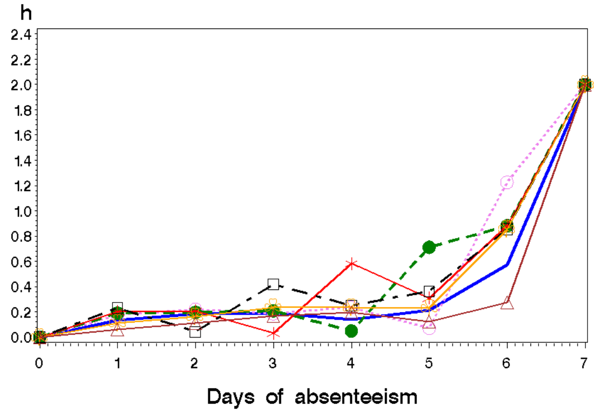
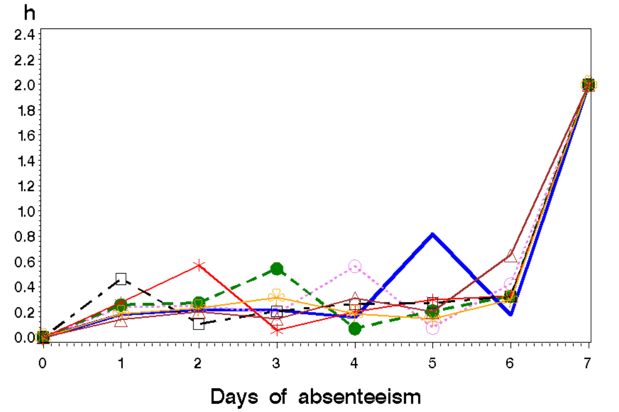
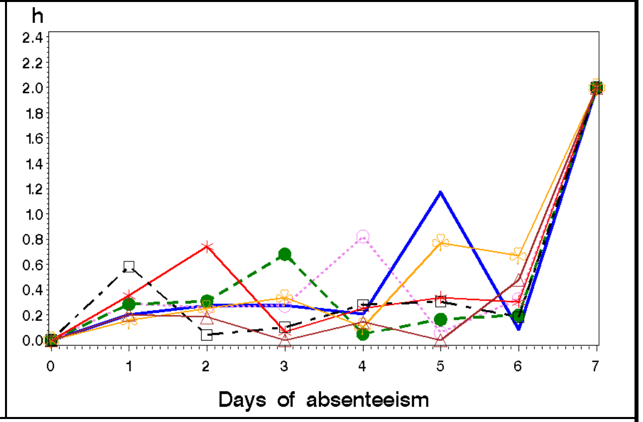
Data	Before the 1987 reform	December 1987 – February 1991	After the 1991 reform
IP			
LSIP			
Weekday when the spell began	Monday, Friday	Tuesday, Saturday	Wednesday, Sunday, Thursday

Table 4 Hazard Functions (h) by the weekday when absences began, and by regime, and sample

Data	Before the 1987 reform	December 1987 – February 1991	After the 1991 reform
IP			
LSIP			
Weekday when the spell began	Monday Friday	Tuesday Saturday	Wednesday Sunday Thursday

Thus, nonparametric analysis suggests that there were differences across regimes, and also that, during each regime, there was a significant relationship between the weekday when the absenteeism started and its duration; i.e. spells that started at the beginning of the week were longer than those that started at the end of week. The result that absences that started on a Sunday or Saturday after 1991 are the longest, can be interpreted as an effect of the lower replacement rates during the first 3 days.

In the *next* step of the analysis, the effect of various factors on short-term absence due to sickness was estimated using a semiparametric model. Table 5 shows coefficient estimates, standard errors, and hazard ratios of the gamma frailty model for both IP and LSIP samples during the entire period1986-1991, using dummies for the three policy regimes. Kendall's τ was quite small for both samples (about 0.05), which suggests very weak association within the groups, i.e., spells grouped by person. For both samples, there was thus a significant random effect related to the duration of short-term absences.

Women had a higher hazard of ending absenteeism within 7 days than did men, about 1.2 times higher for both samples. In general, the hazard of ending absenteeism was lower for older people, which means that younger people generally returned to work sooner.

For naturalized Swedes and other foreign born individuals, for both samples, the hazard of ending absenteeism was about 81-86% of that of Swedish born people, which means that Swedish born generally returned to work sooner. A poor health background, selection to specific work environments due to ethnic background, and/or cultural differences might explain this. For married people, the hazard of ending absenteeism was slightly higher than for singles; i.e., married employees returned to work sooner.

Although, as discussed in Appendix A2, the absence rate during summer months was the lowest during the year, the hazard ratios by quarter show that, for both samples, absences which began during summer lasted longest. This means that people use sick leave instead of vacation days.

Table 5 Estimation results for short-term absences during 1986-1991 (gamma frailty)

Variables	Insured Population (IP)			LTS-Insured Population (LSIP)		
	Estimate	Standard error	Hazard ratio	Estimate	Standard error	Hazard ratio
Frailty	**0.096**	0.008	1.101	**0.106**	0.007	1.111
Female (CG[a]: Male)	**0.194**	0.030	1.214	**0.181**	0.024	1.199
Age (CG: -35 years)						
36-45 years	-0.046	0.032	0.955	0.027	0.025	1.028
46-55 years	**-0.136**	0.035	0.873	-0.035	0.028	0.966
56-65 years	**-0.203**	0.044	0.816	-0.042	0.033	0.959
Citizenship (CG: Swedish born)						
Naturalized Swede	**-0.195**	0.061	0.823	**-0.187**	0.043	0.830
Other foreign born	**-0.151**	0.053	0.860	**-0.213**	0.039	0.808
Married (CG: Unmarried)	**0.090**	0.027	1.095	**0.089**	0.021	1.093
Quarter (CG: Winter)						
Spring	-0.007	0.026	0.993	-0.002	0.020	0.998
Summer	**-0.096**	0.026	0.908	**-0.079**	0.020	0.924
Autumn	-0.028	0.025	0.972	-0.015	0.020	0.985
Diagnosis (CG: Respiratory)						
Musculoskeletal	**-0.074**	0.033	0.929	0.004	0.023	1.004
Cardiovascular	-0.199	0.119	0.820	0.150	0.081	1.162
Mental	-0.180	0.111	0.835	0.027	0.060	1.028
General symptoms	**0.375**	0.030	1.454	**0.374**	0.023	1.454
Injuries and poisoning	**-0.127**	0.050	0.881	-0.017	0.038	0.983
Other	**0.376**	0.024	1.456	**0.410**	0.019	1.506
Weekday when absence started (CG: Weekend)						
Monday	**0.100**	0.044	1.105	**0.117**	0.033	1.125
Tuesday	**0.182**	0.045	1.200	**0.181**	0.034	1.198
Wednesday	**0.196**	0.046	1.216	**0.212**	0.034	1.236
Thursday	**0.193**	0.047	1.213	**0.248**	0.035	1.281
Friday	**0.178**	0.049	1.195	**0.200**	0.037	1.222
Previous cases [b]	-0.001	0.001	*-0.072*	0.001	0.001	*0.085*
Previous LTS[c] **cases**	-0.006	0.024	*-0.643*	-0.018	0.012	*-1.807*
Daily loss[d] (100 SEK)	**0.005**	0.001	*0.475*	**0.004**	0.001	*0.363*
Unemployment Rate	-0.005	0.011	*-0.500*	-0.013	0.008	*-1.258*
Regime (CG: before Dec 1987)						
Dec 1987 - Feb 1991	**0.127**	0.027	1.135	**0.090**	0.022	1.094
After Feb 1991	**0.275**	0.046	1.316	**0.253**	0.039	1.288
Kendall's τ	0.046			0.050		
	no Frailty	Frailty	Chi-Square	no Frailty	Frailty	Chi-Square
-2 Log Likelihood	54312.35	53901.91	410.4417	92021.48	91175.16	846.3198

Note: **Bolds** are significant for the IP sample at the 5% level, and for the LSIP sample at the 1% level; *Italics* for hazard ratio (*hr*) indicate that, for the continuous variables, it has been recomputed as *phr* = 100*(*hr*-1).

[a] CG indicates the comparison group.

[b] Previous cases of sickness before the analyzed spell, since January 1983, regardless of their duration.

[c] Previous cases of long-term sickness (LTS) before the analyzed spell, since January 1983, given that are at least 60 days of duration.

[d] Daily earnings loss due to absence.

Hazard ratios by diagnosis are rather different for the two samples. For the IP sample, persons with musculoskeletal, cardiovascular, and mental diagnoses, as well as injuries and poisonings, were slower to return to work than those with respiratory diagnoses. However, for the LSIP sample, except for injuries and poisonings, all diagnostic groups returned to work faster than those with a respiratory diagnosis.

For both samples, those whose absences started during the week (Monday-Friday) returned to work faster than those whose absences started on a weekend, and those whose absences started *earlier* in the week generally returned to work faster than did those whose absences that started later, although this trend was broken on *Friday* for both samples, and already on *Thursday* for IP.

Loss of earnings (due to sickness) is another factor that had a statistically significant impact on absence duration. For each 100 Swedish crowns in daily earnings loss, the hazard of ending an absenteeism spell went up by about 0.4-0.5%.

Neither of previous sickness history variables (total cases and total LT cases) was found to be a significant determinant of short-term absence duration. Regional unemployment also failed to pass the significance test.

The regime dummies are also statistically significant, and show that the 1991 reform had an especially strong impact on absenteeism. After the 1987 reform, people in both samples were more likely to return to work sooner (hazard ratios: 1.13 and 1.09), and even more so after the 1991 reform (hazard ratios: 1.32 and 1.29). Given the differences on the magnitude of regime dummies, a separate analysis was also done for each regime. Table 6 shows similar estimation results for the IP sample alone, but divided into the three regimes. The gamma frailty model was estimated for the first two regimes, but a standard Cox model for the last.[34] Table 7 shows estimation results from the gamma frailty model for the LSIP sample alone, also divided in three regimes.

[34] The data for the last regime of the IP sample did not support the gamma frailty model, possibly due to a short time horizon for this regime. The EM algorithm computes a likelihood assuming independence, i.e., $\theta = 0$, and then increases this values until it finds a likelihood which is larger than the likelihood at $\theta = 0$. From there it starts a numerical routine to find the root. If it cannot find that point, then it is considered the independence case. Therefore for the IP sample, only the first spell of short-term absence after the 1991 reform was used, i.e., 559 spells out of 967 total. For the other two regimes, and for all three regimes with the LSIP sample, there is a significant random effect related to absence duration by person.

Table 6 Estimation results for short-term absences, by regime, IP sample

Variables	Before Dec 87 (n = 3580)			Dec 87 – Feb 91 (n =8326)			After Feb 91 (n = 559)		
	Estimate	S.E.	HR	Estimate	S.E.	HR	Estimate	S.E.	HR
Frailty	**0.07**	0.02	1.07	**0.08**	0.01	1.08			
Female (CG[a]: Male)	**0.22**	0.05	1.25	**0.21**	0.03	1.24	**0.26**	0.10	1.30
Age (CG: -35 years)									
36-45 years	-0.03	0.05	0.97	-0.05	0.04	0.95	-0.17	0.12	0.85
46-55 years	**-0.19**	0.06	0.83	**-0.11**	0.04	0.90	**-0.21**	0.12	0.81
56-65 years	**-0.29**	0.08	0.75	**-0.14**	0.05	0.87	**-0.38**	0.14	0.68
Citizenship (CG: Swedish Born)									
Naturalized Swede	-0.08	0.09	0.93	**-0.20**	0.07	0.82	**-0.40**	0.22	0.67
Foreign born	-0.13	0.08	0.88	**-0.14**	0.06	0.87	-0.26	0.18	0.77
Married (CG: Unmarried)	**0.13**	0.04	1.14	**0.08**	0.03	1.08	0.02	0.09	1.02
Quarter (CG: Winter)									
Spring	0.01	0.05	1.01	0.00	0.03	1.00	-0.09	0.11	0.92
Summer	-0.06	0.05	0.94	**-0.09**	0.03	0.91	-0.25	0.13	0.78
Autumn	0.05	0.05	1.05	-0.04	0.03	0.96	0.19	0.43	1.21
Diagnosis (CG: Respiratory)									
Musculoskeletal	**-0.15**	0.06	0.86	-0.05	0.04	0.95	-0.15	0.15	0.86
Cardiovascular	**-0.41**	0.25	0.66	-0.15	0.15	0.86	-0.24	0.52	0.79
Mental	**-0.32**	0.19	0.73	-0.14	0.15	0.87	-0.45	0.43	0.64
General symptoms	**0.19**	0.06	1.21	**0.39**	0.04	1.48	**0.73**	0.13	2.07
Injuries & poisoning	**-0.18**	0.09	0.84	**-0.13**	0.07	0.88	0.13	0.26	1.13
Other	**0.24**	0.05	1.28	**0.42**	0.03	1.52	**0.47**	0.11	1.59
Weekday when absence started (CG: Weekend)									
Monday	-0.02	0.07	0.98	**0.15**	0.07	1.16	0.24	0.29	1.27
Tuesday	**0.16**	0.07	1.17	**0.21**	0.07	1.23	0.36	0.29	1.43
Wednesday	**0.23**	0.07	1.26	**0.24**	0.07	1.27	0.21	0.30	1.23
Thursday	**0.20**	0.07	1.22	**0.25**	0.07	1.28	0.21	0.31	1.24
Friday	**0.25**	0.07	1.28	**0.20**	0.07	1.22	0.29	0.30	1.33
Previous cases [b]	**-0.01**	0.01	*-1.00*	0.00	0.00	*-0.20*	-0.01	0.00	*-0.48*
Previous LTS[c] cases	-0.12	0.09	*-11.51*	-0.03	0.03	*-2.49*	0.07	0.07	*6.74*
Daily loss[d] (100 SEK)	**0.01**	0.00	*0.78*	**0.01**	0.00	*0.47*	0.00	0.00	*0.18*
Unemployment rate	-0.02	0.02	*-2.14*	0.01	0.02	*0.93*	-0.02	0.05	*-2.07*
Kendall's τ	0.03			0.04					
	No frailty	Frailty	Chi-Sq.	No frailty	Frailty	Chi-Sq.	No covariate	Cov.	Chi-Sq.
-2 Log Likelihood	15462.6	15422	39.9	34583.4	34435	148.9	6254	6174	79.7

Note: **Bolds** are significant for the IP sample at the 5% level, and for the LSIP sample at the 1% level; *Italics* for hazard ratio (hr) indicate that, for the continuous variables, it has been recomputed as phr = 100*(hr-1). [a] CG indicates the comparison group.

[b] Previous cases of sickness before the analyzed spell, since January 1983, regardless of their duration.

[c] Previous cases of long-term sickness (LTS) before the analyzed spell, since January 1983, given that are at least 60 days of duration. [d] Daily earnings loss due to absence.

Table 7 Estimation results for short-term absences, by regime, LSIP sample

Variables	Before Dec 87 (n = 3580)			Dec 87 – Feb 91 (n =8326)			After Feb 91 (n = 559)		
	Estimate	S.E.	HR	Estimate	S.E.	HR	Estimate	S.E.	HR
Frailty	**0.08**	0.01	1.08	**0.10**	0.01	1.11	**0.07**	0.03	1.08
Female (CG[a]: Male)	**0.19**	0.03	1.20	**0.19**	0.03	1.21	0.13	0.08	1.14
Age (CG: -35 years)									
36-45 years	0.02	0.04	1.02	**0.05**	0.03	1.06	0.02	0.09	1.02
46-55 years	-0.05	0.04	0.96	-0.02	0.03	0.98	-0.02	0.09	0.98
56-65 years	-0.07	0.05	0.93	-0.02	0.04	0.98	-0.02	0.12	0.98
Citizenship (CG: Swedish Born)									
Naturalized Swede	**-0.13**	0.06	0.88	**-0.22**	0.05	0.81	-0.17	0.14	0.85
Foreig born	**-0.19**	0.06	0.83	**-0.22**	0.05	0.80	-0.14	0.12	0.87
Married (CG: Unmarried)	**0.12**	0.03	1.12	**0.08**	0.03	1.09	**0.14**	0.07	1.15
Quarter (CG: Winter)									
Spring	0.01	0.04	1.01	-0.01	0.03	0.99	-0.03	0.10	0.98
Summer	**-0.02**	0.04	0.98	**-0.09**	0.03	0.92	**-0.17**	0.10	0.84
Autumn	0.05	0.05	1.05	-0.04	0.03	0.96	-0.39	0.21	0.68
Diagnosis (CG: Respiratory)									
Musculoskeletal	-0.01	0.04	0.99	0.01	0.03	1.01	-0.02	0.09	0.98
Cardiovascular	0.14	0.13	1.15	**0.27**	0.11	1.31	-0.53	0.34	0.59
Mental	-0.14	0.10	0.87	0.11	0.08	1.11	-0.30	0.32	0.74
General symptoms	**0.27**	0.04	1.31	**0.43**	0.03	1.54	0.13	0.11	1.14
Injuries & poisoning	-0.03	0.06	0.97	-0.02	0.05	0.98	-0.23	0.17	0.79
Other	**0.31**	0.03	1.37	**0.46**	0.03	1.59	**0.15**	0.09	1.16
Weekday when absence started (CG: Weekend)									
Monday	**0.11**	0.05	1.11	**0.08**	0.05	1.09	0.23	0.19	1.25
Tuesday	**0.26**	0.05	1.30	**0.14**	0.05	1.14	0.26	0.19	1.29
Wednesday	**0.35**	0.05	1.42	**0.16**	0.05	1.18	0.23	0.20	1.25
Thursday	**0.37**	0.05	1.45	**0.19**	0.05	1.21	**0.35**	0.19	1.42
Friday	**0.37**	0.05	1.44	**0.16**	0.06	1.17	-0.31	0.22	0.74
Previous cases [b]	0.00	0.00	-0.34	0.00	0.00	0.18	0.00	0.00	0.06
Previous LTS[c] cases	**-0.05**	0.03	-5.23	**-0.04**	0.01	-3.60	-0.02	0.03	-2.05
Daily loss[d] (100 SEK)	**0.01**	0.00	0.50	**0.00**	0.00	0.36	0.00	0.00	0.19
Unemployment rate	0.00	0.01	-0.14	**-0.03**	0.01	-2.50	0.02	0.04	1.86
Kendall's τ	0.04			0.05			0.04		
	No frailty	Frailty	Chi-Sq.	No frailty	Frailty	Chi-Sq.	No frailty	Frailty	Chi-Sq.
-2 Log Likelihood	30854	30754	100	54469	54077	392	19231	19110	121

Note: **Bolds** are significant for the IP sample at the 5% level, and for the LSIP sample at the 1% level; *Italics* for hazard ratio (hr) indicate that, for the continuous variables, it has been recomputed as phr = 100*(hr-1).

[a] CG indicates the comparison group.

[b] Previous cases of sickness before the analyzed spell, since January 1983, regardless of their duration.

[c] Previous cases of long-term sickness (LTS) before the analyzed spell, since January 1983, given that are at least 60 days of duration.

[d] Daily earnings loss due to absence.

Kendall's τ was quite small (about 0.04) for both samples and all regimes, which suggests very weak association within the groups. During all three regimes for both samples, women returned to work faster than men (their hazard ratios were in the range 1.14-1.30). Differences between the IP and LSIP samples might be due to the different average health status of the two samples (those from LSIP returned to work slower than did those from IP). Differences between the first two and the third regime, for IP and LSIP, might relate to changes in the replacement rate.

In general, as one might expect, younger people returned to work faster than did older people although, not all estimates were statistically significant, especially for LSIP.

Although all the results did not meet the statistical significance test, the hazard of ending absenteeism for foreign-born people (whether naturalized or not) was always lower than that for Swedish born, across all regimes, and in fact, for both samples, seemed to go down after the first reform, and at least for the IP sample, it went down further after the second.

For the IP sample, the hazard for ending absenteeism was higher for married people than for those who were unmarried, though it fell after the first reform, and still further after the second. For the LSIP sample, the fall after the first reform was reversed after the second.

For the IP sample, during all three regimes the hazard of ending absenteeism was lower for those with musculoskeletal, cardiovascular, and mental diagnoses, as well as those with injuries or poisonings, compared to those with respiratory diagnoses. During the third regime, this was also true for the LSIP sample. During the other two regimes, however, for the LSIP sample people with a diagnosis of general symptoms had a higher hazard of ending absenteeism that did people with a respiratory diagnosis.

The results again show that there was a *timing of absenteeism* with respect to the weekday when the spell began, after the 1987 reform. For both IP and LSIP samples, regardless of which weekday their absence began on, employees were less likely to return to work sooner (compared to the weekend) before the first reform, and even after this reform (except for Friday), but the trend disappeared after the second reform. On the other hand, the magnitude of the impact of the first reform was not the same for the IP and LSIP samples, which might be related to the different health status of the two samples, though exactly how or why is not obvious. Moreover, for both samples, loss of earnings had a very weak effect. For each 100 Swedish crowns increase in daily earnings loss, the hazard of ending an absenteeism spell went up by about one half percent.

The level of regional unemployment had no significant effect on absence duration before the 1987 reform, nor after the 1991 reform, but it had a significant *negative* effect for the LSIP sample during the middle regime (December1987-February 1991). Each additional percentage point of regional unemployment was then associated with about a 2.5% decrease in the hazard of ending the absenteeism spell.

8 Summary and conclusions

Both the nonparametric and the semiparametric analyses suggest that there were differences between the IP and LSIP samples (i.e., insured people, and insured people with poorer health) for the *entire* period, but also *across regimes*. Differences between the IP and LSIP samples might be due to the *different* average health status of the two samples, while the differences across regimes might be due to *different* replacement rates (i.e., different economic incentives).

The *nonparametric analysis* suggests that there was a significant relationship between the *weekday* when the absenteeism started and its duration. In general, the closer was the beginning of the spell to the following weekend, the shorter was the spell, so that the most likely *ending* day was Friday. In both samples, in both survival and hazard plots, this effect is especially visible (in both of the following periods) after the 1987 reform, which restricted the coverage of the earnings lost only to scheduled work, which increased the probability of uncompensated weekends. After both the 1987 and the 1991 reform, spells became shorter. For the 1987 reform, this indicates that the effect of limiting the compensation to only scheduled work was (much) stronger than the effect of eliminating the first waiting day. This is an expected result after the 1991 reform, because the replacement rate was lowered, from 90% to 65% for the first 3 days, and to 80% from day 4. The result that absences that started on a Sunday or Saturday after 1991 are the longest can be interpreted as an effect of the lower replacement rates during the first 3 days. Another general result across regimes was that the hazard rates were much *higher* for the IP sample than for LSIP, meaning that people in the IP sample were more likely to return to work *sooner*.

The *semiparametric analysis for the entire period* tells us that while the *direction* of impact of the *determinants* of the absence duration was the same, the *magnitude* of their impact was different. Women had a higher hazard of ending absenteeism within 7 days than did men, and in general, the hazard of ending absenteeism was lower for older people, which means that younger people generally returned to work sooner. For naturalized Swedes and other foreign born individuals, for both samples, the hazard of ending absenteeism was lower than that of Swedish born people, which means that *Swedish born persons* generally returned to work *sooner*. For married people, the hazard of ending absenteeism was slightly higher than for singles, i.e., *married* employees returned to work *sooner*. For both samples, absences started during the week (Monday-Friday) were shorter than absences started on a weekend, in line with the nonparametric analysis, and absences during the summer lasted longest. The regime dummies are also statistically significant, and show that while the direction of the impact of both 1987 and 1991 reform was the *same* for the IP and LSIP samples, the *magnitude* of the impact of both reforms was higher for the IP sample. This last result might be related to the different health status of the two samples, as both reforms had a higher positive impact on the hazard of those from the IP sample. This means that even though economic incentives mattered, people with poorer health did not "shorten" their absences in the same extent as those with better health.

The *semiparametric analysis for the three regimes* estimated separately suggests that women returned to work faster than men. For the IP sample, the hazard for ending absenteeism was higher for married people than for those who were unmarried, though it fell after the first and second reforms. For the LSIP sample, the fall after the first reform was reversed after the second. Except general symptoms, and other diagnoses, people with respiratory diagnoses (mainly, *common colds*) get well faster, and this is generally true for both IP and LSIP samples. For both IP and LSIP samples, regardless of which weekday their absence began on, people were less likely to return to work sooner (compared to the weekend) before the first reform, and even after this reform (except for Friday), but the tendency disappeared after the second reform. Moreover, for both samples, loss of earnings had a very weak effect: For each 100 Swedish crowns increase in daily earnings loss, the hazard of ending an absenteeism spell went up by about one half percent. The level of regional unemployment had no significant effect on absence duration before the 1987 reform, nor after the 1991 reform, but it had a significant *negative* effect for the LSIP sample during the middle regime (December1987-February 1991).

In sum, the 1991 reform, which reduced the replacement rate, had a stronger effect on reducing the duration of short-term absences than the 1987 reform, which restricted the payment of sickness cash benefit to only scheduled workdays. After the 1987 reform, fewer reported sickness starting on the weekend, and more on Monday. Generally, the closer to the end of the week was the beginning of the absence, the shorter was the spell. The change in the frequency of spells by the weekday when they started, before and after the 1987 reform (i.e., fewer absences started on weekend, more on Monday), may be explained by the existence of a waiting day prior December 1, 1987, while the change in the frequency of spells by the weekday when they ended (i.e., the most ended on Friday) can be explained by the restriction of the coverage only to the scheduled days of work. In conclusion, the *rules* clearly influenced people's decisions about *when* to report the beginning and ending of sickness spells.

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Appendix A1 To get equation (5)

(A1) $\frac{\partial U}{\partial t_w} = -\lambda w + \mu$

(A2) $\frac{\partial U}{\partial t_a} = -\lambda \rho w + \mu$

(A3) $\frac{\partial U}{\partial t_l} = \mu$,

where $\frac{\partial U}{\partial t_j} = \frac{\partial U}{\partial Z_j} \times \frac{\partial f_j}{\partial t_j}$.

By substitution for μ from (A1) into (A2) and (A3) we get

(A4) $\lambda w = \frac{\partial U}{\partial t_l} - \frac{\partial U}{\partial t_w}$

(A5) $\lambda \rho w = \frac{\partial U}{\partial t_l} - \frac{\partial U}{\partial t_a}$,

From (A4) and (A5) results

(A6) $\lambda (1-\rho) w = \frac{\partial U}{\partial t_a} - \frac{\partial U}{\partial t_w}$,

which is equation (5).

Appendix A2 Descriptive statistics for the IP and LSIP samples

Table A1 shows descriptive statistics of both IP and LSIP *full* samples by individual. The LSIP is slightly older on average. It also contains more women, more single persons with deceased spouse, and more persons with lower education and with lower earnings than the IP sample.

Table A1 Descriptive statistics of individuals in the IP and LSIP samples, 1991

Variable	Insured population (N=1813)		Long-term sick insured (N=2761)	
	Mean	Std Dev	Mean	Std Dev
Age	44.56	11.25	47.57	11.88
Gender (1= Female, 0=Male)	0.49	0.50	0.55	0.50
Citizenship				
Swedish born	0.88	0.33	0.85	0.36
Foreigner born	0.07	0.26	0.08	0.28
Nationalized Swede	0.05	0.22	0.07	0.26
Marital Status				
Unmarried	0.17	0.38	0.17	0.38
Married	0.74	0.44	0.68	0.47
Divorced	0.08	0.27	0.12	0.33
Widow/er	0.01	0.10	0.02	0.14
Level of education				
Low	0.49	0.50	0.63	0.48
Medium	0.35	0.48	0.28	0.45
High	0.16	0.37	0.09	0.28
Annual earnings (deflated using 1997 CPI)	183365	100998	146795	87233
Days of absenteeism (1986-1991)	18.22	21.27	20.18	22.74
Absent during 1986-1991	0.78	0.43	0.78	0.43

Note: *Italics* indicate dummy variables.

The data sets provide exact dates and defined states for the beginning and end of each compensated sickness spell, as well as diagnosis. Table A2 shows the characteristics of those individuals in both IP and LSIP samples with short-term (ST) sickness during 1986-1991. Even though those in the LSIP sample were long-term (LT) sick at least once during 1986-1991, the two samples were very similar with respect to short-term absenteeism. The average number of days absent due to sickness was only slightly higher for the LSIP, and slightly higher in each diagnosis category as well. The average number of spells of ST sickness spells was also slightly higher for the LSIP-sample, and also by diagnosis, with the single exception of the number of respiratory spells. In both samples, the average number of spells that began on a Monday was higher than that of those that began on any other weekday, and the number decreased through the week. This "non-randomness" suggests a kind of "timing" of absenteeism, or perhaps a tendency for spells to conclude by the end of the following weekend.

Table A2 Descriptive statistics of reported ST absences due to sickness by individual, IP and LSIP samples, 1986-1991

Variables	IP (N=1416)		LSIP (N=2165)	
	Mean	Std Dev	Mean	Std Dev
Total days ST absent due to sickness, 1986-91	30.85	29.75	37.26	33.19
Total days of ST sickness, 1986-91, by diagnosis				
Musculoskeletal	3.71	8.68	6.13	11.44
Cardiovascular	0.23	1.47	0.30	1.55
Respiratory	15.66	16.60	16.15	16.74
Mental	0.31	2.75	0.75	5.38
General symptoms	3.34	6.06	4.48	7.82
Injuries and poisonings	1.39	3.78	1.82	5.24
Others	6.21	9.12	7.64	11.18
Total number of ST sickness spells, 1986-91	9.11	8.19	9.88	8.80
Total number of ST spells, 1986-91, by diagnosis				
Musculoskeletal	0.93	2.12	1.44	2.59
Cardiovascular	0.06	0.35	0.08	0.42
Respiratory	4.25	4.10	3.85	3.84
Mental	0.07	0.65	0.18	1.17
General symptoms	1.20	2.02	1.42	2.38
Injuries and poisonings	0.34	0.81	0.42	1.15
Others	2.27	3.20	2.49	3.45
Number of spells, by the weekday they began				
Monday	2.53	2.73	2.82	3.06
Tuesday	1.95	2.27	2.05	2.30
Wednesday	1.67	2.05	1.73	2.04
Thursday	1.46	1.77	1.59	2.03
Friday	1.02	1.48	1.09	1.49
Weekend	0.48	1.01	0.60	1.13

As Figure A1 shows, for both samples, the frequency of one- and two-day spells increased substantially after the 1987 reform eliminated the unpaid "waiting day", while the frequency of six-day spells decreased dramatically.[35] The increases suggest strongly that the number of ST absences due to sickness was affected by the availability of a sickness cash benefit from the first day after the reform. On the other hand, the decrease in six-day (but not seven-day) spells might be interpreted as a "timing" of absenteeism.

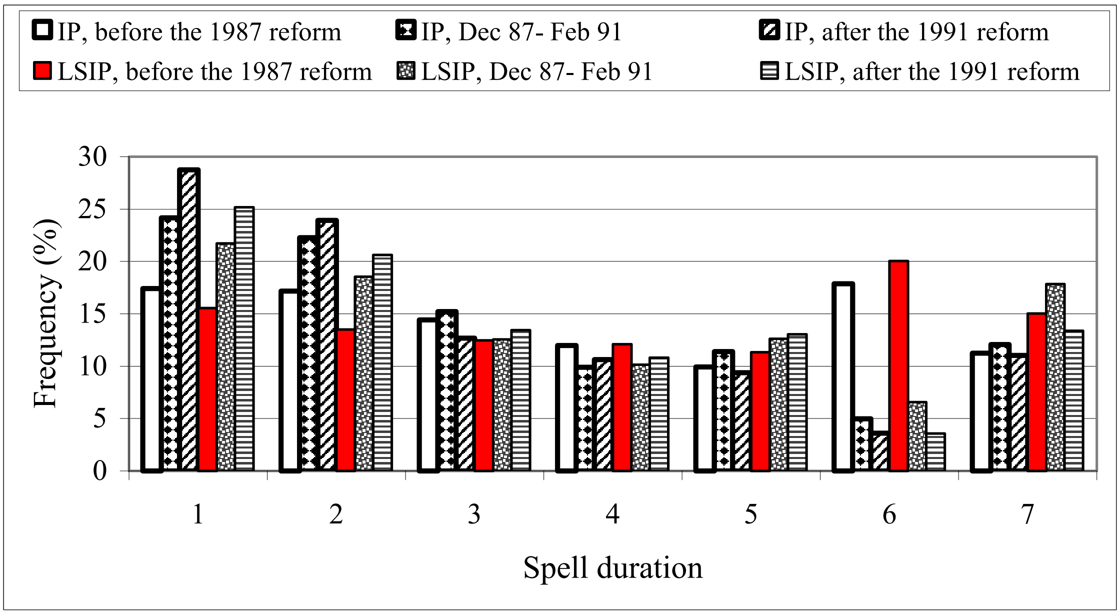


Figure A1 Distribution of ST sickness spell-durations, IP and LSIP, under three regimes

After the 1991 reform reduced the replacement rate from 90% to only 65% of lost earnings for the first three days (and then to 80% through the 90th day) people seem to have returned to work sooner; i.e., the proportion of one- and two-day absences again increased for both samples, and the proportion of 6-day (and even 7-day) absences again decreased.

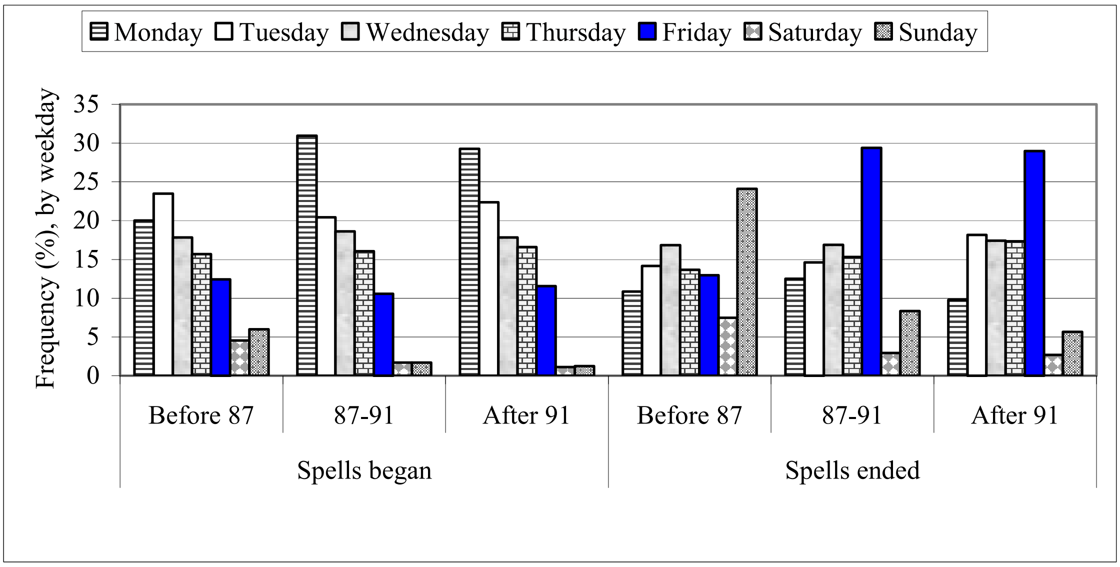
[35] Before the 1987 reform, people could in principle call in sick on any day and then be compensated for up to seven of the first seven days without a medical certificate. Social insurance did not cover the first day, but there were collective agreements that covered even this day for some occupations, such as day-care and restaurant personnel, where it was thought especially important to shield customers/clients from infectious diseases. Nevertheless, many more people seem to have reported very short illness after social insurance started paying from the first day.

Regardless of the regime, the proportion of one- and two-days spells was higher for the IP sample than for the LSIP sample, while the proportion of five-, six- and seven- day spells was higher for LSIP-sample, compared to IP-sample.

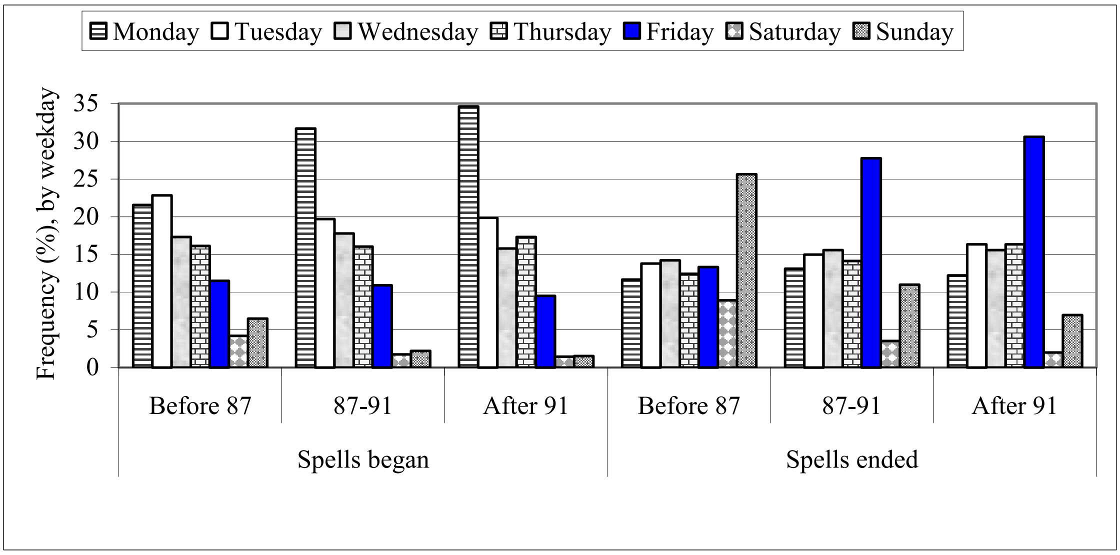
Figures A2 a) and b) show, for the two samples, how the three regimes compared with respect to the weekday when reported short-term absences began and ended, while Figures A3 a) and b) show the overall distribution for the entire period, i.e., for the three regimes pooled together.

Before the first reform, the highest proportion of reported short-term sickness, for both samples, started on Tuesdays. In principle, the database is designed to record all days of sickness, including uncompensated days (such as waiting days and regular non-working days). However, the Tuesday phenomenon could indicate that some spells recorded then during the first regime actually began on Monday (which would have been the unpaid waiting day). After the 1987 reform, this sort of "confusion" would have disappeared, and Monday clearly became the most "popular" starting day, for both samples, during the remaining two regimes. After the 1987 reform eliminated coverage on non-working days, there were also fewer spells reported starting on the weekend.

For both samples, the 1987 reform clearly had a big impact on the weekday when spells ended. Before the reform, spells ended most often on Sunday (regardless of when they started), but afterwards they ended most often on Friday. The 1991 reform made little difference in this respect.

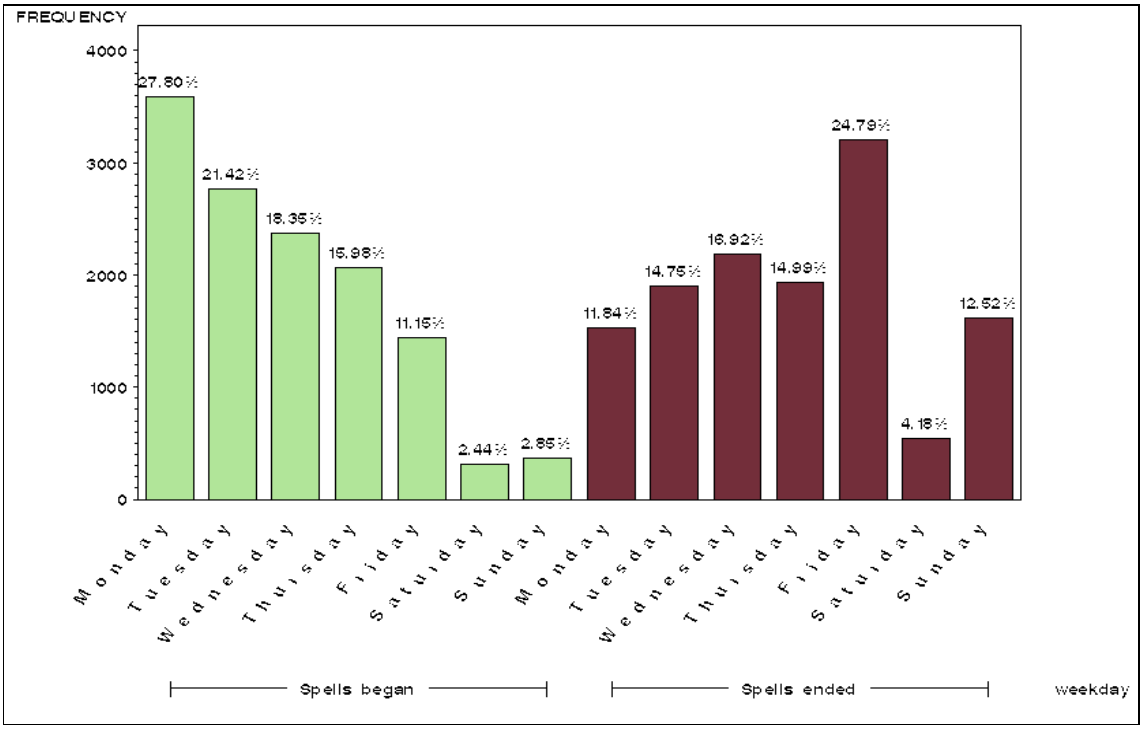


a) Insured population (IP)

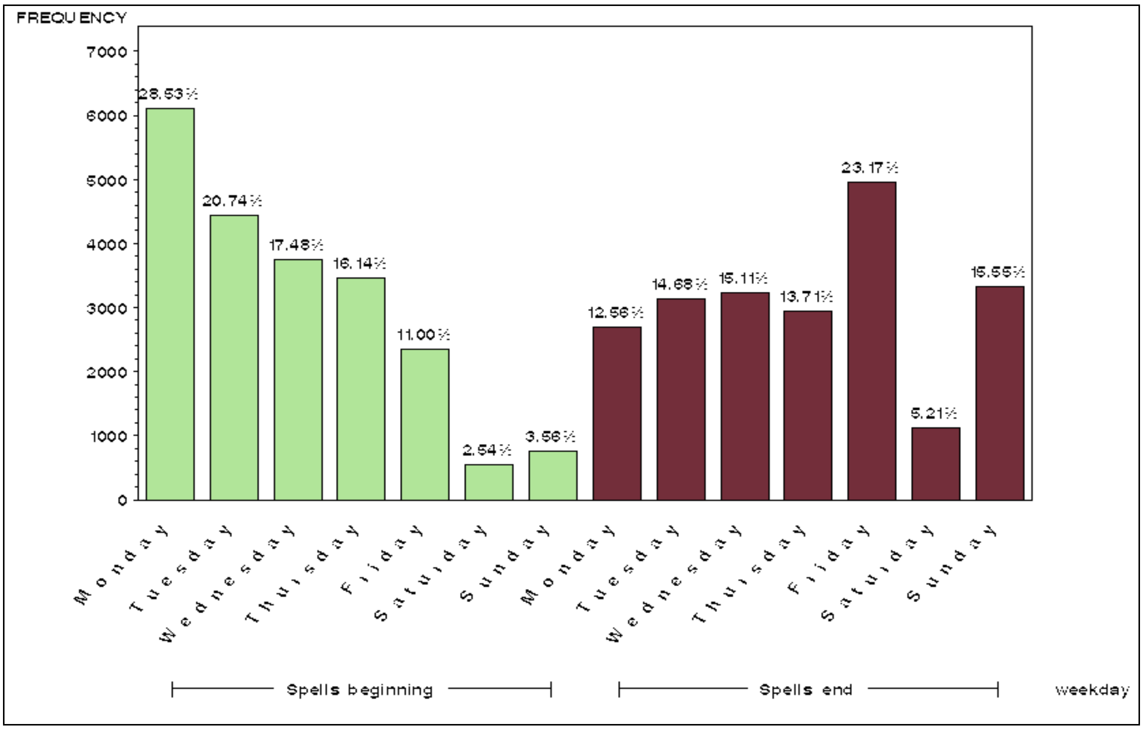


b) Long-term sick insured population (LSIP)

Figure A2 Distribution of ST sickness spells by the day they began and ended, IP and LSIP, under three regimes



a) Insured Population (IP)



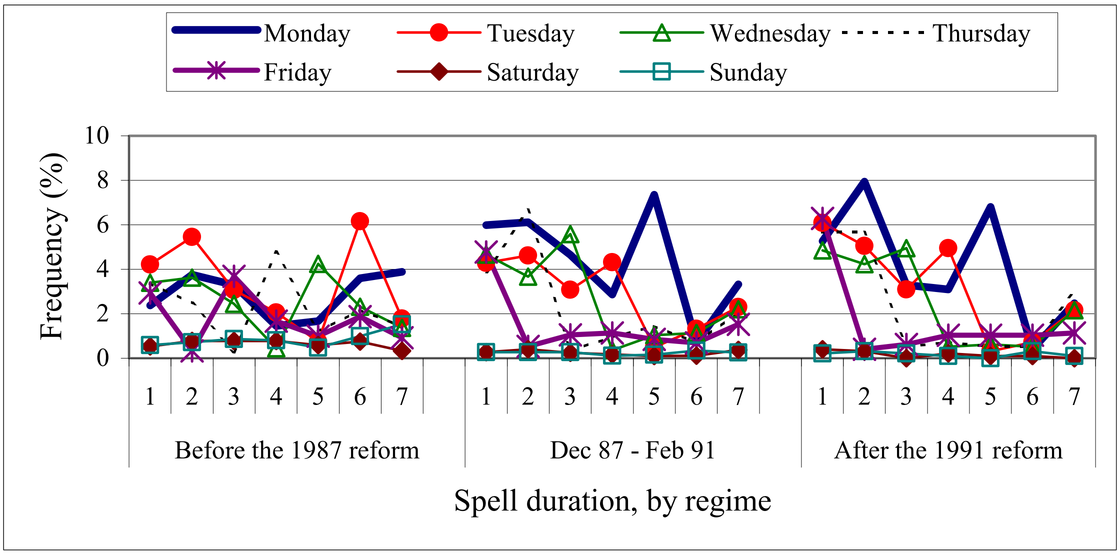
b) Long-Term Sick, Insured Population (LSIP)

Figure A3 Distribution of pooled ST sickness spells by the day they began and ended, IP and LSIP, 1986-1991

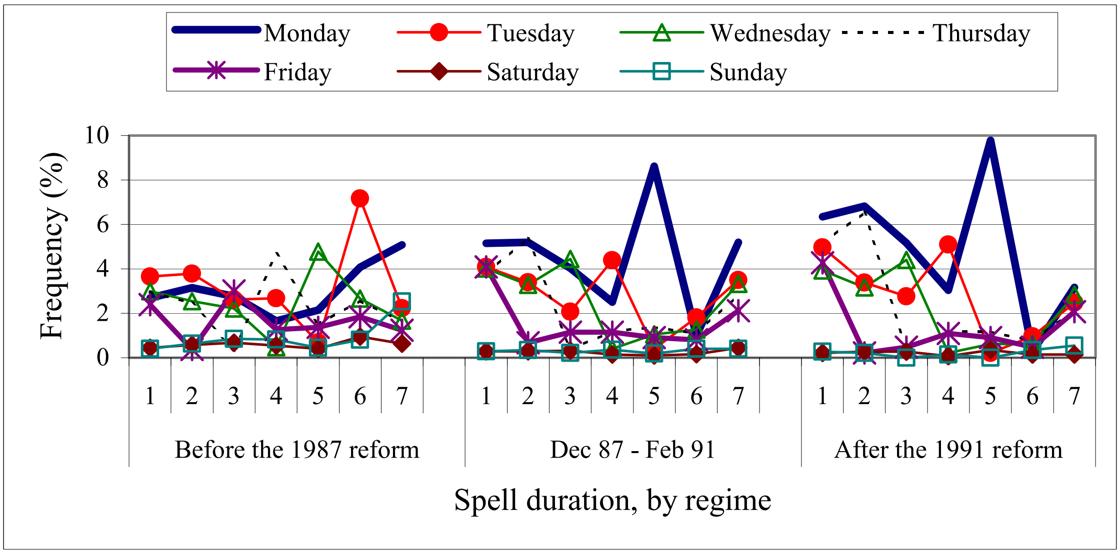
Figures A4 a) and b) illustrate, for the two samples, the distribution of ST absences by duration and the weekday when they began, during the three regimes. As we also saw in Figure A2, before the 1987 reform there were more spells starting on Tuesday, afterwards more on Monday (including after the 1991 reform). Of those starting on Monday after the 1987 reform, the percentage of one- and two-day absences was slightly higher for the IP sample than for the LSIP sample (as was also visible in Figure A1, regardless of the starting day), while the percentage of five- and seven-day absences was slightly higher for LSIP sample. For both samples, before the 1987 reform, the highest percentage of reported sickness started on Tuesday and lasted six days (i.e., ending on Sunday), whereas after the reform, the highest percentage started on Monday and lasted five days (i.e., ending on Friday).

After the 1991 reform, two-day spells starting on Monday were the most frequent for the IP sample, while five-day spells starting on Monday were most frequent for the LSIP sample.

Before the 1987 reform, it seems that, regardless of the weekday when they started, most spells ended on Sunday, whereas afterwards most spells ended on Friday (i.e., before the weekend). Nevertheless, afterwards most spells *started* on Monday.



a) Insured population (IP)



b) Long-term sick insured population (LSIP)

Figure A4 Distribution of ST sickness spells by duration and the day they began, IP and LSIP, under three regimes

In sum, regardless of the rule changes, it seems that there was no big difference between insured people in general (the IP sample) and insured people with long-term sickness (the LSIP sample) with respect to the distribution of weekdays when ST absences began and ended.

As Figure A5 shows, during at least the first two regimes,[36] there was also little difference between the IP and LSIP samples with respect to the distribution of absences by the month when they began, and the slight difference *between* the two regimes is not necessarily the result of the 1987 reform. Rather, the higher percentage of spring and fall cases during the earlier period could reflect different epidemiological conditions during that period, i.e., more virulent colds, and/or flu. There were fewer spells of ST absence due to sickness reported during summer, when most people take vacations, even though they were entitled to sickness cash benefit even then (and thus, if they were sick, could save their vacation for later). But, besides indicating "honesty" in reporting, it is also possible that summer is generally a healthier time, especially with lower depression (caused by the "darkness" of other seasons) and less stress generally, because of vacations.

[36] The third regime (after the 1991 reform) is not included because the observation period ended in December 1991, and thus would not allow analyzing a full 12 months.

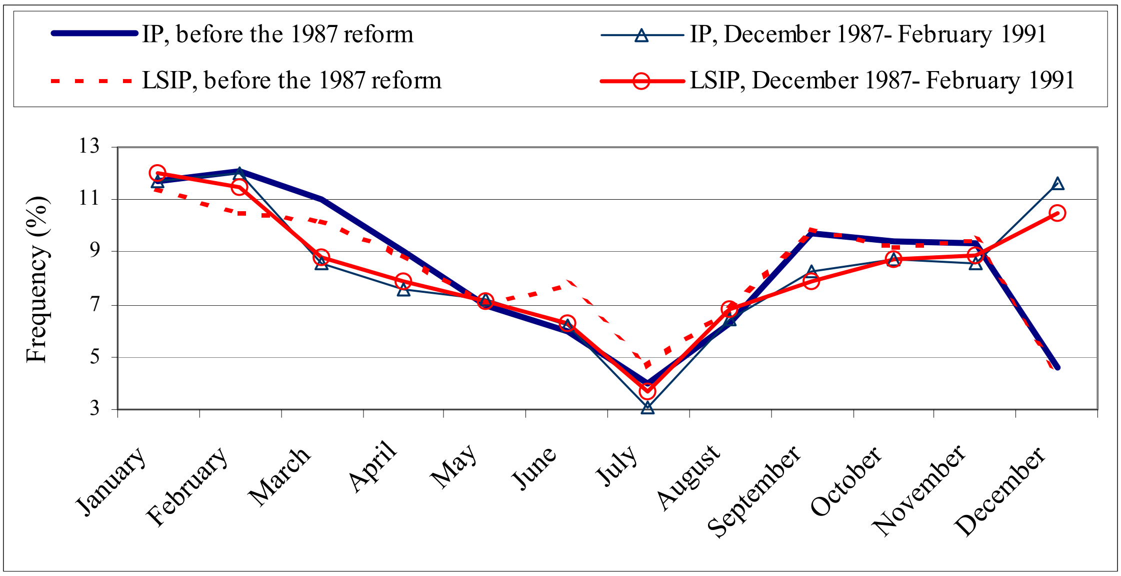
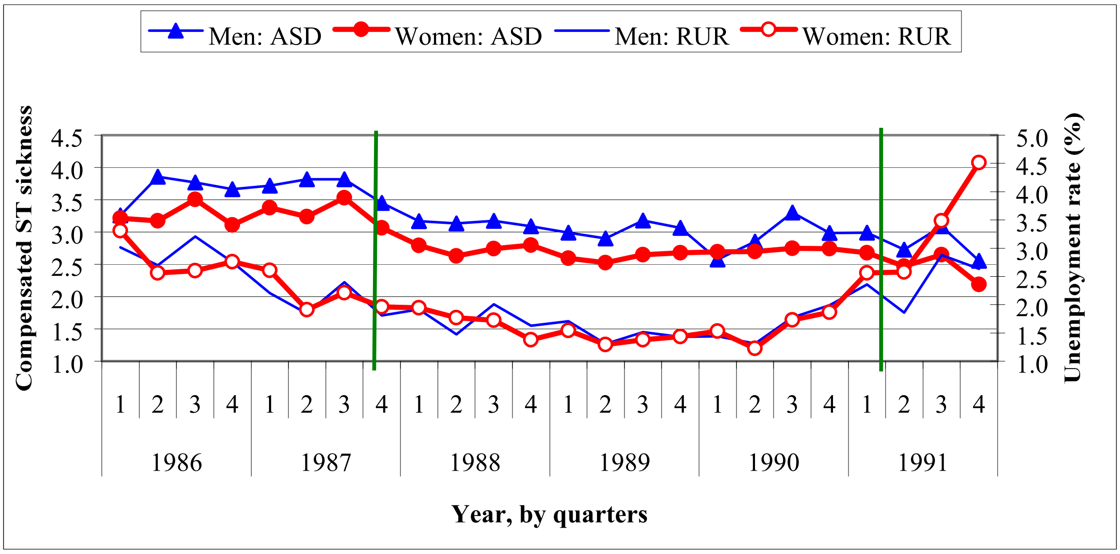
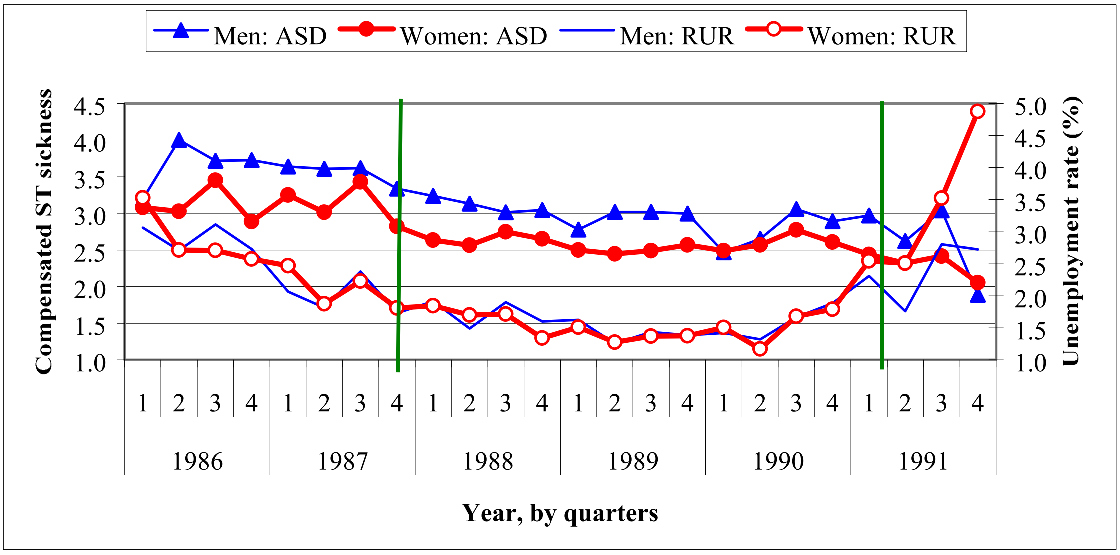


Figure A5 Distribution of ST sickness spells by month when they began, IP and LSIP, under two regimes

Figures A6 a) and b) show, for each sample, the average short-term sickness duration (ASD) and the average regional unemployment rate (RUR) during 1986-1991, by quarter and gender. Men's durations were generally longer than women's. Unemployment was generally declining until mid-1990, and average ST sickness durations also generally declined correspondingly. After that, unemployment increased spectacularly, while durations remained virtually unchanged, or fell even further. The direction of any effect of regional unemployment on the duration of short-term absences due to sickness is thus not clear.



a) Insured population (IP)



b) Long-term sick insured population (LSIP)

Figure A6 Average ST sickness duration (ASD) and regional unemployment rate (RUR), by gender, IP and LSIP, 1986 -1991

Paper III

LONG-TERM ABSENTEEISM DUE TO SICKNESS: THE SWEDISH EXPERIENCE, 1986-1991*

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Abstract

Long-term absenteeism due to sickness has been increasing in the past two decades. This has raised many questions about causes, financing, and policy measures to prevent further increases. Answering these questions is even more important in a society with an aging population, which is expected to record even more cases. With data from the Swedish National Insurance Board, proportional hazards models for multiple spells are used in this study to account for shared unobserved group-level characteristics (or frailty) associated with long-term sickness. When the spells were grouped by individual, diagnosis or region, there were significant positive random effects. There was "more" heterogeneity among diagnosis-groups and individual-groups than among regions as groups. Both individual and labor market characteristics had significant effects on the length of absence, which suggests policies aimed to prevent and slow down the increasing trend of long-term sickness of those in older age-groups, but also special policies orientated to prevent deterioration of health status of younger employees.

Key words: long-term sickness, absenteeism, multiple spells, unobserved heterogeneity.

JEL classification: J2; J3; J7.

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1 Introduction

The increasing number of cases of long-term sickness registered in Sweden during the 1980s and 1990s has attracted a lot of attention. There have been several changes taken or proposed concerning social insurance in order to combat long-term sickness, specifically with regard to the source of financing the first weeks of each sickness spell, and to a better specification of the skills required for evaluating the working capacity of employees reporting sick.[37] Since 1992 the employer has had the responsibility for providing sick pay during the first weeks of sickness. Before this, from December 1987 social insurance covered the *entire* absence. Prior to that, the compulsory sickness insurance (implemented in 1955) stipulated a *waiting period* of three days and a limit of two years replacement in long-term sickness. In 1967 the waiting period was reduced to the day of calling in sick. In 1985 some administrative changes (for state employees) implied that also the day for calling in sick and weekends were in the records, counted as sickness absence days.

The basic evaluation procedure remains a (simple) medical evaluation and doctor's certification of illness after the first week, and then review at periodic intervals. Improved collaboration between the physician, employer, and social insurance officers has been suggested, with more attention to rehabilitation and consideration of alternative employment.

Even for those who are not working, Sweden's social welfare system provides adequate funds for food, housing and healthcare.[38] Other factors than material deficiency are thus expected to explain the increasing number of long-term absences due to sickness. Many seem to result not from obvious physical causes, but rather from

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[37] In Sweden the term *sickness cash benefit* is used to make it clear that the "*sick pay*" is usually paid by the social insurance system, rather that the employer. The employer provided sick pay the first 14 days in 1992-1996, and since 1st April 1998, and the first 28 days during the time period January 1, 1997 – March 31, 1998.

[38] Healthcare is actually provided directly "in kind" through a heavily subsidized, mostly publicly owned and managed system; only minimal cash payments are required of patients, including for prescription drugs.

changing social and economic conditions, stress related illnesses, such as back pain, and (consequent) psychological problems, such as depression.

It is the goal of this paper to analyze underlying causes for long-term absences due to sickness using frailty models using longitudinal data on sickness. The data are provided by the Swedish National Social Insurance Board. Section 2 summarizes the relevant characteristics of the social insurance system in Sweden, describing the rules today and the main changes made in recent years, and briefly reviewing some statistics on long-term absence due to sickness.[39] Section 3 reviews previous studies relevant for the analysis. Section 4 sets up the theoretical framework and Section 5 presents the data. Sections 6 and 7 present the econometric specification and the results, while Section 8 summarizes and draws conclusions.

2 Social insurance rules and sickness facts in Sweden

2.1 Sickness insurance rules during 1986-1991 and beyond

Everyone in the labor force is covered by *sickness insurance* (i.e., they are eligible for sick pay or/and sickness cash benefit when absent due to sickness). The aim of sickness insurance is to replace the earnings loss due to sickness. Since July 1990, a sickness benefit is available when working capacity is reduced by at least 25%; depending on the extent of working capacity reduction and consequent reduction in working hours, the benefit can be paid at a full, three-quarters, half, or one-quarter rate. Prior to July 1990 there were only two rates, full and 50 percent of full rate. A medical certificate is required after seven days, and a more detailed certificate is required from the 29th day of absence. A sickness benefit can be paid out for an *unlimited* period, is considered

[39] Other reasons why employees might be absent from their jobs for extended periods (with right of return) include military service, parental leave, education, and trial period of alternative employment. Unless stated otherwise, “absence” herein will refer to absence due to sickness.

taxable income, and counts towards ones pension base.[40] However, for those over 70 or persons receiving a full old age pension, the period is limited to 180 days. Persons receiving full disability pensions are not entitled to a sickness benefit.

Replacement rates and related rules have changed many times. Under the period studied, there was a uniform replacement rate of 90% of lost income up to March 1991, and after that, until January 1992, only 65% was paid for the first three days, then 80% from the 4th up to the 90th day, and starting with the 91st day of the sickness spell, the previous rate of 90%. However, most workers also received another 10% from negotiated benefit on the top of the 80%.

2.2 Trends in long-term sickness spells[41]

Figures 1 and 2 show the number of ongoing *compensated* spells of sickness at the end of each year, by duration, for men and women, during the period 1974-1999. The changes in the magnitude of sickness benefit absence during the last two decades can be explained by expansive or restrictive reforms regarding *rules* within the sickness insurance system and by the *business cycles*. For example, the long-term sick listed have *decreased* sharply during in the beginning of the 1990s together with a more *restrictive* sickness insurance system and perhaps owing to the deep recession, while since 1997 the long-term sickness absence has started to increase (dramatically), with economic expension.

The reported statistics refer to sickness spells *regardless* if they were full or partial cases. The very similar shapes of the plots for men and women are *partly* explained by the rule-changes over time, since everyone is affected by same rules. It is more difficult to explain differences in levels. The increasing number of women who worked during the last two decades can explain some of the increasing differences in

[40] The compulsory sickness cash benefit system insurance, implemented in 1955, stipulated a limit of two years replacement for long-term sickness. Except for old-age pensioners, this limit was abolished in 1963.

[41] Unless otherwise noted, all data are from the National Social Insurance Board.

levels between women and men. The *regional unemployment* might explain another part of the difference: Women, who to a great extent work in the public sector, were more exposed to unemployment than men, with a resulting tendency towards sickness, and, hence a sickness benefit instead of an unemployment benefit.

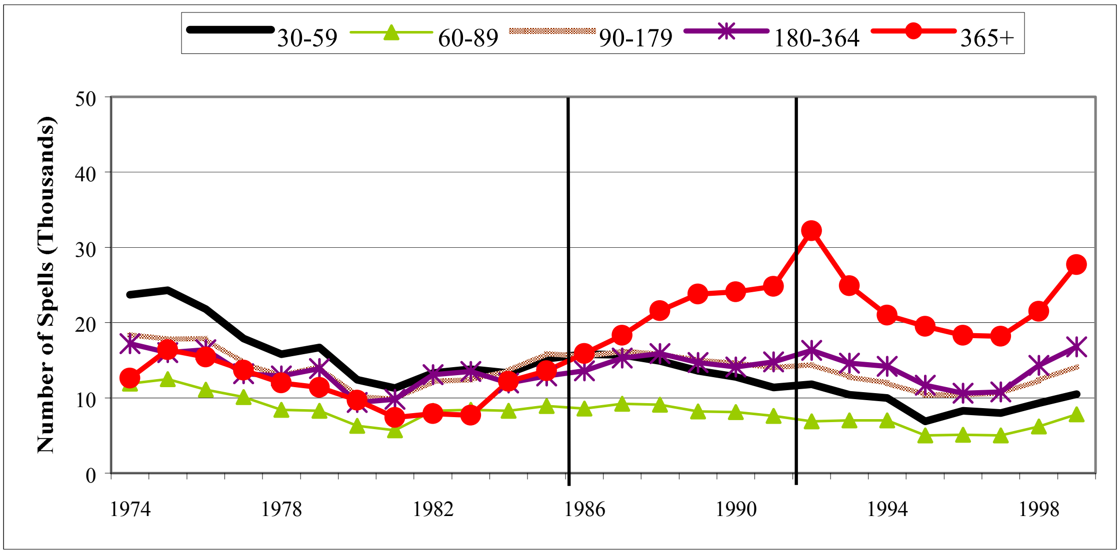

Figure 1 Number of ongoing compensated sickness spells at the end of December, by duration, *men*, 1974-1999

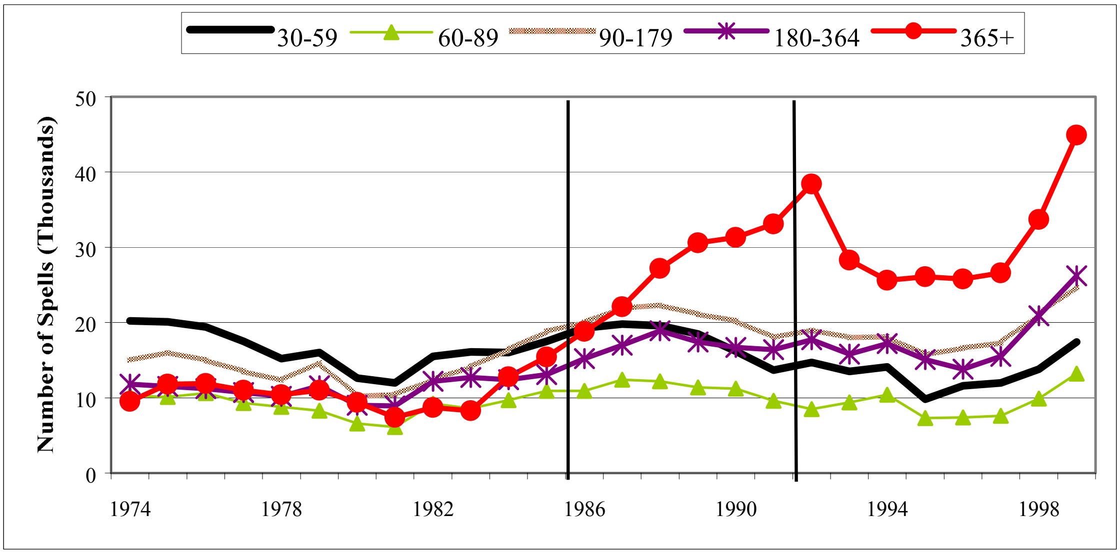

Figure 2 Number of ongoing compensated sickness spells at the end of December, by duration, *women*, 1974-1999

Another factor tending to increase the number of spells for both men and women is the *aging* process: More employees are older, and thus can be expected to have more health problems.

An explanation for the increase in long-term sickness absence in the end of the 1990s can be the very low levels of sickness absence during the recession period (1993-1997), which might "postponed" the absence due to sickness. If this is the case, this is a very good example that the prevention and good care of health is more efficient and less costly than no care or superficial care of any health problem.

Figure 3 shows the average number of compensated sickness days per year (both full *and* partial cases) for women and men during 1974-1999. The greatest difference between men and women was reached during the period analyzed in this study, although the most recent years show diverging (and again, upward) trends.

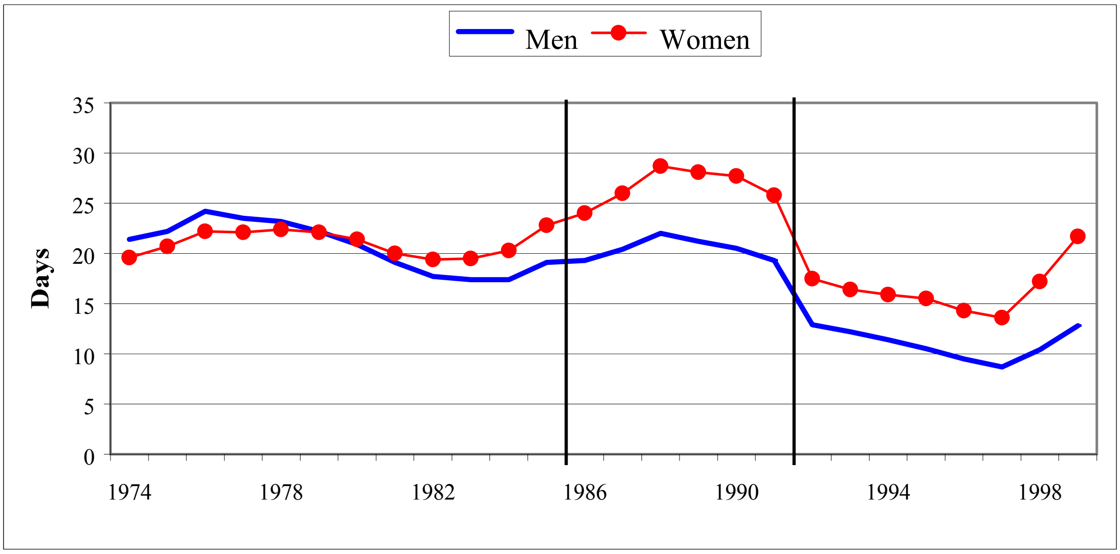

Figure 3 Average annual compensated days of sickness per insured person, men and women, 1974-1999

The plots show substantial changes when rule-changes occurred. Despite the fact that the first day of sickness had been covered by the employer for *some* occupations, the December 1987 elimination of the waiting day before social insurance provided sickness cash benefit seems to have resulted in 1988 peaks for both men and women. On the other hand, the requirement that employers pay the first 14 days of sickness (during 1992-1996, and since April 1998) and the first 28 days (during January 1, 1997 – March 31, 1998) corresponds with a clear fall and declining trend through 1996. As already mentioned, the increase since 1997 can be related to the lower absence rates during 1992-1996. Another characteristic for the end of the 1990s is the increasing number of people in occupations *outside industry* that formed a new group of long-term sick.[42]

2.3 Behind the reported numbers

Figures 1-3 can be misleading since they report on compensated days of sickness without regard to whether absences were *full* or *partial*. There are no statistics showing how many people are absent part-time, but it is well known that in Sweden there are more women than men working part-time[43]. It is also possible to receive a partial benefit even though one is employed full time, for example in conjunction with rehabilitation for persons returning to work after a long-term sickness.

Total compensation figures are equally ambiguous. For example, of about SEK 13.9 billion paid in sickness benefits in 1997, about 50% was paid to women and 50% to men, but *more* women than men were long-term sick; in other words women's average compensation was lower than men's (Table 1). Although in total men had a higher average number of *compensated days of sickness*, the number of days was higher for women than men for the age-groups 35-39, 40-44, 45-49, and 50-54 (see also Figure 4), while the average benefit for all these age-groups was *always* much higher for men (Table 1). But again, these figures have not been adjusted for partial days. Thus the results are not necessarily a result of wage discrimination, but may be mostly explained by hours of work, as well as by differential years of work experience for men and women.

[42] According to the National Social Insurance Board (National Social Insurance Board, *Social Insurance-Annual Review of Budget Year* 1999), the number of teachers, nurses, hospital auxiliaries, and social insurance officers on the sick list rose in 1999.

[43] For example, in 1997 there were about 783,600 women and 159,200 men employed part-time (Table A1 in the Appendix).

Table 1 Sickness benefit in 1997, women and men, by age

Age	Number of recipients		Average number of days		Average benefit over the year, SEK	
	Women	Men	Women	Men	Women	Men
16–19	391	366	34	41	5,215	9,295
20–24	11,971	6,912	51	57	11,191	19,942
25–29	29,382	13,639	61	70	15,393	25,876
30–34	38,059	20,141	74	78	19,177	29,377
35–39	32,523	20,594	93	88	23,566	32,432
40–44	31,099	21,911	109	98	27,531	35,739
45–49	34,073	24,157	120	112	30,544	40,774
50–54	39,645	28,411	129	127	33,019	45,468
55–59	32,294	24,538	138	143	34,036	50,286
60	17,204	15,847	164	169	37,085	54,698
Total	**266,641**	176,516	106	**110**	26,356	**39,171**

Source: National Social Insurance Board (1999), *Social Insurance in Sweden 1999*, page 61.

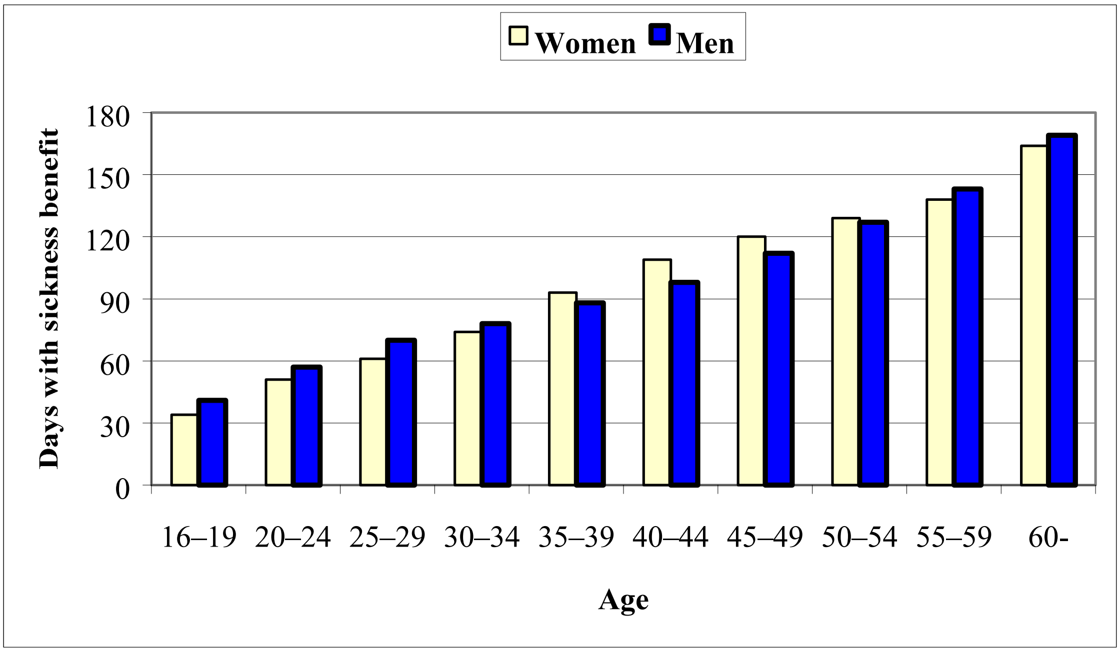

Figure 4 Average annual compensated days of sickness per insured person in 1997, women and men, by age

It is obvious that the official statistics should be more detailed in order to allow adjustment for partial days with compensated sickness, especially since there are such large differences between men and women.

3 Literature review

The problem of employee absenteeism has long been an important subject of psychological and economic research and modelling. In both, individuals are often assumed to decide daily on the work or non-work alternative, depending on which gives the highest utility.[44] The conventional labor supply model of absence focuses on the role of contractual arrangement, assuming that the wage rate plays a central role in the decision to work or not work. There are other economic factors that might influence this decision, however, such as the replacement rate, the tax rate, and employee sharing plans (e.g., profit-sharing and/or employee share-ownership). Previous studies have found that economic incentives have a significant impact on absences from work.[45]

There are also some (long-term) longitudinal studies that measure the effects of various past and current factors on the actual absence.[46] Some other studies have analyzed the *duration of sickness* and estimated the hazard of returning to work and the expected duration of work absence.[47] The results showed that as the relative generosity of sick pay (the replacement rate) increased, there was a clear "disincentive" effect, as the duration of illness lengthened. Other significant factors were wages, the type and severity of injury, the physical demand of the job, and the willingness of employers to help the worker return to work.

Using a dynamic stochastic model, Gilleskie (1998) analyzed the medical care consumption and absenteeism decision of employed individuals with acute illness. Policy simulations based on her theoretical model showed substantial responses to

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[44] Chelius (1981); Winkler (1980); and Youngblood (1984).

[45] Dunn and Youngblood (1986); Chaudhury and Ng (1992, 1994); Dalton and Mesch (1992), Drago and Wooden (1992); Barmby et al. (1991, 1995); Johansson and Palme (1996); Johansson and Brännäs (1998); Gilleskie (1998); Arthur and Jelf (1999); and Brown (1999).

[46] Baum and Youngblood (1975); Scott and Markham (1982); Scott et al. (1985); Barmby et al. (1995); David (1996); and Barmby (1998).

[47] Fenn (1981); Butler and Worrall (1985); and Johnson and Ondrich (1990).

economic incentives. Generally, medical treatment and work absenteeism appeared to be *substitutes* during an illness episode, while for acute infections and parasitic diseases, and acute respiratory conditions, absences were 50% more common than doctor visits. With policy that restricts access to physicians during the first three days of illness, the average number of both doctor visits and absences fell, while the duration of absences lengthened, suggesting that medical treatment and work absenteeism in this case may be *complements*.

Other studies analyzed long-term sickness and the unemployment,[48] some of them concluding that official unemployment figures do not accurately reflect the true extent of joblessness. Armstrong (1999) found that many men in Northern Ireland registered as long term sick but who, under plausible assumptions, would be available for work.

There are several Swedish studies that analyzed the relationship between unemployment and (long-term) absenteeism due to sickness, and found that people who were or are unemployed face a higher risk of being sick than people without unemployment history.[49] Lidwall (1997) found that older employees, those with lower education and those who worked in a bad physical or social environment had a higher risk of being long-term sick. His results show that not only unemployment itself increased the duration of the absence due to sickness, but also the complex interaction between being unemployed, socialy isolated, and depressed.

Knutsson and Goine (1998) analyzed long-term absence due to sickness among twelve typically male and female occupations in two Swedish counties, and found a strong positive correlation between age and absenteeism. When controlling for age and occupation, they found no relationship between unemployment rates and sickness absences among women. Among men, however, an inverse relationship between unemployment rates and long-term sickness absence was found.

Lidwall and Skogman Thoursie (2000) analyze the development of absences due

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[48] Disney and Webb (1991), Forsythe (1995), Beatty and Fothergill (1996), Gustafsson and Klevmarken (1993), and Bäckman (1998).

[49] Marklund (1995), Hammarström (1996), Marnetoft et al. (1996), Selander et al. (1996a, 1996b), and Marklund and Lidwall (1997).

to sickness and newly granted disability pensions, using official statistics produced by the National Social Insurance Board since 1955. They show that, in the beginning of the 1990s, long-term sickness absence decreased for *all* age groups, but most of all for age groups with weak positions on the labor market such as the youngest, for whom it was harder to get established on the regular labor market and consequently, qualify for a sickness benefit. On the other hand, they explained the increase in long-term sickness since 1997 by the decrease in unemployment rate, but also by the fact that the labor force has gotten older.

4 Theoretical framework

Employees with *bad health status* are defined in this study as persons experiencing a sickness spell of 60 days or more. What is characteristic for them is that they may undergo various transitions, as for example, transitions between the labor market states of employment, unemployment, and nonparticipation. This reflects the *dynamic aspects* of economic behavior. Data on “waiting times” until the transition takes place describe the duration until an event occurs as the outcome of a decision on the optimal moment for doing the transition to another state. With such a design, the question is what economic model is suitable to explain individuals’ experiences in various (labor market) states. The theoretical models most frequently used for reduced-form econometric duration analyses are *search model*s.[50]

As suggested by Fenn (1981), conventional search models used in analyzing the behavior of unemployed people could be relevant for analyzing the behavior of sick people *if* their employment contract were terminated, either at their own initiative, or at that of their employer. In Sweden employees are protected against contract termination in the case of sickness. Nevertheless, the conventional search model can be used for analyzing the behavior of sick people, given the fact that they would like to have a job and working conditions that fit better their health status.

[50] *Job search models* have been very popular as explanatory theoretical frameworks for reduced-form econometric duration analysis (see Devine and Kiefer, 1991).

People can often return to work after their sickness spells, although it is not given that it is appropriate for them to return to their current job tasks or place of employment. If no other alternative is offered, it is expected that the duration of the sickness spell would be even longer. Sick employees have the alternative to enter a rehabilitation program, at their own initiative, or at that of the social insurance office together with the company physician. The rehabilitation program can be vocational (directed mainly in getting skills for a new job), medical (directed to medical treatment and/or physical exercises that are expected to recuperate from the loss on working capacity), and social (alcohol programs belong to this group in Sweden). If medical evaluations show that employees have some limitation in doing their previous job, a change of job may be the optimal alternative, even if it requires the acquisition of new skills through a vocational rehabilitation program. If the medical evaluation shows that they have not yet recuperated at least partially, but it is expected that they will in the future, then, if it is not possible to participate in a rehabilitation program, they can "choose" to remain on sickness benefits.[51]

Medical evaluation can also conclude with a recommendation for participating in a rehabilitation program, or with a recommendation for temporary or permanent exit from the labor market with a disability pension, either of which can be either partial or full. If no hope for total or partial or recovery exists, full permanent disability exit will be recommended.

In many cases, people may be able to return to their previous job, doing the same task as before, but some changes in the working conditions may be required (e.g., an ergonomic desk, a better chair, etc). These possibilities are quite realistic, especially in Sweden, where much funding is allocated for improvement of the working conditions and the working environment, for vocational rehabilitation programs, special programs aimed at the employment of the disabled, etc.

[51] "Being sick" is viewed in a very general way here as not being a choice, but at the margin, choice may still be possible. We will assume that medical evaluations are very well done, showing the true health status of employees. We will also assume that, given a reasonable wage, employees prefer to work, and would choose any work reasonable alternative their health status allows.

If people return to work with a residual disability, it may also be realistic to assume that their wage offer (w) is higher than the disability benefit (b), so that $b < w$. It may also be realistic to assume that their wage offer (w) can be lower than what they had before sickness (w_0), but still higher than their initial reservation wage (w^r), so that $w^r < b < w < w_0$. It implies that the financial alternative of disability benefit can have impact in the decision of return to work. Therefore, a generous social insurance benefit level can decrease the propensity to return to work, which does not necessarily imply that people who leave the labor market with a disability benefit would be better off in the long-run. Additionally, their health and/or financial dependency would require even more support later on than if they would chose to work at least some hours. If working *some* hours is one avenue for better life, then the problem is to find such jobs.

Unlike the job search process for "healthy" people that can require considerable time and resources, and where the returns of these investments are uncertain, job search for employees with long-term sickness spell can require less effort if the opportunity at his/her current place of employment are sufficiently varied. In addition, there may be less uncertainty because of programs designed to help the employee back to the same place of employment. For example, there is continuous collaboration between social insurance offices, employers and medical personnel. Thus, in this study we will assume that those with "poor health" aim to maximize the expected present value of their income over their lifetime with a subjective rate of discount, anticipating (or not) that the job offer and its distribution, and compensation for earnings loss due to sickness or disability, may change over time. More precisely, one can return to work with the same wage as before, but there is an alternative to change jobs to a lower (and even higher) wage than before; and to work fewer hours than before. Additionally, the financial alternative (disability benefit) can vary over time, which can also affect the expected value or present value of the income of sick employees.

5 The data

This paper analyses the LSIP sample from the Long-term Sickness (LS) database, from the National Social Insurance Board of Sweden. This sample of 2789 persons represents all residents in Sweden registered with the social insurance office, born during 1926-1966, and who had at least one sickness spell of at least 60 days during the period 1986-1989. The sample is longitudinal and contains all compensated sickness spells during the period January 1, 1983 through December 31, 1991, including exact beginning and ending dates. However, there is no data on possible long-term sickness spells before 1983, and there is no information on diagnosis for spells that started before January 1, 1986 (except for ongoing spells at this date). All people who died or left the country during the observation period were excluded in this study, resulting in final a sample of 2666 persons, who had 4430 spells of long-term (LT) sickness.

Table 2 presents the descriptive statistics, at the beginning of analyzed spells of long-term sickness, by spell. The share of women increases by spell of LT sickness which is consistent with the national statistics, which show that women are generally sick more often and longer the men. The percentage of young women (35 and under) is considerably higher than that of young men, possibly explained by complications related to childbirth, but perhaps also due to less emphasis on the environment in typically female occupations (health care, education, etc.). The opposite is true for the oldest age group (56-65 years). The fact that the first two spells of LT sickness, the percentage of older men is higher than that of older women in this group, may be explained by the fact that, in the 1980s, women who were born in the 1920s and 1930s had, on average, fewer years in the work force and thus perhaps a lower risk of disability.

The proportion of Swedish born people decreased by spell, while the proportions of naturalized Swedes and (other) foreign born persons increased by spell. This may suggest lower human and/or health capital, as well as possible cultural factors.

Table 2 Descriptive statistics, at the beginning of analyzed LT sickness spell, by gender and spell, 1986-1991

	First spell of long-term sickness						Second spell of long-term sickness						Third spell of long-term sickness					
	All		Men		Women		All		Men		Women		All		Men		Women	
	$n = 2666$		$n = 1187$		$n = 1479$		$n = 1089$		$n = 452$		$n = 637$		$n = 415$		$n = 160$		$n = 255$	
Variable	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Gender (1=Female)	0.56	0.50					0.58	0.49					0.61	0.49				
Age	43.70	11.81	44.72	11.71	42.88	11.84	44.53	11.61	45.38	11.57	43.92	11.60	44.38	10.97	43.98	11.49	44.63	10.65
Age-groups																		
35 and under	0.29	0.46	0.26	0.44	0.32	0.47	0.26	0.44	0.24	0.43	0.28	0.45	0.25	0.44	0.29	0.46	0.23	0.42
36-45 years	0.24	0.43	0.24	0.43	0.24	0.43	0.26	0.44	0.25	0.43	0.27	0.44	0.29	0.45	0.26	0.44	0.31	0.46
46-55 years	0.25	0.43	0.25	0.43	0.24	0.43	0.25	0.43	0.26	0.44	0.24	0.43	0.26	0.44	0.26	0.44	0.27	0.44
56-65 years	0.22	0.41	0.25	0.43	0.19	0.40	0.23	0.42	0.25	0.43	0.22	0.41	0.20	0.40	0.19	0.40	0.20	0.40
Citizenship																		
Swedish born	0.85	0.36	0.84	0.37	0.85	0.35	0.82	0.38	0.82	0.39	0.82	0.38	0.78	0.41	0.81	0.40	0.77	0.42
Foreign born	0.08	0.28	0.09	0.29	0.07	0.26	0.09	0.29	0.10	0.30	0.09	0.29	0.12	0.32	0.13	0.33	0.12	0.32
Nationalized Swede	0.07	0.26	0.07	0.26	0.07	0.26	0.09	0.28	0.08	0.27	0.09	0.28	0.10	0.30	0.07	0.25	0.12	0.32
Educational level																		
Low	0.63	0.48	0.69	0.47	0.59	0.49	0.65	0.48	0.71	0.45	0.61	0.49	0.67	0.47	0.69	0.46	0.65	0.48
Medium	0.28	0.45	0.27	0.44	0.30	0.46	0.29	0.45	0.26	0.44	0.31	0.46	0.28	0.45	0.29	0.45	0.27	0.45
High	0.08	0.28	0.05	0.21	0.11	0.32	0.06	0.24	0.03	0.17	0.08	0.27	0.06	0.23	0.02	0.14	0.08	0.27
Marital status																		
Unmarried	0.27	0.44	0.31	0.46	0.23	0.42	0.25	0.43	0.31	0.46	0.21	0.41	0.24	0.42	0.31	0.47	0.19	0.39
Married	0.55	0.50	0.52	0.50	0.57	0.50	0.53	0.50	0.51	0.50	0.54	0.50	0.49	0.50	0.44	0.50	0.52	0.50
Divorced	0.16	0.37	0.16	0.37	0.17	0.37	0.19	0.39	0.16	0.37	0.21	0.41	0.24	0.43	0.22	0.42	0.25	0.44
Widowed	0.02	0.15	0.01	0.11	0.03	0.18	0.03	0.18	0.02	0.12	0.04	0.21	0.04	0.19	0.03	0.16	0.04	0.20
No. of children (<7 years)	0.17	0.48	0.01	0.09	0.30	0.62	0.20	0.54	0.00	0.05	0.34	0.68	0.15	0.49	0.01	0.08	0.24	0.61
No. of children (7-16 years)	0.17	0.49	0.02	0.16	0.29	0.61	0.21	0.52	0.02	0.14	0.35	0.64	0.21	0.49	0.03	0.21	0.32	0.58
Spell duration (in days)	306.4	371.9	327.8	384.2	289.1	360.8	271.0	282.7	285.0	300.5	261.1	269.1	282.0	261.8	289.5	271.2	277.2	256.1

Variable	First spell of long-term sickness						Second spell of long-term sickness						Third spell of long-term sickness					
	All		Men		Women		All		Men		Women		All		Men		Women	
	n = 2666		n = 1187		n = 1479		n = 1089		n = 452		n = 637		n = 415		n = 160		n = 255	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
No. of spells before spell *i*	5.31	5.96	4.66	5.69	5.84	6.13	10.34	8.79	9.41	8.74	10.99	8.77	13.23	9.45	12.45	9.88	13.72	9.15
No. of ST spells before spell *i*	2.98	4.86	2.42	4.38	3.43	5.18	5.13	6.58	4.31	6.06	5.70	6.86	5.88	6.63	5.02	6.17	6.42	6.86
Diagnosis																		
Musculoskeletal	0.39	0.49	0.38	0.49	0.39	0.49	0.44	0.50	0.41	0.49	0.47	0.50	0.47	0.50	0.43	0.50	0.49	0.50
Cardiovascular	0.07	0.25	0.10	0.30	0.04	0.20	0.06	0.24	0.09	0.28	0.04	0.20	0.03	0.18	0.04	0.21	0.03	0.16
Mental	0.12	0.32	0.12	0.33	0.12	0.32	0.13	0.34	0.17	0.38	0.11	0.31	0.19	0.39	0.26	0.44	0.14	0.35
Respiratory	0.03	0.16	0.03	0.17	0.02	0.15	0.03	0.17	0.03	0.17	0.03	0.18	0.01	0.11	0.03	0.16	0.00	0.06
General Symptoms	0.04	0.20	0.03	0.16	0.05	0.22	0.05	0.22	0.05	0.22	0.06	0.23	0.06	0.23	0.03	0.18	0.07	0.26
Injuries and poisoning	0.13	0.34	0.18	0.39	0.09	0.28	0.07	0.25	0.11	0.31	0.04	0.19	0.06	0.24	0.08	0.27	0.05	0.21
Other	0.23	0.42	0.16	0.37	0.29	0.45	0.21	0.41	0.15	0.35	0.26	0.44	0.19	0.39	0.13	0.34	0.22	0.42
Annual earnings (1000 SEK)*	160.2	76.3	184.8	83.4	140.6	63.7	162.9	61.7	184.6	66.5	147.3	52.9	162.5	61.7	186.7	69.1	147.3	51.1
Unemployment rate**	2.30	1.29	2.40	1.38	2.21	1.21	1.96	1.09	1.96	1.02	1.96	1.13	1.86	1.02	1.77	0.91	1.91	1.08

Note: * *Annual Earnings* of the year when the first LT sickness spell began were inflated to "present" values using the 1997 CPI;
** *Unemployment rate* is reported by quarter, gender and administrative region, and is shown here for the quarter when LT-sickness spell began.

The proportion of persons with lower education increased by spell, which might be explained by the characteristics of the job and/or working environment, perhaps in combination with the selection of persons with lower education to specific tasks.

The proportion of married people decreased by spell, perhaps because married people cannot afford the income loss; on the other hand, marriage might be a healthier state. It could also happen that "poor health" might make marriage less likely, or make the transition from married to divorced more likely.

Third spells were, on average, shorter than first spells, but longer than second spells. The average number of short-term sickness spells (i.e., spells of seven days or less) preceding the LT sickness increased by spell, from about 3 before the first LT spell, to over 5 before the second, and almost 6 before the third.

The proportion of spells with muskoloskeletal, mental, and general diagnoses increased by spell, while the proportion of injuries and poisoning decreased by spell, as did cardiovascular and "other" diagnosis. The fact that injuries and poisoning decrease relatively makes sense since these are usually *not conditional* on whether a person has previously had an event of this kind. On the other hand, the other diagnoses are more likely, although not necessarily so.

The annual earnings of the year when the first LT sickness spell began, "adjusted" for the loss due to sickness, changed very little by spell. The average regional unemployment rate at the beginning of the LT sickness spell decreased by spell, but there is no gender specific tendency.

Table 3 shows descriptive statistics of sickness variables (days and spells) by individual. The average person in the sample was sick 582 days during the analyzed period, with 1.7 spells of long-term sickness, and 8.9 spells of short-term sickness.

Table 3 Descriptive statistics by individual during 1986-1991 (N=2666)

Variable	Min	Max	Mean	Std Dev
Days of Long-Term Sickness	60	3153	483.38	447.25
Days of Short-Term Sickness	0	1106	99.39	110.95
Total Days of Sickness	60	3346	582.78	466.78
Number of Long-Term Sickness Spells	1	10	1.66	1.02
Number of Short-Term Sickness Spells	0	101	8.89	10.41

Table 4 presents descriptive statistics regarding the duration of the LT sickness, by spell. Mean duration generally decreases with the number of spells, that is, there is a shorter "waiting time" before exit. This can be due to a combination of factors, including a quicker process for the transition into disability. Less than half of the sample (1088 persons, or about 41%) had more than one spell of LT sickness, while 16% had at least three spells, and about 6% had at least four.

Table 4 Descriptive statistics for the duration (in days) of all long-term sickness spells

Long-term sickness	N	Median	Mean	Std. Dev.	Min**	Max
Spell 1	2666	146	306.42	371.91	60	3096
Spell 2	1088	136	271.02	282.61	60	1904
Spell 3	413	175	282.01	261.77	60	1620
Spell 4	158	148	230.33	214.62	60	1196
Spell 5	65	153	235.94	193.90	62	994
Spell 6	28	138	241.89	293.16	63	1276
Spell 7	8	118.5	148.38	103.04	60	395
Spell 8	2	140.5	140.50	82.73	82	199
All spells*	4430	143	290.90	335.30	60	3096

Note: *There was one person with nine spells and one with ten;
** Long-term sickness is defined as 60 or more days, which account in many cases for the minimum value.

6 Econometric modeling

Sickness duration can be modeled by specifying a hazard function, which can be viewed as the product of the probability of recuperation (of the loss of working capacity) and the probability of wanting to return to work. The lack of economic theory about the relationship between the hazard rate at any time and elapsed duration of sickness at that point, can lead to incorrect assumptions about the form of the baseline hazard, which can potentially bias the estimated effects.

Let us explain this. We might specify a model in which a sick employee has each day the same probability of becoming healthy (i.e., to return to work); that is, conditional on being sick through yesterday, the probability of becoming healthy today is h, which means that the sequence of conditional probabilities would be a constant.

But this assumption would not seem to represent the data used here, which contain spells of long-term sickness, for which it might be more appropriate to assume that the "conditional probability" of becoming healthy $h(t)$, *decreases* with the length of spell.[52] The random variable, D, which represents duration of sickness is expressed as the number of days and the hazard function for this random variable, and is defined in terms of the cumulative distribution function $F(t)$ and the probability density function $f(t)$ by

$$\textbf{(1)} \qquad h_D(t) = \frac{f(t)}{1 - F(t)}$$

which, considering that $1 - F(t) = S_D(t)$, can be rewritten as:

$$\textbf{(2)} \qquad h_D(t) = -\frac{d \log S_D(t)}{dt}$$

where $S_D(t)$ is the survival function, or the probability that the sickness spell did not end prior to time t.

The evolution of the hazard function in time gives information about the duration dependence of an underlying stochastic process. If $h(t)/t > 0$, then the process exhibits positive duration dependence, which in our case would mean that the hazard of ending sickness any given day increased over time. If $h(t)/t < 0$, then the process exhibits negative duration dependence, which in our case would mean that the hazard of ending sickness decreased over time.

The proportional hazards model developed by Cox (1972) assumes that the hazard falls or rises over time at the same rate for all individuals, differing only according to the individual's vector of personal characteristics, x. Following Cox's model, we assume that the hazard function can be thus factored into a function of time and a function of variables related to spell and to individual. A corresponding model for the hazard of ending sickness is

[52] The hazard rate (also called hazard function, risk function, intensity rate, failure rate, transition rate, or mortality rate), expresses the instantaneous risk of ending sickness at time t, given that this event did not occur before time t. It is not a probability, because $h(t)$ is a positive number that can be greater than 1.

(3) $h(t;x_i) = h_0(t)\exp(\beta x_i)$,

where β are the coefficients to be estimated, and $h_0(t)$ is an unknown function of time. The expression $h_0(t)$ gives the hazard function for the "standard" set of conditions, $x = 0$. This model and its special cases, most notably the proportional hazards (PH) model, have been used in hundreds of empirical studies (see Devine and Kiefer, 1991, for references in micro labor economics). A *flexible* specification of the baseline hazard rate allows for non-monotonic variation with duration, and therefore a wider range of possible effects of duration on the hazard rate are captured.

A problem, associated in the literature with Heckman and Singer (1985), is that the presence of unobserved heterogeneity tends to produce estimated hazard functions that decline with time even when the hazard is not declining for any individual in the sample. This occurs when "high hazard" individuals are "exiting" more rapidly at *all* points in time, leaving in time a risk set that is made up *only* of "low hazard" people. This problem could lead to errors in computing and interpreting the hazard functions and the coefficients for the covariates. Additionally, with longitudinal data with multiple spells, another problem is whether, given the observed explanatory variables, the various durations are independently distributed or not.[53] Current econometric research often involves the simultaneous analysis of multiple observed spells, of either the same type or of different types of duration for a given individual.

In trying to learn more about factors affecting long-term sickness spells, we will here consider "families" of spells, i.e., groups of spells by individual, by diagnosis, and by region. Thus we can consider the impact of unobserved group-level heterogeneity on sickness duration. We will assume that spells in the same group share a common set of time-invariant, generalized, unmeasured characteristics that can be captured by an unobserved variable representing the group's propensity to exit from LT sickness.

[53] Van den Berg (2000) examines various types of relations between duration variables, as motivated by economic theory, and how they can be incorporated into multivariate extensions of the mixed proportional hazards model. One of his main conclusions regarding multiple-duration models is that, in micro-econometric research involving self-selection, duration data are much more informative than binary data.

Groups with identical observed characteristics can have different absence behavior due to long-term sickness. Given otherwise similar characteristics, spells in one group might be longer than spells in another partly as a result of genetics, but also because of different nutrition, living conditions and access to healthcare at different times in life. These factors are here considered to be part of an unmeasured group-level component (or random effect) that contributes to the risk of exit from LT sickness. Other factors (that unfortunately we cannot observe here) are working conditions, social contacts, job satisfaction and cultural background. Similarly, the other "families" of spells (groups of spells by diagnosis, and groups of spells by regions) share (other) common characteristics.

Based on the various groups of spells, let T_{i1}, …. T_{iJ} denote the J "waiting times" (or, durations) before exit from long-term sickness in the "family" i. Let x_{ij} denote the fixed and time-varying covariate vector associated with the j^{th} individual in the i^{th} group. A group-level random effect, or frailty term, (w_i) can be introduced to account for the dependence of "waiting times" before exits from LT sickness within the groups. Conditional on this unobserved "characteristic", event times within groups are mutually independent with the conditional (on heterogeneity) hazard function

(4) $$h(t_{ij} \mid w_i) = h_0(t_{ij})\exp(x'_{ij}\beta)w_i\,,$$

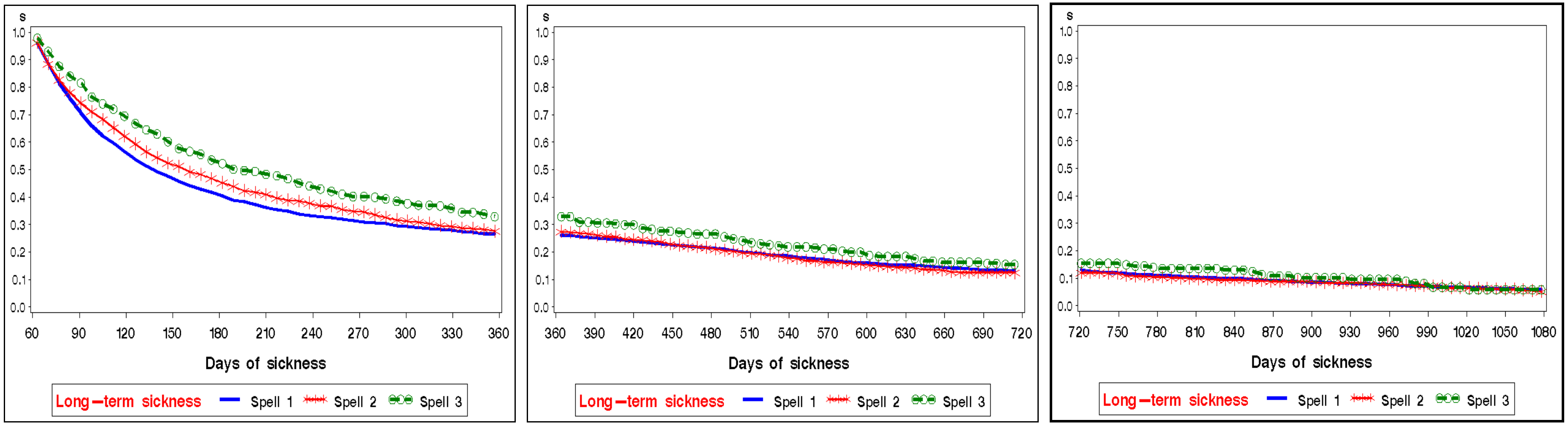
where β is a vector of fixed and time-varying effects, and $h_0(t_{ij})$ denotes the baseline hazard. The group-level random effect, w_i, acts multiplicatively on the group i risk of exit from LT sickness so that all spells' risks of ending in a particular group are multiplied by this common factor. We will assume that the frailty term follows a gamma distribution with density function, $g(w_i) = \alpha^{\alpha} w_i^{\alpha\text{-}1}\exp(\text{-}\alpha w_i)/\Gamma(\alpha)$, where the distribution is normalized to have a unit mean and a variance of σ. When $\sigma = 0$, the observations are mutually independent and the equation reduces to the standard proportional hazards model for individual-spell data (3). The estimate of σ can be interpreted in terms of the relative risk of exit from a hypothetical spell of long-term sickness.

Considering a group (i) of J spells, <u>the ratio</u> of the conditional hazard for a long-term sickness spell on day t_1, given that all other spells in the group ended at day t_2, t_3, …t_J, <u>to</u> the conditional hazard of exiting a long-term sickness spell at day t_1, given that a specific subset of spells had *not* ended at those times <u>is</u> (1+σ) times the number of spells hypothesized to have had ended at the specified times. The intra-group rank correlation coefficient (or Kendall's tau) can be interpreted as the percentage of total variation in the risk of exiting sickness that is between-group variation. The Expectation Maximization (EM) algorithm is used to fit this model. Given the data, the algorithm finds a frailty estimate for each group. The frailty distribution parameter, α, is estimated in one step, and is then used to estimate each group's frailty (w_i). The estimated frailty ($\hat{w}_i$) is substituted for w_i, and this process is repeated until the difference in successive estimates of α is negligible.

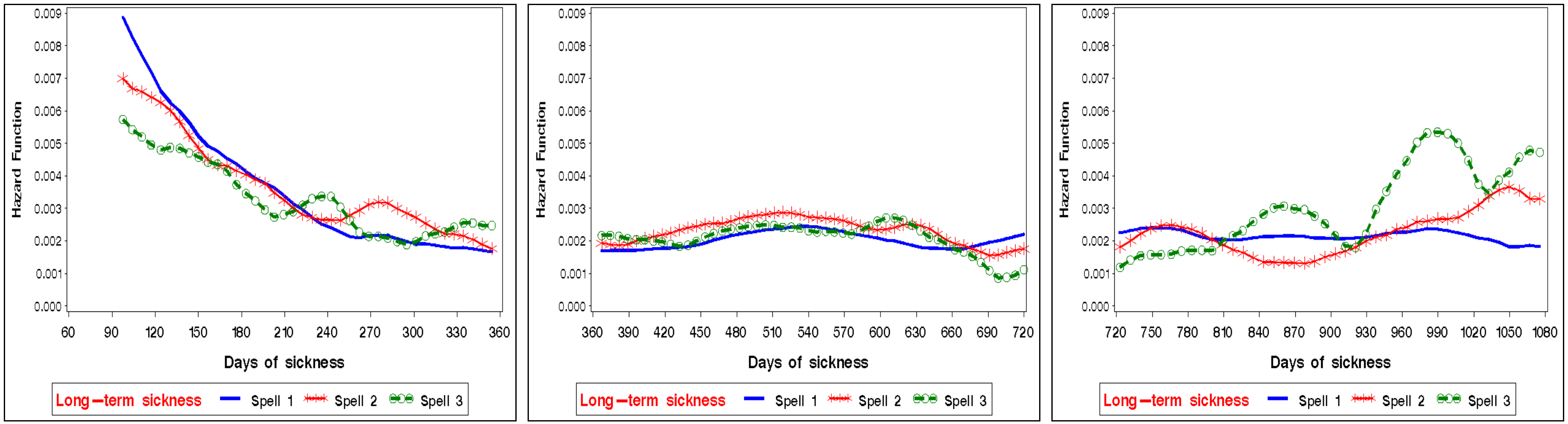
7 Results

7.1 Nonparametric survival analysis

Figures 5a and 5b show the survival and hazard functions for first, second, and third spells of long-term sickness, estimated by the life-table method. In order to have a (more) detailed graphical representation, the plots were “truncated” for the first, second, and third years of sickness. Spell durations were also “truncated” into intervals of seven days, so the results can depend to some extent on these arbitrarily defined intervals. In addition, there are relatively large numbers of cases for the first and second spells of LT sickness (2021 and 1080, respectively), and relatively few (413) for the third, which means that the method gives relatively better approximations for the first two spells of long-term sickness.



a) Survival estimates (s) during I) first year, II) second year, III) third year of long-term sickness



b) (Smoothed) hazards during I) first year, II) second year, III) third year of long-term sickness

Figure 5 Survival and hazard functions of absenteeism due to long-term sickness, by spell, 1986-1991.

The plots of the survival function (Figure 5a) show estimates of the proportions of sick people who have not yet become better (finished their sickness spell) up to a specific duration calculated from the *first* day of sickness (even though all spells are of at least 60 days). Most notable, the estimated proportion of people remaining sick fell rapidly during the first four months, and then slowed considerably. After one year about 30% of all analyzed people were still recorded as being long-term sick, while about 70% have already exited.

Table A2 (in the Appendix) shows results of tests of whether spells 1, 2 and 3 can be considered "equal". They cannot, which means we cannot pool all spells and treat them as single spells without affecting the parameter estimates and their standard errors. The great variety in the number of spells per individual (Table 4) also suggested that the analyzed sample is quite heterogeneous. As discussed above, neglected or unobserved heterogeneity across observations can lead to apparent time-dependence and wrong conclusions. Therefore, an unobservable multiplicative random effect shared by spells within a group is considered, and the model is estimated now using *all* spells of LT sickness (not only the first three), grouped by individual, diagnosis, and region.

7.2 Multivariate analysis

Table 5 shows the estimation results for the conditional hazard function (4) for spells grouped by spells by individual, spells by diagnosis, and spells by regions. In general the hazard of ending LT sickness was (18-46%) higher for women than men during 1986-1991. The hazard of ending LT sickness was lower for older people: For people aged 36 to 45 it was about 77-81% of the hazard of those aged 35 or younger, while for those aged 46 to 55 it was about 66-74%, and for those aged 56 to 65 it was 55-64%.

Table 5 Estimations results for 4430 spells grouped by individual, diagnosis, and region

Variables	Individuals (J = 2666)			Diagnosis (J = 346)			Region (J =25)		
	Estim.	S.E.	HR	Estim.	S.E.	HR	Estim.	S.E.	HR
Frailty	**0.31**	0.03	1.36	**0.32**	0.04	1.37	**0.01**	0.01	1.01
Female (CG[a]: Male)	**0.38**	0.05	1.46	**0.21**	0.04	1.23	**0.16**	0.03	1.18
Age (CG: < 36 years)									
36-45 years	**-0.26**	0.06	0.77	**-0.21**	0.05	0.81	**-0.25**	0.05	0.78
46-55 years	**-0.42**	0.07	0.66	**-0.30**	0.05	0.74	**-0.35**	0.05	0.70
56-65 years	**-0.59**	0.07	0.55	**-0.45**	0.06	0.64	**-0.47**	0.05	0.63
Citizenship (CG: Swedish Born)									
Naturalized Swede	-0.12	0.08	0.89	**-0.12**	0.06	0.88	**-0.10**	0.06	0.90
Foreign born	0.04	0.08	1.04	0.04	0.06	1.04	-0.02	0.06	0.98
Marital status (CG: Married)									
Unmarried	-0.09	0.06	0.91	-0.07	0.05	0.94	**-0.14**	0.04	0.87
Divorced	-0.06	0.06	0.94	-0.04	0.05	0.96	-0.02	0.04	0.98
Widowed	0.06	0.13	1.07	0.09	0.11	1.10	0.08	0.10	1.08
Educational level (CG: low)									
Medium	-0.02	0.05	0.98	-0.03	0.04	0.97	0.01	0.04	1.01
High	**-0.26**	0.09	0.77	**-0.17**	0.07	0.84	-0.04	0.06	0.96
Quarter (CG: Winter)									
Spring	-0.06	0.06	0.94	-0.04	0.05	0.96	-0.06	0.05	0.94
Summer	**-0.30**	0.05	0.74	**-0.24**	0.05	0.78	**-0.23**	0.04	0.79
Autumn	**-0.15**	0.05	0.86	**-0.15**	0.05	0.86	**-0.14**	0.05	0.87
Year (CG: ≤ 1986)									
1987	**0.12**	0.06	1.13	**0.14**	0.05	1.14	0.17	0.05	1.18
1988	-0.06	0.07	0.95	-0.03	0.06	0.97	0.02	0.06	1.02
1989	-0.13	0.08	0.88	-0.07	0.07	0.93	0.02	0.06	1.02
1990	**-0.22**	0.10	0.80	-0.14	0.08	0.87	-0.05	0.08	0.95
1991	**-0.87**	0.13	0.42	**-0.75**	0.12	0.47	**-0.65**	0.12	0.52
Diagnosis (CG: respiratory)									
Musculoskeletal	-0.12	0.12	0.88				-0.04	0.10	0.96
Cardiovascular	-0.16	0.14	0.85				-0.06	0.12	0.94
Mental	0.00	0.13	1.00				0.03	0.11	1.03
General symptoms	0.17	0.15	1.19				0.13	0.13	1.14
Injuries & poisoning	**0.39**	0.14	1.48				**0.32**	0.11	1.38
Other	**0.24**	0.13	1.27				**0.24**	0.10	1.27
Previous cases [b]	0.00	0.00	*-0.29*	0.00	0.00	*0.10*	0.00	0.00	*0.16*
Daily loss[c] (100 SEK)	**0.03**	0.00	*3.16*	**0.02**	0.00	*2.20*	**0.01**	0.00	*1.22*
Unemployment rate	**-0.07**	0.03	*-6.68*	**-0.06**	0.02	*-5.95*	**-0.05**	0.02	*-4.72*
Region (CG: Göteborg)									
Kronoberg	**0.36**	0.19	1.43	**0.25**	0.15	1.29			
Bohuslän	**-0.30**	0.15	0.74	**-0.29**	0.11	0.75			
Varmland	**0.35**	0.14	1.41	**0.27**	0.11	1.31			
Kendall's TAU	**0.13**			**0.14**			**0.006**		
-2 Log Likelihood	48550	48323	227	48628	48340	288.1	48621	48603	17.5

Note: **Bolds** are significant at the 10%-level; *Italics* for hazard ratio (HR) indicate that for the continuous variables it had been recomputed as *phr* = 100*(*hr*-1); [a] CG is the comparison group; [b] Previous cases of sickness before the analyzed spell, and starting with January 1983, regardless of their duration; [c] Daily earnings loss due to sickness.

The hazard of naturalized Swedes to exit LT-sickness was 88-90% of the hazard for Swedish born people.

The hazard to exit LT-sickness for those with higher education was lower (about 77-84%) than the hazard for people with lower education. This result can be explained by several characteristics of the two groups, such us: income, work environment and working conditions, and health capital. Especially in Sweden, where medical insurance is universal, it is possible that the individuals' care for their health is an important factor driving this difference. People with higher education may be more careful with their health, and more receptive to all information related to health issues than less educated people.

People whose spells started in winter showed the highest hazard of exiting from LT sickness. For those whose spells started in a summer quarter, the hazard of exiting from LT sickness was 74-79% of the hazard of those whose spells started during the winter quarter, while for those whose spells started in a autumn quarter it was about 86-87%.

The hazard for exiting from LT sickness was (13-18%) higher for spells that started in 1987 compared to those that started in 1986 or before (i.e., 1983-1986), while for those started in 1991 it was only 42-52% as high. These were the only years with several highly significant results, and they happen to coincide with two reforms of the social insurance, which occurred under two very different macro trends: the relatively good period of the end of the 1980s, and the beginning of the recession period in the early 1990s. This can be an explanation of the different sign of the estimated coefficients for years 1987 and 1991.

The hazard of exit from LT sickness was (38-48%) higher for those with injuries or poisoning diagnosis, than for those with a respiratory diagnosis; and those with "other" diagnosis were 27% higher.

The daily loss of earnings had a significant impact on the duration of absence due to sickness: For each 100 Swedish crowns daily earnings loss, the hazard of exit from LT sickness went up by 1.2-3.2%. The regional unemployment rate also had a significant effect: Each additional percentage point was associated with a 4.7-6.0% decrease in the hazard of exit from LT sickness.

There are also geographical differences. The hazard of exit from LT sickness was

(29-43%) higher for those living in Kronoberg and Värmland compared to those living in Göteborg, while for those living in Bohuslän it was only about 75% of the hazard of those living in Göteborg. Parameter estimates and hazard ratios for the other regions that were not significant at the 10%-level are shown in Table A3 in the Appendix.

Judging by Kendall's tau, the intra-group correlation was about 0.13 for spells grouped by individual and by diagnosis, and less than 0.01 for spells grouped by region. Thus there was a relatively low association in the risk of exit from LT sickness among individuals and diagnoses, and almost no association among regions.

8 Summary and conclusions

This paper presented new evidence on the determinants of the duration of long-term sickness for employed individuals in Sweden from mid-1980s through beginning of the 1990s, using longitudinal data from a representative subset of the insured population. The probability of exiting long-term sickness declined considerably after about four months (Figure 5), which suggests that policies aimed at helping the long term sick return to work should focus on helping employees with health problems before this period. Regarding this, prevention methods directed towards improving working conditions and evaluating job tasks should be considered more often.

During the period of the study, women had a higher hazard to exit from LT sickness than men (Table 5), much of which might be explained by the fact that women exited into disability more often than men. The older people were, the lower was the hazard of exit from LT sickness, which indicates that little is done to help older workers back to the work place. This suggests that policy initiative to improve health status, speed up the recovery and encourage work should also be targeted towards those in older age groups. On the other hand, to prevent or slow down the increasing trend of LT sickness, besides helping these people, special policies should be oriented to prevent deterioration of the heath status of younger employees. These policies should relate both to working conditions and to health problems related to work. One such policy would be greater flexibility in working time. In this context the consequence of overtime work and the burden of both paid careers and house work (usually) for women needs to be analyzed in a long-term perspective as well, since over use work capacity today might cause health problems in the future.

The hazard of exit from LT sickness was lower for naturalized Swedes than the Swedish born. There was labor migration to Sweden during 1960s and early 1970s, often to jobs requiring hard physical effort and/or with a less amenable working environment (there was less competition from Swedes for these jobs). Many may have worked many overtime hours as well, hoping to return home "wealthy". If they did not then return home, and they belong to the group of naturalized Swedes, it would not be surprising that their LT sickness might last longer. This indicates that it is important to pay more attention both to physical working conditions and to hours of work. Generally, improving working conditions and designing the tasks of each job so as to prevent a misuse of individuals' working capacity should be priorities for employers. In this sense the involvement of employers in payment of their employees' sick pay (during the first 2, or even 4, weeks of each spell) is well motivated, not only as an instrument for "disciplining" employees' absenteeism, but also as an indicator telling employers something about the working conditions in their organizations. Under these considerations, the employers' contributions to the social insurance should also be redesigned.

The quarter when a LT sickness spell started also had an impact on the hazard of exiting the spell: Starting during the summer implied the lowest hazard of exiting compared to winter. These findings may suggest an effect of weather. During the colder and darker months, persons with rheumatic or psychological problems may be affected more.

Loss of earnings due to sickness decreased the length of the spell. On the other hand, the presence of high unemployment increased the length of the spells, perhaps, due to the uncertainty about the outcome if people return to work.

The medical examination is clearly a very important element in this whole process, but even more so regarding the future of employed individuals. Having a well-done evaluation, and flexible programs connected to it, can help the individual's health and wealth, and the society too. Nevertheless, being active in a "well-balanced" way is considered to have a positive impact on health, especially in the long run.

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Appendix

Table A1 Employed part-time (in 100), by gender and age groups.

	Age-groups							Total
	16-19	**20-24**	**25-34**	**35-44**	**45-54**	**55-59**	**60-64**	
Women								
1987	570	680	2120	2790	1836	839	677	9512
1988	552	669	2105	2700	1835	813	688	9362
1989	578	634	2080	2700	1839	780	650	9261
1990	581	599	2099	2582	1907	765	685	9218
1991	558	585	2028	2521	2004	742	699	9137
1992	469	577	1920	2420	2011	732	701	8830
1993	385	585	1830	2312	1971	727	636	8446
1994	354	680	1811	2231	1921	735	555	8287
1995	389	690	1804	2166	1915	727	573	8264
1996	354	684	1741	2079	1867	741	546	8012
1997	343	664	1663	2089	1830	762	485	7836
1998	383	664	1677	2010	1795	783	455	7767
1999	425	637	1632	1990	1783	763	470	7700
Men								
1987	271	167	240	174	141	64	271	1328
1988	283	177	219	187	136	79	336	1417
1989	320	186	237	201	120	83	360	1507
1990	339	164	263	215	128	95	329	1533
1991	309	175	264	194	138	86	348	1514
1992	253	190	273	190	153	105	367	1531
1993	206	204	276	207	175	90	377	1535
1994	212	234	307	231	196	101	348	1629
1995	203	244	307	218	207	116	313	1608
1996	214	251	320	213	214	119	275	1606
1997	213	271	317	240	230	116	205	1592
1998	233	264	297	263	239	129	173	1598
1999	267	297	332	241	231	139	179	1686

Source: Statistics Sweden, Anställda (AKU) efter kön, ålder, hel/deltid och veckoarbetstid. År 1987-1999

Table A2 Test of equality over strata

Test	Chi-Square	DF
Log-Rank	**12.05**	2
Wilcoxon	**24.70**	2
-2Log(LR)	<u>4.69</u>	2

Note: **Bold** =significant at less than 1%, and <u>underline</u> = significant at the 10% level.

Table A3 Estimates for region dummies (control = Göteborg)

Region	Individuals (J =2666)			Diagnoses (J =346)		
	Estimate	Std. Error	Hazard ratio	Estimate	Std. Error	Hazard ratio
Blekinge	-0.01	0.18	0.99	-0.01	0.14	0.99
Bohuslän	-0.30	0.15	0.74	-0.29	0.11	0.75
Gotland	0.21	0.25	1.24	0.18	0.19	1.20
Gävleborg	-0.12	0.14	0.89	-0.14	0.11	0.87
Halland	0.02	0.17	1.02	-0.05	0.13	0.95
Jämtland	0.04	0.17	1.04	-0.01	0.14	0.99
Jönköping	-0.03	0.15	0.97	-0.06	0.12	0.94
Kalmar	0.05	0.15	1.05	0.01	0.12	1.01
Kopparberg	-0.03	0.15	0.97	-0.04	0.11	0.96
Kristianstad	0.13	0.14	1.14	0.15	0.11	1.16
Kronoberg	0.36	0.19	1.43	0.25	0.15	1.29
Malmöhus	0.07	0.13	1.08	0.01	0.10	1.01
Norrbotten	0.13	0.14	1.14	0.07	0.11	1.07
Skaraborg	0.29	0.17	1.34	0.19	0.13	1.21
Stockholm	0.05	0.12	1.05	0.00	0.09	1.00
Södermanland	-0.11	0.16	0.90	-0.14	0.12	0.87
Uppsala	-0.06	0.15	0.94	-0.10	0.12	0.91
Värmland	0.35	0.14	1.41	0.27	0.11	1.31
Västerbotten	-0.05	0.15	0.95	-0.05	0.12	0.95
Västernorrland	-0.18	0.15	0.83	-0.12	0.12	0.89
Västmanland	-0.17	0.14	0.84	-0.16	0.11	0.86
Älvsborg	0.06	0.14	1.06	0.05	0.11	1.05
Örebro	0.03	0.15	1.03	0.00	0.12	1.00
Östergötland	-0.08	0.14	0.92	-0.09	0.11	0.91

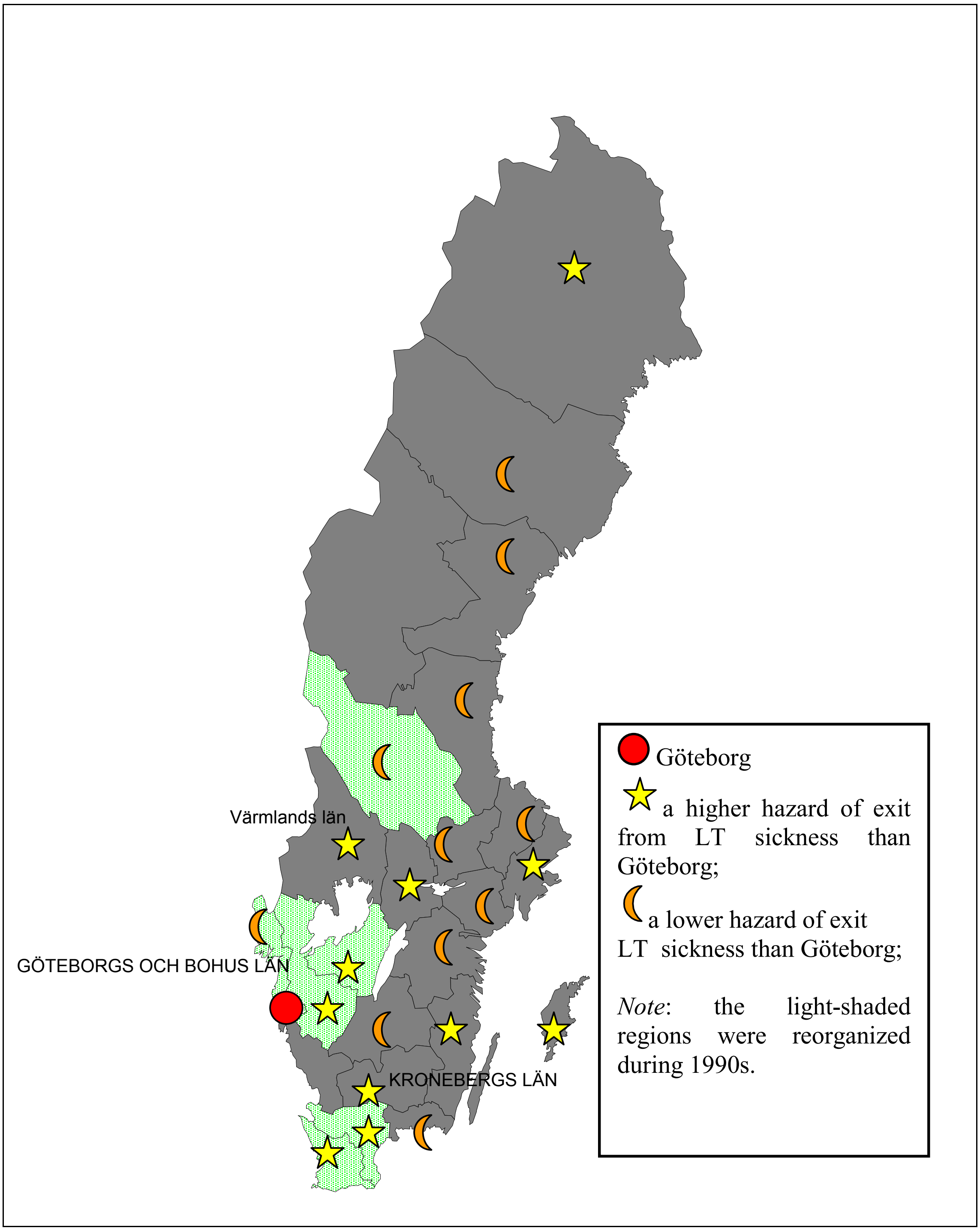

Figure A1 The hazard of ending sickness of Sweden's administrative regions, compared to Göteborg, 1986-1991.

Paper IV

EXITS FROM LONG-TERM SICKNESS IN SWEDEN*

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Abstract

In this paper, we analyze exits from long-term sickness spells in Sweden. Using spell data for more than 2500 people, aged 20-64 years during 1986-1991, and who had at least one sickness spell of at least 60 days during 1986-1989, the aim is to analyze the transition to different states, i.e., return to work, full disability pension, partial disability pension, and other exit from the labor force. Given the complexity of the exit decision, which encompasses both the individual's choice, the medical evaluation and the decision of the insurance adjudicator, we will consider the outcome as being the result of two aspects of the exit processes: an aspect that governs the duration of a spell prior the decision to exit, and another that governs the type of exit. Therefore, the analysis will be done in two steps: First, we will analyze the duration of the sickness spells, and then we will analyze the process that governs the type of exit. The results indicate that both individual characteristics, and push factors, such as regional unemployment, are important for both components of the decision process.

Key words: Long-term sickness, returns to work, full and partial disability, spell data, competing risks model, multinomial logit model.

JEL Classification: I12; J21; J28

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1 Introduction

The macro-statistics for Sweden show that the numbers of both recorded sickness days per capita and long-term sickness spells have evolved cyclically over the years,[54] while life expectancy,[55] another measure of health, has increased continuously. The World Health Organization (WHO) presented in June 2000 the new healthy life expectancy rankings. For the first time, the WHO has calculated healthy life expectancy for babies born in 1999 based upon Disability Adjusted Life Expectancy (DALE).[56] Sweden ranks number four (among 191 countries) with a health life expectancy of 73 years (71.2 for men, and 74.9 for women), after Japan (74.5 years), Australia (73.2 years) and France (73.1 years). In Sweden, the health care system and relatively low use of tobacco, are considered as having the strongest contribution on the ranking. This ranking does not shade much light one understanding and explaining the long-term sickness phenomenon in Sweden, but may imply that its effects are contributing to the increase of life expectancy.

The extent to which increased absence due to sickness is attributable to changes in actual or perceived poor health among the employed is not easy to determine. Also, it cannot be ruled out that in the long term a change in the level of absence may be due to changing attitudes and values with regard to reporting sick.[57] Given the *generosity* of the social insurance system, people can choose to leave the labor market, permanently or temporarily more easier now than 30-50 years ago. People are better informed and they

[54] Statistics from the Swedish National Insurance Board (*RFV*).

[55] *SCB Befolkningsstatistik* del 4, 1997, and *Statistical Yearbook of Sweden* 2000, Statistics Sweden. Additionally, Table A1 in Appendix 1 presents life expectancy, number of survivors, and chances per 1000 of eventually dying from specified causes, at selected ages, by sex in 1996.

[56] DALE summarizes the expected number of years to be lived in what might be termed the equivalent of "full health". To calculate DALE, the years of ill health are weighted according to severity and subtracted from the expected overall life expectancy to give the equivalent years of healthy life. Previously, life expectancy estimates were based on the overall length of life based on mortality data only.

[57] Sickness-spell indicators probably do not give an accurate image of the average health of the Swedish population. This is not the main issue of this study, merely an observation that, on average, employees have not gotten sicker as time progresses.

can invest more in their health throughout their lifetime. Investment in health (especially, maintaining a good diet, exercising, etc.) drives the path of choices available for people. *Poor health* is, thus, a relative term and it has different implications for different people and different situations. In order to decrease the heterogeneity in this variable, this study borrowed the Swedish National Social Insurance Board's definition for *long-term sickness* (as *any sickness spell of at least* 60 *days*), and used it for defining poor health.

The exit alternatives from a spell of long-term sickness for persons younger than 65 are: return to work, exit with full or partial disability, and other non-working exits. The sickness benefit is available for an unlimited period, and given the medical evaluation, the patient can choose the exit alternative that maximizes their utility. Given the requirement of a medical evaluation, the patient's final decision does not look as if it is a choice. Following the medical evaluation, the doctor can suggest different alternatives, but the employee is the one who really decides. We are all familiar with the fact that there are people who prefer to work even though they have the opportunity to leave the labor market with a disability benefit. The real problem is the difficulty to adapt work environment or find a proper job for their health status. Additionally, it is not clear which are the factors that steer people toward one of these alternatives. Are people's decisions related to the duration of the sickness spell, and what determines this? How important is the diagnosis? Do economic incentives influence the choice? How do other factors (e.g., marital status, education, age, and citizenship) influence the decision? This study addresses these questions using data from the LS-database of Swedish National Insurance Board. The main data used here relate to the sickness history of the individuals. Individuals selected have been away from work with compensation *at least* once for *at least* 60 days during the period 1986-1989.

Given the complexity of the exit decision, which encompasses both the individual's choice, the medical evaluation, and the decision of the insurance adjudicator, we will consider the outcome as being the result of two aspects of the exit processes: an aspect that governs the duration of a spell prior the decision to exit, and another that governs the type of exit. Therefore the analysis will be done in two steps: First, we will analyze the spells of sickness, estimating nonparametically the survival and hazard functions, and then estimating a competing risks model (distinguish different types of exit). Second, we will analyze the process that governs the type of exit by using a multinomial logit model.

The study is organized as follows. The next section briefly presents some social insurance facts related to sickness in Sweden, upon which our study is based. Section 3 discusses the literature on labor market participation and exits there from. Section 4 we discusses the supply and demand of labor, stressing health aspects, while sections 5, 6, and 7 present the data, the econometric framework, and the estimated results. The last section summarizes and draws conclusions.

2 Some background facts

2.1 Social insurance during the study period

All residents in Sweden with an annual estimated earned income, from either employment or self-employment, of at least 6000 Swedish crowns (during the period analyzed by this study) are covered by the national insurance regulations on *cash benefits* during illness or injury.[58] People with relatively high incomes do not, however, receive payments from the social insurance office for the entire amount of income lost, in that the insured earned income is limited to of 7.5 times the base amount, although mandatory social security contributions for insurance purposes are levied on their entire income.[59] A sickness benefit (sick-pay) is available for an *unlimited* period when an illness reduces working capacity by at least 25 percent.

During the 1980s and 1990s, social insurance rules changed largely in response to economic developments, with expansion during the good years, and cut backs in bad

[58] Those entitled to use the Swedish health services at subsidized prices are *all* residents of Sweden regardless of nationality, as well as patients seeking emergency attention from EU/EEA countries and some other countries with which Sweden has a special convention.

[59] In 1991 (the end of the analyzed period), the base amount was 32,200 Swedish kronor (U.S.$1.00 equals about 10 kronor in December 2000). This amount is fixed for one year at a time, and it is appreciated in the line with price changes, which are, in turn, measured using the Retail price index.

times. During the period studied (1986-1991), there were two main social insurance reforms, which took effect December 1, 1987 and March 1, 1991.

The first change followed an economic expansion in the middle of the 1980s when the national economy grew at a relatively rapid rate, and unemployment was the lowest since the mid 1970s. From December 1, 1987 sickness insurance began to cover the loss of earnings from the first day the illness was reported; previously there had been an unpaid one-day waiting period. Both before and after, the replacement rate was 90%. Additionally, the 1987 reform constrained the compensation's payment of the first 14 days of sickness only to those days when people were scheduled to work, which affected compensations for persons with irregular schedules.

The second change took place in 1991, the year when Sweden began a recession period. The replacement rate for the sickness benefit had been 90% from the *first* day since December 1987, but from March 1, 1991, this replacement rate was not used until after the 90th day of the sickness spell. Only 65% was now paid for the first three days of the sickness spell, and 80% from then through the 90th day. However most workers also received another 10% from negotiated benefits (i.e., paid directly by their employer, not by the social insurance system), which meant that, for them, the greatest difference was during the first 3 days.

During the period analyzed, a *self-employed* person could opt for a waiting period of 3 or 30 days, the sickness insurance premium being lower for the longer waiting period.

Since July 1, 1990, there have been four rates of sickness cash benefits (full, 75%, 50%, and 25%; that is, one can be on sick leave full-time or partial (75%, 50%, or 25%). Previously only full or 50% could be obtained. The idea behind allowing more partial rates is to aid the gradual return of persons with more serious illness.

Since this study focuses on long-term spells, the changes in rules that occurred during the period analyzed would not be expected to have much effect on the analysis.

2.2 Facts and rule-changes in a longer perspective

Figure 1 shows the flows of people who, due to ill health, left the labor market partially or totally (PD/TD) during the period 1974-1999.

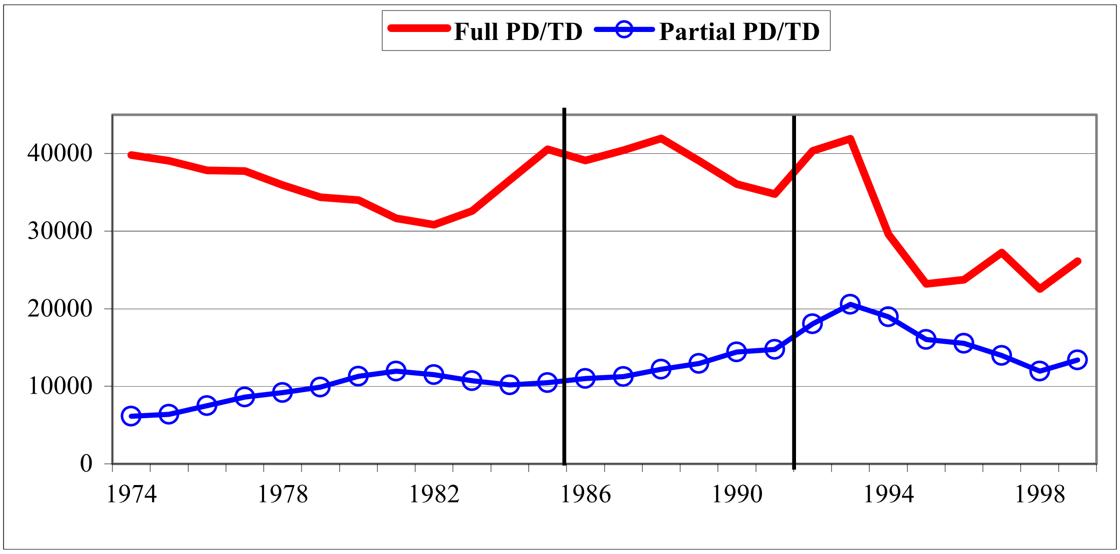

Figure 1 Inflows of full or part-time disability[60]

The exit could be into either *permanent* disability (*PD*) or *temporary* disability (*TD*), compensated either *fully* (1/1), or *partially* (3/4, 2/3, 1/2, or 1/4). Between 1970 and 1993 three forms of partial disability pension were possible: the full pension, and for those retaining some work capacity, a 2/3 or a 1/2 pension. Since July 1993 two new forms were added: the 3/4 and 1/4 pensions, and no further 2/3 pensions were granted.

Figure 2 shows the development of ongoing spells in December 31 of each year, compensated by the social insurance during the time period 1974-1999, all spells, and by duration for spells of 30 days of more.

[60] Source: if no other source is mentioned, all data come from the National Social Insurance Board (RFV).

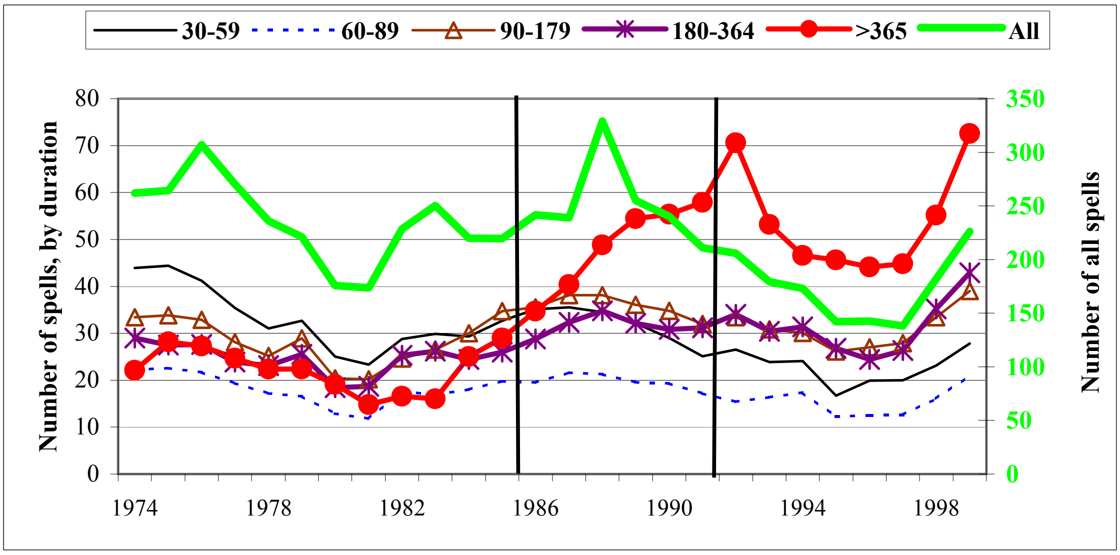

Figure 2 Number of ongoing spells of sickness on December 31 each year (in thousands), by duration and *all* spells

Figure 1 shows that, during the period studied (1986-1991) the number of permanent and temporary exits with a partial pension of some kind increased, while exits with full pensions fluctuated: after a slow decrease in 1986, they increased slowly until 1988, after which they decreased again through 1991. Figure 2 shows that the number of sickness spells longer than one month fluctuated considerably during the period studied. *Only* the number of compensated spells of sickness longer than 1 year *increased* from about 35 thousand in 1986, to almost 60 thousand in 1991, and to more than 70 thousand in 1992. The number of all *other* spells longer than one month decreased after 1987 or 1988. The most spectacular change was the spike in *all* spells (including those under 30 days) in 1988, very likely due to the reform of December 1987, which eliminated the waiting day before compensation was paid.

At the end of the 1980s, there were about 170 thousand people on sick leave with spells of at least 30 days, but in the first half of the 1990s, the number was less than 90 thousand. Many people with long-term sicknesses received permanent or temporary disability pensions in 1992 and 1993 as a result of a policy to “clean the books” of persons who had been on sick leave well over a year. A large number of people on long-term sick leave were granted permanent disability pensions because they were not considered suitable candidates for rehabilitation.

Additionally, there were changes on the replacement rates. From April 1993 the sickness cash benefit available after the 90th day of illness was reduced from 90% to 80%, and the rehabilitation cash benefit was lowered to 95% of the daily salary. From July 1993 the sickness cash benefit was reduced from 80% to 70% after the 365th day, though this rule did not apply to those spells covered by medical treatment. These changes might explain the drop in the numbers of all longer-period sickness spells during and after 1993. This might also explain the peaks of various pension exits from the labor market in 1993. Additionally, in April 1993, a waiting day was introduced again; i.e. sick pay was again not paid for the day when the sickness spell was reported. This may have reduced the number of very short-term sicknesses reported, and thus contributed to the continuing decline in *all* spells after that date.

After the peak year in 1993, the granting of disability pensions fell and in 1995 and 1996 reached the lowest level since the beginning of the 1970s. The fall was due to stricter rules and a more restrictive application of them. For example, since July 1, 1995, the level for the basic pension has been reduced to 90% of the lower base amount for single pensioners, and to 72.5% for married pensioners.

The number of cases of long-term sickness rose in 1999. The number of people terminating their period on the sick list by being declared fit or with a disability pension has not increased to the same extent. Although the level of absence due to sickness is still somewhat lower than in the late 1980s, the trend is worrying. More people have direct access to sickness insurance when the number of people employed rises, and also because people are often more inclined to report sick when the state of the labor market is better. Another explanation is that more people are reaching the age when it is more common to be absent sick.

From these macro facts, we may reasonable conclude that individuals' behavior is a function of the opportunities and restrictions they face. The analysis bellow will be limited to a shorter period (1986-1991), due to the homogeneity of the rules governing long-term sickness, and exits into disability during these years.

3 Literature review

The empirical literature on labor market participation, explaining whether or not people work in general, is vast, but there is relatively little research focused on disability exits per se.[61] The effects of health on labor market participation are theoretically ambiguous, although most research seems to assume that poor health will decrease participation. Little consensus on the magnitude of the effects has been reached, mainly due to different definitions of health.

Until the late 1980s most of the literature on labor market participation concentrated on factors that influence the number of hours worked, but few studies attempted to distinguish different non-working states, such as unemployment, long-term sickness, disability, or early-retirement for other reasons. Those studies that have focused on transitions between states have mainly examined on the transition to and from unemployment.

Nevertheless, there is an emerging genre of literature focusing on retirement decisions of the older labor force, and there is also quite a vast literature regarding the labor force participation of *older workers*. Bound and Burkhauser (1999) reviewed the literature on the labor supply of people with disability and how it is affected by disability program characteristics. They concluded that empirical analyses of programs targeted on individuals with disabilities have focused almost exclusively on trying to understand the behavioral effects of such programs.

During the 1990s there was growing research evidence suggesting that there are many people recorded as long-term sick who could also be classified as unemployed. This calls into question the quality of both the sickness and unemployment statistics. For example in the UK such concerns have been raised at the national level by Disney and Webb (1991) and at regional and local levels by Forsythe (1995), and by Beatty and Fothergill (1996).

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[61] Haveman and Wolfe (2000) survey and discuss the main lines of economic research addressing the issues of economic status and behavior of the working-age population with disabilities.

The literature on labor force participation in Sweden contains some studies related to sickness absenteeism. Using aggregate data, Lantto and Lindblom (1987) estimated the effects on days of compensation of aggregate unemployment, and found a significant inverse relation between days of sickness and unemployment.

Henrekson et al. (1992), analyzed the effects of 1987 and 1991 sickness insurance changes on sickness absenteeism, and found that there is a relation between the replacement rate and the number of compensated sickness days.

Björklund (1992), using regression analysis on the 1981 cross section of the Swedish Level of Living Survey (LNU), analyzed the effect of both individual characteristics and working conditions on sickness absenteeism. The explanatory effects of the individual characteristics decreased when the variables related to working conditions were used. Without considering the working condition variables, but using the wage rate as a proxy for the individual's cost of absenteeism, Björklund's estimates indicated that absenteeism increased with decreasing cost.

Brose (1995) used a random sample from the 1984 cross-section of the Swedish HUS (household) database to analyze the influence of economic incentives and the work environment on sickness absenteeism. Using various models (ordered probit, Poisson and negative binomial) he found that individuals incorporated the economic incentive into their decisions about sickness absenteeism. In addition, his results indicated that the work environment is important. Bad working positions, noisy and unclean working environments increased sickness duration.

Sundén (1995), using 1974 and 1981 cross-sections of the Swedish LNU database examined how the partial retirement program affects the retirement program, introduced in 1976, behavior of workers aged 60 years or more. This program enabled people to work part-time, and take partial early retirement (to replace some of the income lost due to reduced time), but without claiming disability or taking an advance old age pension. Her logit estimates indicated that, after controlling for health, occupational characteristics, the labor market, and family conditions, women were less likely than men to retire fully, and more likely to continue working at least partially until age 65.

Sundberg (1996), using the 1981 cross section of the Swedish LNU database, found that the sickness duration of people with prior unemployment experience was greater than of those who had never experienced unemployment. Again, working conditions also influenced workers' health.

Skogman Thoursie (1999) studied the possible effect of the economic incentives present in the Swedish disability pension system on the probability of a disability pension being granted. Using a mixed conditional logit model incorporating various predicted income levels and a sample consisting of workers aged 25-64 from the 1981 Swedish Level of Living Survey, he found that economic incentives do have a significant and positive effect on the likelihood of a disability pension being granted.

The focus of this study is on analyzing the factors such as age, marital status, income, diagnosis, citizenship, number of children, and the unemployment rate that other studies have suggested might affect the duration of sickness spells and the choice between return to work and other exits, using longitudinal data.

4 The labor market and reduced working capacity

4.1 The supply of labor

Health status may affect the labor supply decision by changing the marginal rate of substitution between leisure and consumption. Poor health or injury increases the disutility from work, and creates incentives for leaving the labor market temporarily or permanently, since it makes leisure more valuable relative to work. Human capital is typically acquired at different rates over the working career. For earnings to rise in early years, relatively more capital must be acquired, and if the earnings profile is then to turn down, as statistical evidence suggests, relatively less capital must be acquired later.

The theory of human capital developed by Ben-Porath (1967) suggests that individuals make incremental decisions about new investments in human capital by performing a sort of mental cost-benefit analysis. In empirical analyses, devised cost and benefit measures for costs and benefits can approximate this. Costs can be explicit, such as those accompanying a decision to spend time in education, or implicit, for example if one decides to train on the job, with the possible consequence of foregoing (higher) immediate earnings. The cost of investment in the first case is the wage not received, while in the second case, is the higher wage not received in the short-run. In both cases there is the prospect of doing better in the long run. People do not have the same marginal cost or marginal benefit curves. Persons with greater endowments of intelligence, social competence, etc. can be expected to gain more from a given investment. Furthermore, a strong initial investment in schooling or in other forms of training may make it easier to enhance human capital later, at a lower cost, while its lack may make it harder. This would explain why persons with lower initial educational attainment also tend to have smaller later additional increments to human capital.

If people invest in human capital at a decreasing rate as they age, then their total stock of human capital will also increase at a decreasing rate, or even decrease, due to "depreciation". In order to maintain a given level of earnings, acquisitions of job knowledge must at least equal this depreciation. For many, this may simply mean keeping up through "learning by doing" daily tasks on the job. For others, who might be stuck in a "fixed" technology, i.e., with little "learning by doing" renewal opportunities, the situation might be worse and earnings could stagnate or even decline as they age. They would certainly decline in a free labor market setting where hourly earnings were related to productivity.

This interpretation of the theory suggests that persons with lengthy spells of sickness, even if they become completely well afterwards, will lose some job experience, and may lose some relative job productivity. On the other hand, people with sickness whose human capital is low (highly depreciated) might find long-term sickness leading to disability to be a way out of the predicament. Certainly, long periods of sickness can deplete workplace specific capital, as the dynamics of the workplace continue.

The seriousness of these problems will depend on individual characteristics, the length of sickness and the requirements of the job. Persons with jobs requiring a lower level of skills or less ongoing technical training would experience less serious problems than would persons with jobs requiring more. Also, the effort, and associated costs, to the individual to recapture a training loss, will by definition be greater the higher are the demands of the job.

There may also be an interaction between the type of sickness and human capital. For example, chronic musculoskeletal problems might make it more difficult to perform specific tasks, e.g., stationary tasks or tasks requiring heavy or awkward lifts; depression might make it more difficult to work in an environment where a high level of social competence is necessary; etc. One would need a sophisticated and large database in order to estimate these kinds of interactions.

Because of sickness, an individual's capacity may thus be temporarily or permanently reduced, at least *vis à vis* a specific work task. This suggests a decline in productivity with a given human capital profile, or technically speaking, what we might call extra human capital depreciation.

Of course, changing employers is easier in a tight labor market rather than in a labor market with high unemployment and few new openings, and it is also easier the larger the local job market is. There are other considerations to changing employers, however, among them the total cost for the family: An overall household calculation might show that the most desirable alternative is to stay put in a situation with lower earnings potential, because it costs something to search for a new job, it costs to move, and it may be difficult for a spouse to get their reservation earnings in another location.

Changing occupations usually involves an even higher cost, and probably a more uncertain outcome, the older one is. In addition, the older one is, the fewer are the remaining years of benefits to be reaped from a given investment in training/education. This, together with the other disadvantages listed above, might weight the calculation in favor of no move.

Reduced earnings capacity due to sickness may or may not qualify the individual for a partial disability benefit, depending on the social-insurance legislation in a country and how it is applied in practice. In addition, the medical condition may only be temporary, in which case the individual may not want to apply for disability benefit.

4.2 The demand for labor

Individual earnings are a result of demand as well as supply. In a competitive market profit-maximizing employers will seek out employees whose human capital best suits the requirements of a job at the lowest cost. Given this perspective, employers have no reason to discriminate against persons who have been sick, as long as their human capital is not perceived as being impaired. In fact, human capital may in part be employer or even employer-task specific, rather than general, which means that there are hiring and training costs associated with acquiring new employees. In this case, it is also costly to lay off persons if their only problem is that they are temporarily sick, even if the spell is long.

If the normal situation is that sickness does not impair human capital or work capacity, and if future performance and/or sickness is not normally a function of past sickness, then (ceteris paribus) we should not be able to observe differences between the earnings of persons with lengthy sickness history and those persons without.[62] So long as there is no rational reason for wage differences between persons with a history of sickness and others, i.e., due to reduced productivity per hour, or reduced capacity to work a normal number of hours, or to increased inconvenience costs, then any observed differences would be due to discrimination. However, if sickness is normally a function of past sickness, i.e., if there are "sick" people and "healthy" people, then employers might be expected to offer lower wages to the "sick" people, because absenteeism does create costs for the employer, through inconvenience (and lower overall productivity) at the workplace. Then cost conscious employers, behaving rationally, would take this increased risk into account when establishing pay-rates.

There is evidence from the time covered previous to this study that persons who are sick longer periods have a higher probability of recurring long spells.[63] This means that there is a higher risk of incurring inconvenience costs with persons with substantial previous sickness.

4.3 Supply versus demand effects

We have some means at our disposal for testing whether effects originate from supply or demand. Decreased hours of work after sickness would be a supply effect, as this

[62] Andrén and Palmer (2000, Paper 1 of this thesis) analyzed the effect of sickness on earnings, and concluded that people can expect some decrease in annual earnings during the period after they experience long-term sickness. This could be explained by the fact that some choose to work part time after their sickness spells or not at all, while others choose an exit into temporary or permanent disability, which also decreases their earnings.

[63] According to Swedish data for the period 1979-1986, almost 60% of those who had been sick for 30 days or more had a new case of at least 60 days in the following year (National Social Insurance Board, Long Spells of Sickness, Rehabilitation and Disability – A System Analysis, Stockholm, 1989).

would be a decision that rests with the individual. We can measure this in our study with a full-time/part-time variable. Transition into partial or full disability status is also a clear supply effect. Changes in tasks, or employers, after lengthy sickness, can be positive action to preserve human capital, but may also lead to a decline in earnings, hence, the sign of such a variable is ambiguous. In the absence of significant values for any these variables, we would conclude that income effects originated solely from demand.

5 Data

The data analyzed came the Long-term Sickness (LS) database of the Swedish National Social Insurance Board. A random sample (LSIP) was used, representing all residents in Sweden registered with the social insurance office and born during 1926-1966, who had had at least one sickness spell of at least 60 days during the period 1986-1989. The LSIP sample contains information on 2666 individuals. For all sickness spells, the exact starting dates are known, but not whether the individuals concerned had a long-term sickness record before 1983, so the analyzed spells are not left censored, but the data are left truncated before 1983. At the end of the observation period, some persons continued to be sick, so these spells are right censored. Table 1 presents descriptive statistics of the "first" spells by exit type.

Table 1 Descriptive statistics for the duration of the first three long-term sickness spells by exit type

Exit type	N	%	Median	Mean	Std. Dev.	Min	Max
Return to work	2021	75.80	109	179.73	202.59	60	1999
Full disabilitry	338	12.68	608.5	711.57	377.85	76	2311
Partial disability	97	3.64	664	791.46	479.91	60	2338
Other exits	210	7.88	464	649.49	618.77	61	3096

The majority (about 76%) returned to work, while the rest either exits into full disability, partial disability, or other (non-working) exits. As expected, people who exited into disability (both full and partial) had longer spells (more than 600 days) that those who returned to work (109 days).

Detailed descriptive statistics of the data by individual, and by spell are presented in Appendix 2.

6 Econometric framework

All the individuals studied here were sick for at least 60 days. The duration of absence as well as the exit is one of the outcomes of a medical examination. There is no standard duration for most diagnoses, and even if there is a norm, individual cases can very greatly around this norm. The determinant for receiving a benefit is reduced work capacity, which also depends on the work situation. On top of this, it is the individual him/herself who must relate to doctor how he/she feels, and this is obviously a subjective measure. A natural way to depict this process is to estimate first a model for the timing of the events, and then a (second) model for the type of event. For the timing of events, we will estimate a competing risks model, while for the type of event we will estimate a multinomial logit.

6.1 Duration analysis

The spells of long-term sickness can be analyzed regardless of exit type, which might be a perfectly acceptable way to proceed.[64] However, more often than not, it is desirable to distinguish different kinds of events and treat them differently in the analysis. In other words, it is essential to use a competing risks model instead of a single risk model. This may give supplementary information about a different impact of various factors on different exit types. Therefore, we would distinguish different types of exit (i.e., return to work, full disability, partial disability and "other" exit) and treat them differently in the analysis by using the method of competing risks.

The competing risks approach presumes that each event type has its own hazard that governs both *occurrence* and *timing* of events of that type. A reduced picture of this approach is one of independent causal mechanisms operating in parallel: for the analyzed spells, the production of an output excludes the production of the other events.

[64] Andrén (2000, Paper 3 of this thesis).

Let D_i be a random variable denoting the time of exit for person *i*, and J_i be a random variable denoting the type of exit that occurred to person *i*. The hazard for exit type *j* at time t for person *i* is defined as

(1) $$h_{ij}(t) = \lim_{\Delta t \to 0} \frac{\Pr\{t \le D_i \le t + \Delta t,\ J_i = j \mid D_i \ge t\}}{\Delta t},\ j = 1, \ldots, 4.$$

The hazard of ending sickness into state *j* is specified as a proportional hazard function

(2) $h_j(t \mid x) = \lambda_j(t) \exp(\beta_j x)$,

where $\lambda_j(t)$ is the baseline, and *x* is the vector of explanatory variable. As a starting-point, the baseline hazard may be specified as a constant, implying time-independence in the decision to exit. This is obviously a rather dubious assumption for analyzing exits from sickness. Another baseline hazard can be specified (i.e. Weibull, exponential, gamma, log-logistic or log-normal).

Although it is a bit unusual, there is nothing to prevent us from choosing a different model for each type of exit, as for example, exponential for return to work, Weibull for both full and partial disability exits, and a proportional hazards model for the "other" exit. It may also be the case that we would not need to estimate models for all event types, and therefore estimate models only for the exit type of interest, treating all other types of exit as censoring.

Before estimating the effects of covariates on different exit types, we would like to test whether the type-specific hazard functions are the same for all events, that is, $h_j = h(t)$. Although the hazards are not equal, it is possible that they might be proportional, that is,

(3) $h_j = w_j h(t)$,

where w_j are constants of proportionality, and $j = 1, \ldots, 4$. This means that, if the hazard for return to work changes with time, the hazards for all other exits may also change over the time. This can be tested by a graphical examination of this hypothesis by plotting log-log survival functions for all exit-types over the time. If the hazards are proportional the plots should be parallel. Additionally, a parametric test of the proportional hazard hypothesis (Cox and Oakes, 1984) in equation (3) can be used. Considering the model

(4) $\log h_j = \alpha_0(t) + \alpha_j + \beta_j t,$

where $j = 1, \ldots, 4$, if $\beta_j = \beta$ for all j, then the proportional hazard hypothesis is satisfied.[65] Otherwise, this model says that the log-hazards for any two types of event diverge linearly with time. Cox and Oakes showed that if two event types diverge, equation (4) implies a logistic regression model for type of event, with time of event as an independent variable. For more than two event types, equation (4) implies a multinomial logit analysis.

If we "subdivide" exits from spells of long-term sickness into four types (return to work, full disability, partial disability, and other exits), under the competing risks approach this implies that there are four parallel processes, an assumption that may not hold for many cases. Rather, there is a process that governs the decision to exit, and another that governs the type of exit. For analyzing the type of exit, a binomial or multinomial logit model is a natural choice, although there are certainly alternatives.

6.2 The multinomial logit model

When choosing the exit pathway at the end of a sickness spell, an employee is assumed to maximize her or his lifetime utility. McFadden (1974) shows how the multinomial logit model can be derived from utility maximization. Consider that the utility of an employee i is associated with J alternatives. We assume that for an employee who has been long term sick, the utility from choosing alternative j is expressed by

(5) $U_{ij} = v_{ij}(x) + \varepsilon_{ij}$

where x is the vector of individual characteristics, and ε_{ij} is an unobservable random variable. The vector of characteristics can be separated into two parts: one, which varies across the choices and possibly across the individuals as well, and the other contains the individual characteristics that are the same for all choices. The alternatives for the exits from long term sickness are specified with respect to the available data: *RW*

[65] Under the proportional hazards hypothesis, the coefficient for time (t) will be zero.

for return to work, *FD* for full (temporary or permanent) disability benefit, *PD* for partial (temporary or permanent) disability benefit, and *O* for other non-working states (homemaking, unemployment, emigration, incarceration, etc.).

The employee's optimization problem is the maximization of his utility function with respect to the alternative *j*:

(6) $\max_j U_{ij}$, where $j \in \{RW, FD, PD, O\}$.

From (6) it follows that the probability that an employee *i* will choose the optimum alternative j^* is

(7) $\Pr\left\{U^* = \underset{j}{Max}\, U_{ij}\right\} = \Pr\left\{\varepsilon_j < \varepsilon_{j*} + \theta_{j*} - \theta_j, \forall j \neq j^*\right\}$, where $\theta_j = v_{ij}(x)$.

McFadden (1974) proved that the multinomial logit is derived from utility maximization if and only if the ε_j disturbances are independent, and identically distributed with a Weibull distribution. Denoting the density function of ε_j by $f(\varepsilon_j)$, the probability that employee *i* will choose the alternative *j* from the *J* given choices is

$$\textbf{(8)}\ \Pr(Y = j) = \frac{e^{\sum_{k=1}^{K} \beta_{jk} x_k}}{\sum_{j=1}^{J} e^{\sum_{k=1}^{K} \beta_{jk} x_k}},$$

where the parameters β_k distinguish the *x* variables.[66]

There are *J* - 1 sets of β estimates, so the total number of estimates will be $(J - 1) \times K$, which implies that the sample size should be larger than $(J - 1) \times K$. There will be four sets of coefficients $\beta(RW)$, $\beta(FD)$, $\beta(PD)$, and $\beta(O)$ corresponding to outcome

66

$$\Pr\left\{U^1 = \underset{j}{Max}\, U_{ij}\right\} = \Pr\{\varepsilon_2 < \varepsilon_1 + \theta_1 - \theta_2, \varepsilon_3 < \varepsilon_1 + \theta_1 - \theta_3, \varepsilon_4 < \varepsilon_1 + \theta_1 - \theta_4\}$$

$$= \int_{-\infty}^{\infty} f(\varepsilon_1)\left[\int_{-\infty}^{\varepsilon_1+\theta_1-\theta_2} f(\varepsilon_2)d\varepsilon_2 \int_{-\infty}^{\varepsilon_1+\theta_1-\theta_3} f(\varepsilon_3)d\varepsilon_3 \int_{-\infty}^{\varepsilon_1+\theta_1-\theta_4} f(\varepsilon_4)d\varepsilon_4\right]d\varepsilon_1$$

$$= \int_{-\infty}^{\infty} \exp(-\varepsilon_1)\exp[\exp(-\varepsilon_1)]\exp[-\exp(-\varepsilon_1 - \theta_1 + \theta_2)]\times\exp[-\exp(-\varepsilon_1 - \theta_1 + \theta_3)]\exp[-\exp(-\varepsilon_1 - \theta_1 + \theta_4)]d\varepsilon_1.$$

categories. However, the model is unidentified, in the sense that more than one set of betas can lead to the same probabilities for the outcomes. To identify the model, one of the betas has to be set to zero (an arbitrary choice). The equations for the other choices are expressed using this normalization, with the numerator is dependent only on the β-coefficients for the choice, and the denominator dependent on the β-coefficients for all choices.

Although the choice of the base-alternative is arbitrary, it influences the estimated values of the remaining alternatives, and, consequently, the estimated coefficients cannot be interpreted straightforwardly. Although it is not very intuitive, the β coefficients for each choice can be interpreted as measures of the effect of changes in x on the log-odds ratio of alternative j relative to the base-alternative. More information about the effects of changes in x are given by the marginal effects (for continuous variables) and probability differences (for dummy variables). The marginal effect is the partial derivative of the probability of choosing alternative j with respect to the variable of interest:

(9) $$\frac{\partial P(Y=j)}{\partial X_k} = P_j\left(\beta_{jk} - \sum_{j=1}^{J} P_j \beta_{jk}\right).$$

The probability differences for dummy variables might be evaluated as $P_j(dummy=1) - P_j(dummy=0)$, with other variables at the sample mean, for example. The estimated coefficients and the marginal effects, or of the probability differences do not necessarily have the same sign.

One important issue in the use of multinomial logit models is the assumption of independence from irrelevant alternatives, IIA. Given any particular observation, the IIA property means that the ratio of the choice probabilities of any two alternatives of the response variable is not influenced systematically by other alternatives. IIA is the notorious assumption, in individual decision theories and in social choice theory, that the choice (preference) a collection of alternatives is not affected if non-chosen alternatives are made unavailable. Hausman (1984) presented a test for the IIA assumption. Hausman's test compares the maximum-likelihood estimator of the beta based on *all* data (β_f) with maximum-likelihood estimator of beta that are based on data in which one alternative j has been dropped (β_r), while cases in which alternative j was actually selected are fully dropped. Under IIA, β_r and β_f should be approximately equal, while IIA is violated if the two estimates are significantly different. Formally, Hausman has shown that the test statistic

(10) $$H = (\beta_r - \beta_f)' \, (V_r - V_f)^{-1} (\beta_r - \beta_f),$$

is approximately chi-square distributed under Ho: IIA, where β and V, respectively, denote the estimate and the approximate variance matrix, based on the full (f) and restricted (r) data.

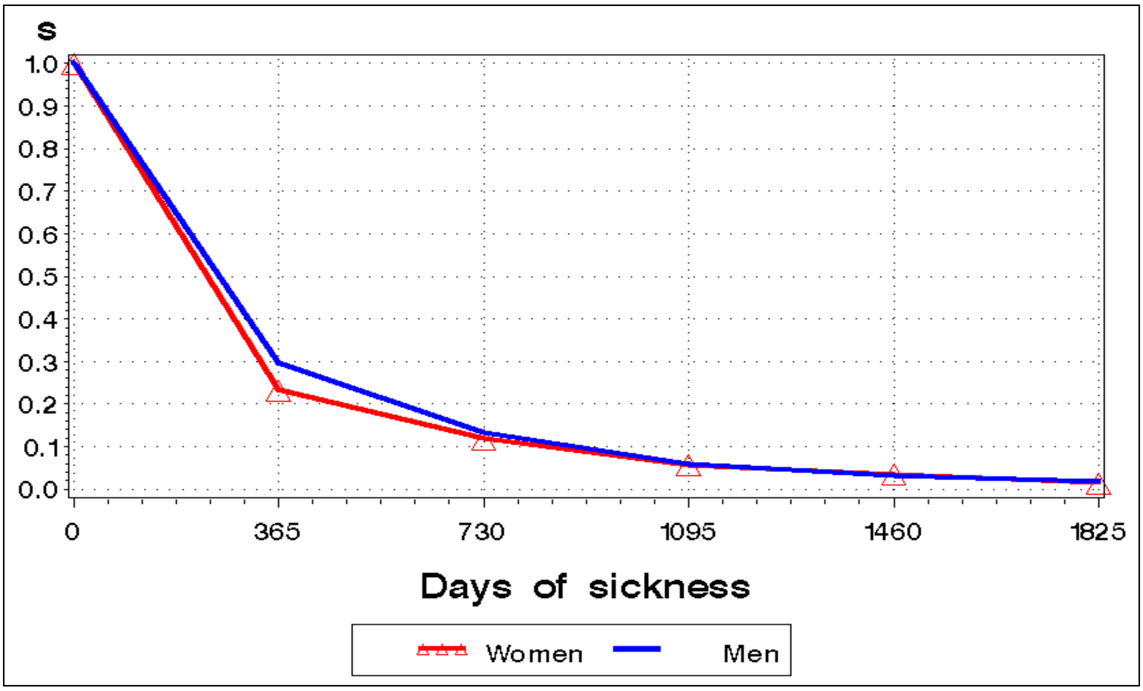
7 The results

7.1 Nonparametric estimates

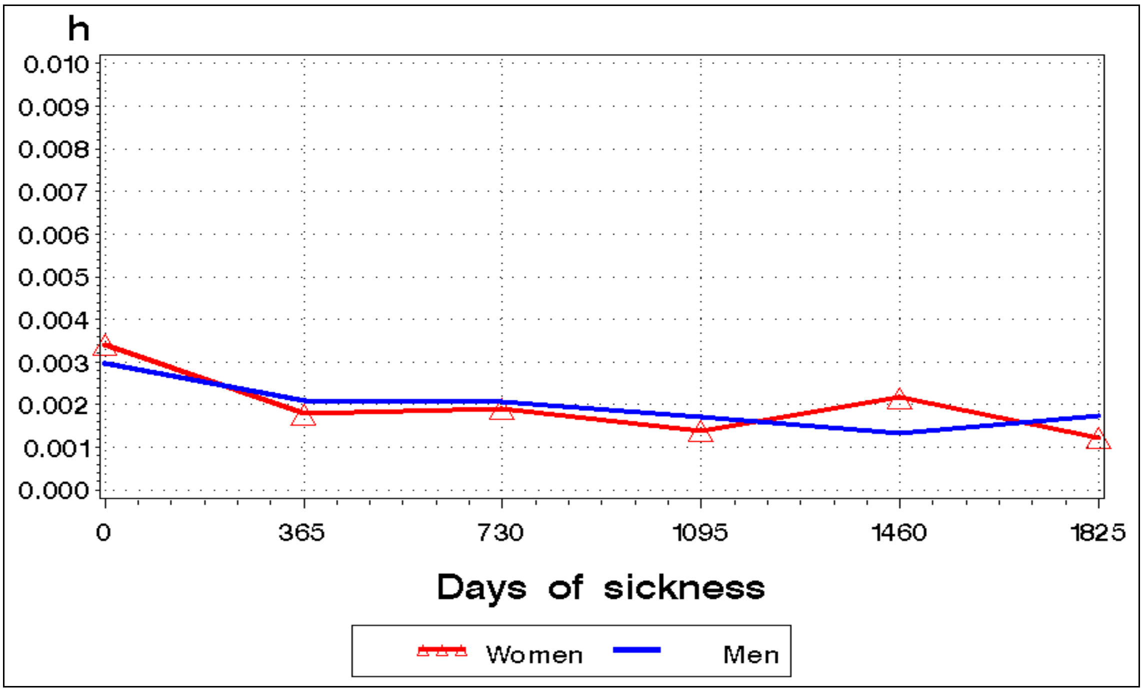
The life-table estimates of survival (s) and hazard (h) curves until the time of exit from long-term sickness (Figure 3-7) show that there are some differences between men and women, among age groups, among persons with different levels of education, by type of exit, and by marital status (Table A4, in Appendix 3, present tests of equality over strata). Figure 3a shows that women generally exited slightly faster than men during the first two years, after that there is no difference between men and women. From about 10 months to about three years of sickness, men had a higher risk to exit than women (Figure 3b).

Figure 4a shows that younger persons generally exited faster than older persons. People aged 46-55 might be quite sick, but their work capacity had not decreased enough to give them the right to leave the labor market. From about 10 months to about two and half years of sickness, people aged 56-65 had the highest risk to exit (Figure 4b), which is logical since they get disability easier.

People with lower education were slower to leave a sickness spell than were those with more education (Figure 5a). On the other hand, their risk to exit after one year is higher than the risk of those with more education (Figure 5b). This might be explained by their work characteristics and work environment, as people with lower education are more likely to be working in more difficult conditions, perhaps executing jobs requiring repetitive movements, heavy lifts, etc.

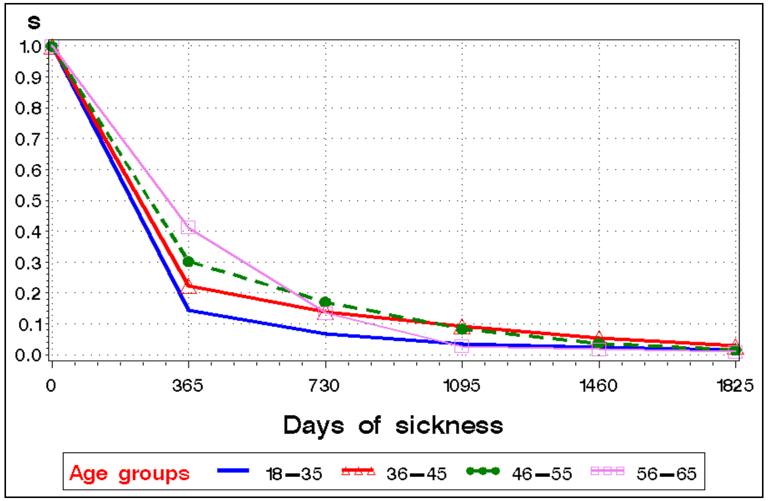


a) Survival estimates

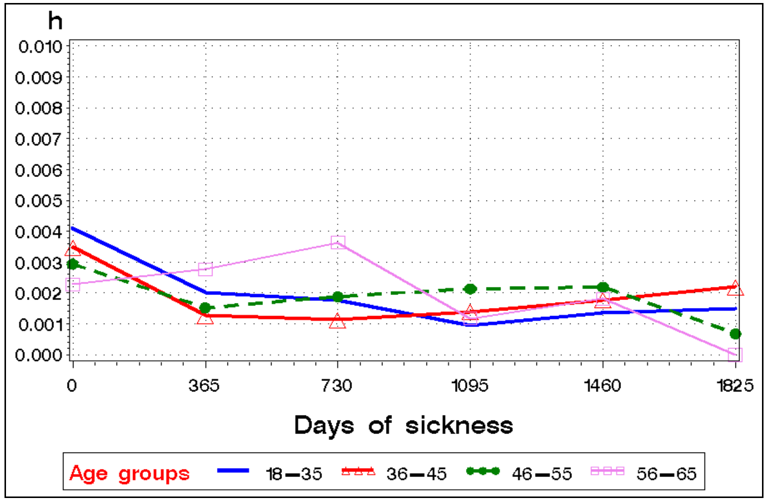


b) Hazard estimates

Figure 3 Survival and hazard estimates by waiting time, and by sex

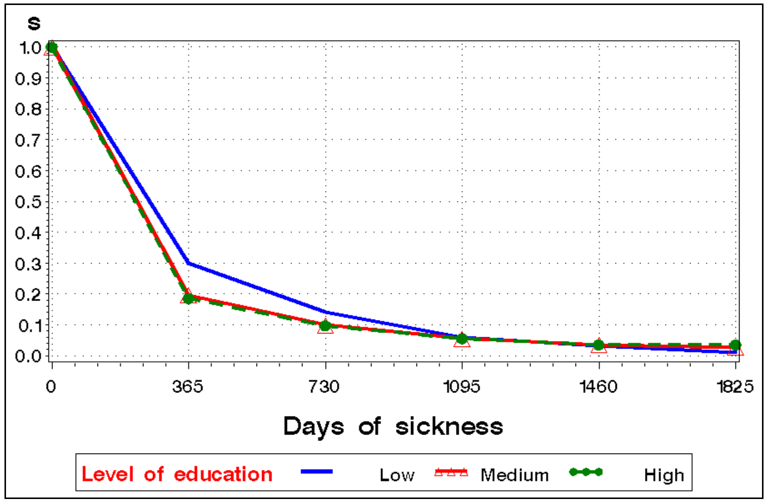


a) Survival estimates

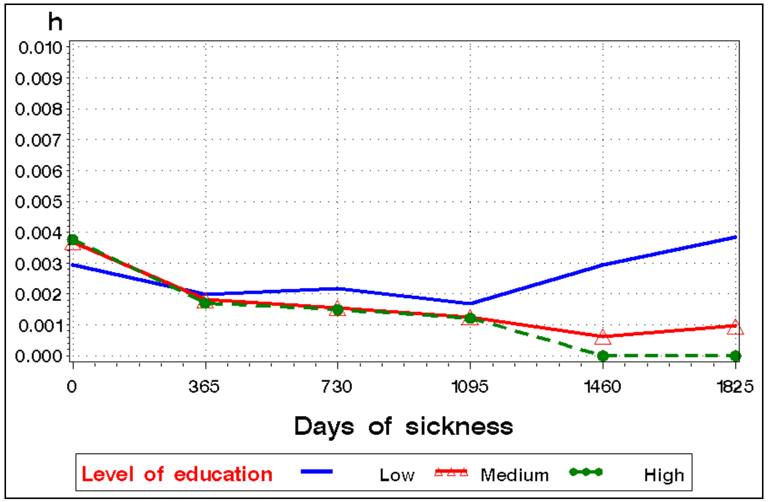


b) Hazard estimates

Figure 4 Survival estimates by waiting time, and by age groups

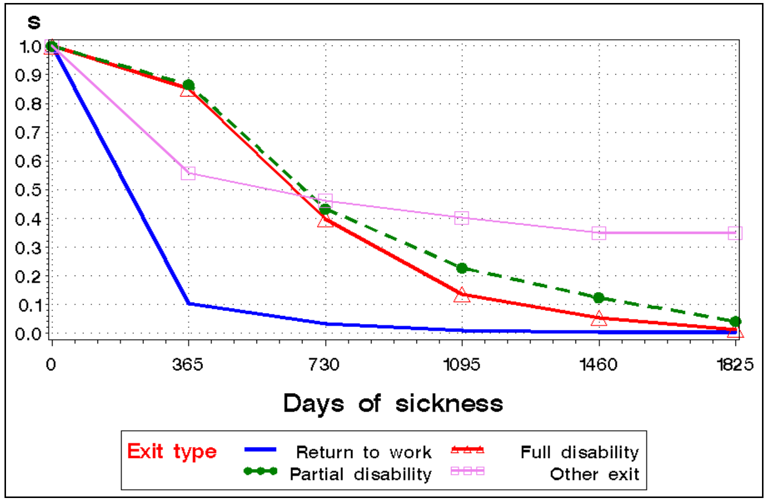


a) Survival estimates

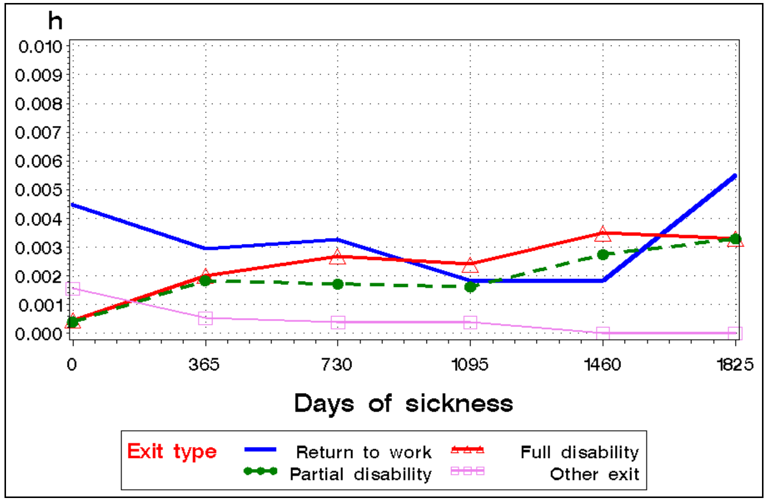


b) Hazard estimates

Figure 5 Survival and hazard estimates by waiting time, and by educational level

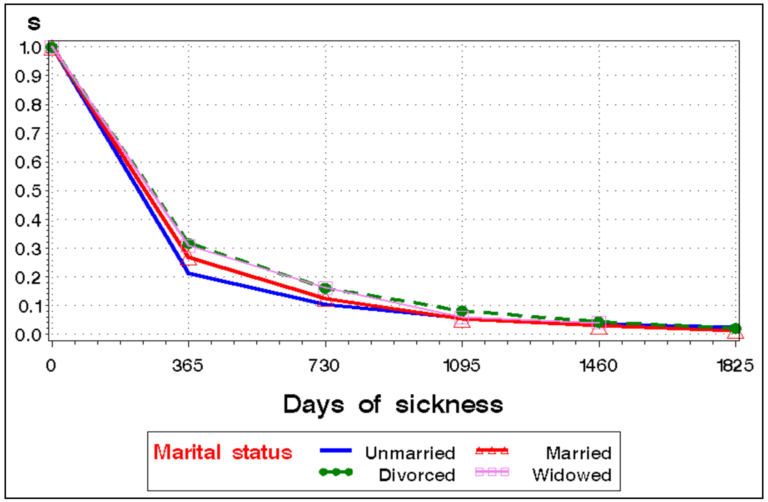


a) Survival estimates

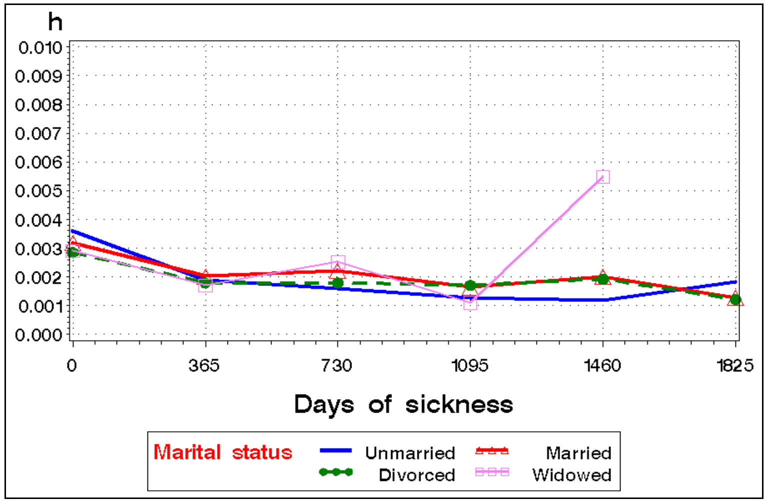


b) Hazard estimates

Figure 6 Survival and hazard estimates by waiting time, and by exit type



a) Survival estimates



b) Hazard estimates

Figure 7 Survival and hazard estimates by waiting time, and by marital status

Figures 6a and 6b show that the vast majority of people who returned to work were back into one year. From one year of sickness onwards, the risk to exit into full disability is higher than the risk to exit into partial disability.

Widowed and divorced people were generally sick longer than those having another marital status (Figure 7a). This may be explained by the fact that widowed people are on average older than the others. Conversely, unmarried people, who are on average younger than the other groups, exited fastest.

7.2 Competing risks model

Figure 8 shows the log-log survival functions for all exit-types over the time, without covariates. For all types of exits, more than 80% of the spells ended before the third year, which means that estimates for later years are based on a relatively small number of observations and may be unreliable. The curve for return to work is always the highest, while the curve for exit to partial disability is much lower than the other three curves during the first 2 years. For more information, we also examine the smoothed hazard plots (Figure 9). The hazard for return to work drops rapidly during the first 420 days of sickness, and fluctuates for the rest of the period, while the hazard for full disability exit increases during the first 600 days. This means that excepting the relationship between full and partial disability, we should reject the proportionality hypothesis.

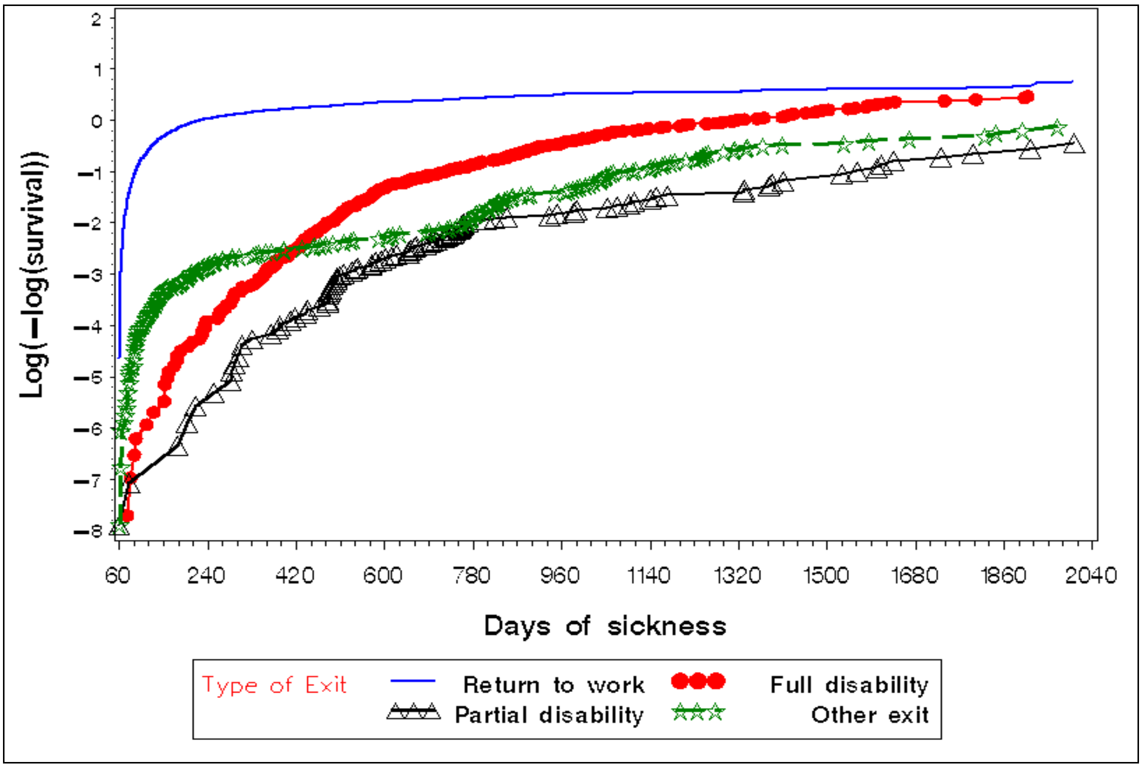


Figure 7 Graphical examination of the proportional hazards hypothesis

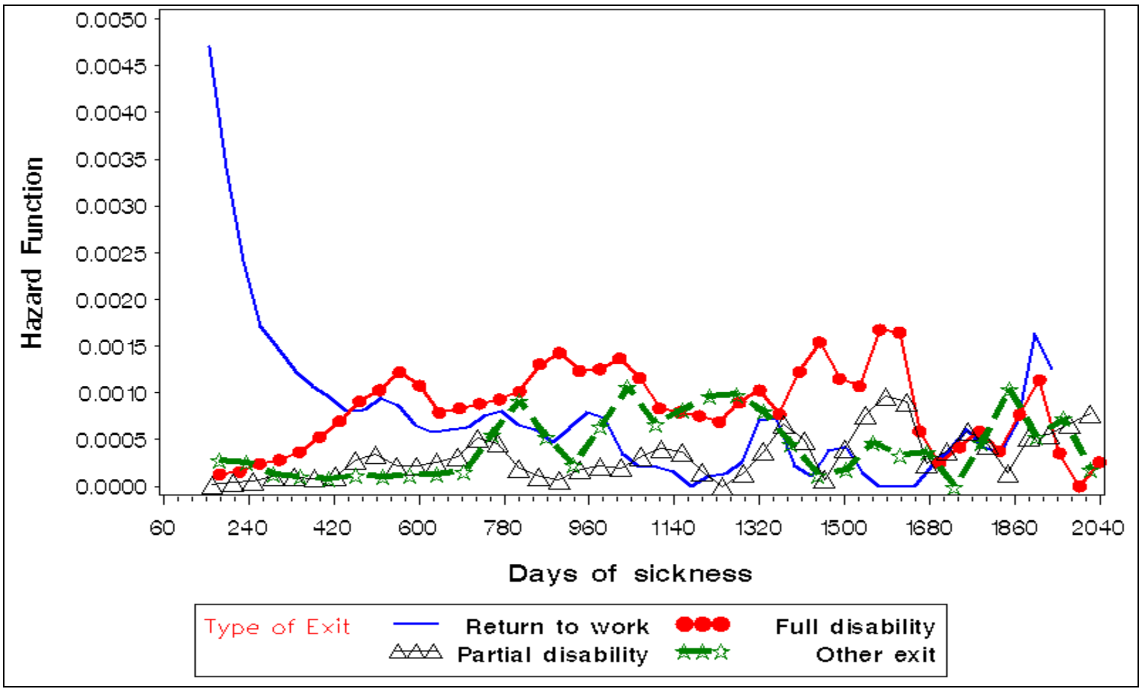


Figure 8 Smoothed hazard of exiting long-tem sickness by destination

In addition to the graphical test, we run a parametric test of the proportional hazards hypothesis (Cox and Oakes, 1984), which shows that the effect of the time variable is highly significant, indicating the rejection of the proportionality hypothesis. Excepting the parameter of the contrast between full and partial disability, all other parameters are significant, which means that proportionality can be rejected for all pairs of two hazard types (Table A5 in Appendix 3).

Table 2 shows only the direction (i.e. the sign) of the relationship between the explanatory variables and the duration of the spell (and the estimates are presented in Table A6 in Appendix 3). The age group of 56-65 years, earnings, earnings loss and the year dummies 1986 and 1987 are the only variables that are significant for all types of exit. Other variables (i.e., the other two age group dummies, the educational level dummies, regional unemployment rate, the other year dummies, and some diagnosis dummies) are significant at the 10% level for some exit types, while others (i.e. some diagnosis dummies) are not significant for any of the exit types.

Excepting the exit into partial disability, the gender effect was significant for all other type of exits, and indicates that women had shorter spells than men for both return to work, and exit into full disability, but they had longer spells than men for "other exits". The age effect varies across exit types: compared to the youngest age group (i.e., younger than 36 years), employees in all other age groups had longer spells of sickness before returning to work or exiting into full disability, while those who exited into partial disability had shorter spells when they were older than 55.

Excepting both types of exit into disability, married people had shorter spells than those with another marital status. This could reflect financial pressure if they are the only income earners in the family, or if both incomes are needed. It is also possible that married persons are healthier, on average.

Those with higher earnings returned to work faster than the other employees, but they had longer spells before full disability and "other exits". Those with higher education who exited into full disability, and those with medium or higher education who returned to work had shorter spells of sickness than those with a lower level of education. Those with medium or higher education leaving with an "other exit" had longer spells than those with lower education.

Table 2 Direction of the effects in the competing risks model for exit destinations

Variable	Return to work	Full disability	Partial disability	Other exit
Intercept	+	+	+	+
Female (CG: Male)	-	-	?	+
Age-group (CG: <36 years)				
36 – 45 years	+	+	?	?
46 – 55 years	+	+	?	+
56 – 65 years	+	+	-	+
Citizenship (CG: Swedish born)				
Naturalized Swede	?	?	?	?
Foreign born	?	?	?	-
Married	-	?	?	-
Educational Level (CG: Low)				
Medium	-	?	?	+
High	-	-	?	+
Annual earnings*	-	+	?	+
Regional Unemployment (%)	+	?	?	+
Year when the spell started				
1986	-	-	?	?
1987	-	-	?	-
1988	-	-	?	-
1989	-	-	?	+
Diagnoses (CG: Musculoskeletal)				
Cardiovascular	?	?	?	+
Respiratory	?	?	?	?
Mental	?	?	?	-
Gen. symptoms	-	?	?	?
Injuries & poisoning	-	?	?	+
Other diagnosis	-	?	?	-

Note: * in thousands of Swedish crowns; CG denotes the comparison group.

Except the disability exits, for all other exit types, higher unemployment rates implied longer spells of sickness, which could be related to both to unemployment fear, or its impact on health status.

7.3 Multinomial logit estimates

A multinomial model was estimated for the whole sample of the “first” spell of long-term sickness, and for sub samples of men and women. Using Hausman's test for independence of irrelevant alternatives, the null hypothesis cannot be rejected (Table A7 in Appendix 4). This means that, given any particular observation, the ratio of the choice probabilities of any two alternatives of the response variable is not systematically influenced by other alternatives.

Table 3 presents the direction of the effects of explanatory variables on the probability of a given exit from the sickness spell. Unlike the analysis of the competing risks model, for which the impact of explanatory variable was estimated for each exit type, now they were estimated using “return to work” as the reference category against other response categories (full disability, partial disability, and other exits). The estimated coefficients of the multinomial model of exits from long-term sickness, the relative risk ratios (RRR)[67] and the marginal effects are reported in Tables A8 and A9 in Appendix 4).

Women exited into full disability less then did men. For the other two exit alternatives (partial disability and “others”), the differences between men and women were not high. The older people were, the higher was the probability that they would exit to either full or partial disability instead of returning to work. Foreigners exited into full disability more often than did Swedish born people. People with medium or higher education had a lower probability of exiting than did those with lower education.

The effect of economic incentives on estimating the probability of choosing another exit than return to work is estimated by using two variables: earnings (i.e., annual work income) at the beginning of each sickness spell, and earnings loss related to the sickness spell. Earnings appear to have been important, as the likelihood of exiting to a non-working state was lower for higher-income earners. On the other hand, the estimated parameter for the loss in earnings (that is an interaction variable) has a positive sign, which suggests that the likelihood of choosing a non-working state increased with the level of the loss of earnings. This variable was computed as a function of expected annual earnings if people would work as scheduled, the ceiling level for compensation, replacement rate and compensated days of sickness, and it can take the same value for a high-income earner with no necessarily very long spells of

[67] The relative risk ratios report the exponentiated value of the coefficient, exp(β). If the RRR = r, and returning to work is the reference category, this means that the relative risk of the exit j over return to work ratio is r for cases when a dummy variable takes value 1 relative to cases with zero value; or r for one unit change in the a continuous variable. Then, the likelihood of choosing a non-working exit (full disability, partial disability, or “other” exit) can then be compared with that of returning to work.

sickness, and a low-income earner with a very long spell of sickness. The relationship between the number of sickness days and the loss of earnings due to (this) sickness is linear, but because of the benefit ceiling, people with high earnings lost more than did those with low earnings for the same duration.

Table 3 Multinomial logit results for various exits from sickness spells, compared to the alternative "return to work"

Variable	Full disability			Partial Disability			Other exits		
	All	Men	Women	All	Men	Women	All	Men	Women
Female (CG: Male)	-			?			-		
Age-group (CG: <36 years)									
36 – 45 years	+	?	?	+	+	?	+	?	-
46 – 55 years	+	+	+	+	+	+	+	?	?
56 – 65 years	+	+	+	+	+	?	+	?	-
Citizenship (CG: Swedish born)		?	?		?	?		?	?
Naturalized Swede	?			?			?		
Foreign born	+			?			+		
Married	?	?	?	?			?	?	?
Educational Level (CG: Low)									
Medium	-	?	-	?	?	?	-	?	?
High	-	?	?	?	+	?	-	?	?
Earnings*	-	-	-	-	-	-	-	-	-
Earnings Loss*	+	+	+	+	+	+	+	+	+
Regional Unempl.	?	?	?	?			?	?	?
Duration of sickness spell (CG: 60-90 days									
91-180 days	+			?			+		
180-366 days	+			?			+		
> 366 days	+	?	?	+	?	+	+	+	+
Year when the spell started									
1986	-	-	?	-	?	?	-	-	-
1987	-	-	?	-	?	?	-	-	?
1988	-			-			-		
1989	-			?			-		
Diagnoses (CG: Musculoskeletal)		?	?		?	?		-	-
Cardiovascular	?	?	?	?	?	?	?		
Respiratory	?			?			?		
Mental	+	+	?	?	?	?	+	?	?
Gen symptoms	?			?			?		
Injuries	-	?	-	?	?	?	?	?	-
Other diagnosis	?			?			+		
Intercept	-	?	-	-	-	-	-	-	-

Note: * in thousands of Swedish crowns; CG denotes the comparison group.
indicates that the variable was not included in the model due to few or no observations.

We already know from the nonparametric analysis that the average duration of the analyzed spells of long-term sickness differed across the exits. The multinomial estimates of duration dummies show that the more days of sickness people experienced, the higher was the probability of another exit than returning to work. The year when people started their sickness spell also had a significant effect on the exit type, which might be explained by events not captured by other variables.

The diagnosis also had a significant effect on people's exits. Comparing to the musculoskeletal group, persons with a mental diagnosis had a higher probability of exit into full disability instead of returning to work, while those with injuries or poisoning had a lower probability.

When the samples of men and women were analyzed separately, given the smaller sample size some characteristics were represented in a very small proportion, and therefore there are fewer explanatory variables. For example, instead of using three dummies for citizenship, only a dummy for those who were Swedish born is used, and this group is compared to all others; instead of using four dummies for the duration of the sickness spell, there is only a dummy for spells longer than a year; and year and diagnosis dummies in each case are compared to the groups which do not have the dummy characteristic.

Comparison of all other three exits with the alternative of returning to work, gives the following results: Some factors had the same significant direction of their effect for both women and men for all exit types (i.e., earnings and earnings loss). Some factors had the same significant directional effect for both women and men for only some exit types (i.e., the dummy for the age group 46-55, only for both full and partial disability; the dummy for spells longer than one year, only for other exits, etc.). Some factors had the significant direction of their effect either only for men, or men, and/or only for one or some exit type (i.e., Swedish born women had a lower probability of having another exit than other women, higher educated men had a higher probability of exiting into a partial disability than other men, men with a mental diagnosis have a higher probability of returning to work than men with another diagnosis, etc).

8 Summary and conclusions

Using the Swedish National Insurance Board's LS-data for the period 1986-1991, exits from long-term sickness were analyzed by using both duration analysis and a multiple choice framework. This analysis in two steps was suggested by the complexity of the exit decision, which implies, in a very simplified framework, at least two aspects of the exit process: an aspect that governs the duration of sickness spell, and another that governs the type of exit. Therefore, first, the analysis of the duration of the sickness spells was done, and then, using a multinomial logit model, the analysis of process that governs the type of exit was done. The results indicate that both individual characteristics, and push factors, such as regional unemployment, were important for the final output, and that there were some factors that had different effects for men and women.

The estimates from the duration analysis showed that excepting the exit into partial disability for which the gender effect was not significant, women had shorter spells of sickness than men before return to work or exit into full disability, and longer spells when they had "other exit" types. Older employees had longer spells than the younger ones for all exit types, excepting partial disability for which they had shorter spells. Except the group of "other exits" for which foreign-born people had shorter spells than people born in Sweden, the citizenship dummies were not significant by the conventional criteria. Excepting the disability exits, married employees had shorter spells of sickness than those who were not married for all other three types of exit, results that could be interpreted either as the pressure of the economic incentive and/or a better health status of these people. For those who returned to work, people with medium and higher education had shorter spells than those with a lower educational level. Excepting the exits into disability, a higher regional unemployment rate implied longer spells for all other three types of exit.

The multinomial logit analysis of the type of exit showed that the probability of not returning to work increased with age and by duration of the sickness spell, and decreased by year during the period studied, which was a growth period. Compared to people born in Sweden, it was more likely that a foreign born person would exit into full disability or "other exits" instead of returning to work. Compared to those with a musculoskeletal diagnosis, it was more likely that a person with a mental diagnosis would exit into full disability exit instead of returning to work.

When the analysis was done by gender, the results showed that for both women and men, higher earnings decreased the probability of choosing another exit than return to work, while higher loss of earnings associated with the spells of sickness increased the probability of having another exit than return to work. This result indicates that for two persons with *same* loss of earnings, but who belong to two different earnings-groups, the person with earnings *under* the ceiling level had *longer* spell than the person with earnings *above* the ceiling level.

Nevertheless, summing together the results of this study with the previous findings and theoretical foundation, it seems that, at least for those people who have been working before the sickness spells, it should be possible to make a greater use of their working capacity through active collaboration between patients, medical personnel qualified for evaluation of working capacity, employer, and social insurance officers. In this process, differences in the conditions and circumstances of different groups (such as, men and women, younger and older employees, etc.) should be considered.

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Appendix 1 Facts on life expectancy in Sweden

Table A1 Life Expectancy, number of survivors, and chances per 1000 of eventually dying from specified causes, at selected ages, by sex, Sweden 1996

Age (X)	Life expectancy at certain ages X	Number of survivors to certain ages out of 100 000 live births	Chances (per 1000) of eventually dying from:							
			Infectious and parasitic diseases	Malignant neoplasms	Diseases of the circulatory system	Heart diseases	Cerebro-vascular diseases	Diseases of the respiratory system	External causes	Motor vehicle traffic accidents
Males										
0	76	100 000	7.7	225.9	493.4	347.1	91.2	88.4	50.5	6.0
1	75	99 605	7.5	226.7	495.3	348.4	91.6	88.7	50.6	6.0
15	62	99 367	7.5	226.7	496.4	349.2	91.8	88.8	50.0	5.8
45	33	96 643	7.3	229.3	506.8	356.4	93.6	90.7	37.8	3.3
65	16	84 528	7.6	216.4	525.2	365.5	99.2	98.7	27.4	2.4
Females										
0	81	100 000	8.7	201.2	502.1	314.1	128.4	84.3	31.0	3.1
1	81	99 640	8.7	201.9	503.8	315.2	128.8	84.5	31.1	3.1
15	67	99 471	8.7	201.9	504.6	315.6	129.0	84.6	30.6	2.9
45	37	98 057	8.7	200.0	510.1	319.1	130.3	85.5	26.5	2.1
65	19	90 468	8.9	171.9	535.7	335.0	136.5	88.9	22.1	1.4

Source: 1997-1999 online version of the World Health Statistics Annual

Appendix 2 Descriptive statistics by individual, and by spell

Table A2 presents some descriptive statistics for the variables used in the model, calculated both for the whole sample and by the type of exit from the first spell of long-term sickness. There are more women (55.48%) than men in the sample, but the proportion of men who exited into full disability was higher (15.42%) than that of women (10.42%). The proportion of women who returned to work (77.55%) was greater than that of men (73.63%).

Under citizenship, "Swedish-born" (84.5%) and "naturalized Swedes" citizens (8.3%) are distinguished, as well as "foreign-born" (12.6%). Swedish-born appear to be over-represented with partial disability and under-represented with "other" exits, while both naturalized Swedish and foreign-born exhibit an opposite pattern. In addition, naturalized Swedes appear to be over-represented with full disability, while foreign-born may be slightly under-represented.

Married persons are by far the largest group in the sample and seem fairly evenly distinguished over all the exits. Those who are divorced are over-represented with partial disability, as well as full disability, and are underrepresented with "other exits". The category *Widowed* includes all widows and widowers, plus 13 older people from whom no information on their marital status was available. They are over-represented with partial disability.

Table A2 Descriptive statistics by individual – (first spell of long-term sickness)

Variable	All exits (*n* = 2666)		Type of exit from long- term sickness: Return to work (*n* = 2021)		Full disability (*n* = 338)		Partial disability (*n* = 97)		Other (*n* = 210)	
	Mean	**Std. Dev**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Women	0.555	0.497	0.568	0.496	0.459	0.499	0.515	0.502	0.605	0.490
Age	43.703	11.817	42.067	11.459	52.914	9.127	51.247	9.584	41.138	11.781
Age groups										
< 35 years	0.294	0.456	0.336	0.472	0.071	0.257	0.072	0.260	0.352	0.479
36-45 years	0.242	0.428	0.260	0.439	0.115	0.320	0.175	0.382	0.295	0.457
46-55 years	0.245	0.430	0.241	0.428	0.290	0.454	0.289	0.455	0.190	0.394
56-65 years	0.219	0.414	0.163	0.369	0.524	0.500	0.464	0.501	0.162	0.369
Citizenship										
Swedish born	0.845	0.362	0.850	0.358	0.840	0.367	0.907	0.292	0.786	0.411
Nationalized Swedes	0.083	0.275	0.080	0.272	0.092	0.289	0.041	0.200	0.110	0.313
Foreign born	0.072	0.259	0.070	0.256	0.068	0.252	0.052	0.222	0.105	0.307
Educational level										
Low	0.634	0.482	0.603	0.489	0.837	0.370	0.722	0.451	0.562	0.497
Medium	0.284	0.451	0.308	0.462	0.127	0.334	0.216	0.414	0.333	0.473
High	0.082	0.275	0.089	0.284	0.036	0.185	0.062	0.242	0.105	0.307
Marital status										
Unmarried	0.266	0.442	0.282	0.450	0.175	0.380	0.155	0.363	0.314	0.465
Married	0.547	0.498	0.538	0.499	0.598	0.491	0.557	0.499	0.538	0.500
Divorced	0.164	0.370	0.158	0.365	0.201	0.401	0.227	0.421	0.124	0.330
Widowed	0.024	0.153	0.022	0.146	0.027	0.161	0.062	0.242	0.024	0.153
Young children (<7 years)	0.169	0.484	0.190	0.516	0.030	0.202	0.021	0.143	0.257	0.536
Children (7-16 years)	0.171	0.489	0.191	0.517	0.036	0.228	0.124	0.415	0.214	0.515
Previous cases of sickness	5.317	5.968	5.489	5.793	3.337	4.335	4.021	4.668	7.443	8.809
Prev. cases of ST sickness	2.984	4.867	3.164	4.885	1.325	3.023	1.969	3.193	4.386	6.698
Days of sickness (spell 1)	306.42	371.91	179.73	202.59	711.58	377.86	791.46	479.92	649.49	618.77
Earnings[68]**(1000 SEK)**	160.292	76.388	165.240	77.050	132.936	76.796	146.917	74.215	162.875	58.738
Earnings loss (1000 SEK)	86.423	72.650	69.362	58.538	141.65	86.768	154.948	85.562	130.08	82.697
Regional unemployment, %	2.296	1.293	2.237	1.253	2.638	1.345	2.759	1.482	2.107	1.365
Diagnosis										
Musculoskeletal	0.386	0.487	0.366	0.482	0.500	0.501	0.505	0.503	0.333	0.473
Cardiovascular	0.068	0.252	0.055	0.229	0.127	0.334	0.144	0.353	0.057	0.233
Respiratory	0.027	0.323	0.024	0.152	0.033	0.178	0.062	0.242	0.029	0.167
Mental	0.118	0.161	0.114	0.318	0.130	0.337	0.103	0.306	0.148	0.356
General symptoms	0.040	0.195	0.045	0.207	0.018	0.132	0.010	0.102	0.038	0.192
Injuries & poisoning	0.130	0.337	0.155	0.362	0.038	0.193	0.062	0.242	0.071	0.258
Other	0.232	0.422	0.241	0.428	0.154	0.361	0.113	0.319	0.324	0.469

[68] Earnings are inflated to "present" values using the 1997 CPI

The unmarried are the only category over-represented with return to work, which might be explained by the fact that they are probably generally younger, but also it may be that with a second income it is easier economically to exit the labor force.

Those with young children and those with school age children are both slightly over-represented among those who return to work, and heavily under-represented with either partial or full disability, again probably because they are generally younger. They are also over-represented among those with “other exits”, which may represent homemakers who chose to stay home after long-term sickness.

The average duration of the first sickness spells analyzed was higher for people who exited to partial and full disability (791, and 711 days respectively), and much lower for people who returned to work (179 days).

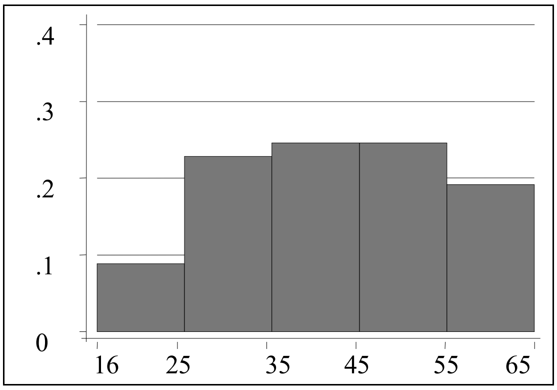
Previous sickness history is measured both by the number of sickness spells shorter than 60 days, and the number of short-term sickness spells (i.e. spells of maximum 7 days) before the analyzed spell of long-term sickness. Given that the first spell of long-term sickness may have started any time from January 1986 through December 1989, it is difficult to compare these measures across the exits. If the truncation is random, we can say that people who exited into either full or partial disability had on average fewer cases than did those who either returned to work or had another exit.

The most "problematic" variable is the earnings of individuals over the observation period. Individual earnings came from incomplete sources in the database: income giving pension rights (PGI); income from work according to the tax records (A- and/or B- income); and, income qualifying for sickness allowance (SGI), i.e., income from the social insurance office records. All of these should give about the same measure. These sources were combined in such a way that missing data were replaced; the highest amount was chosen when two or more sources disagreed.

As expected, the average annual earnings of those who returned to work were highest, while those who exited with partial disability were higher than those with full disability. The relatively high earnings of those who had an “other exit” are difficult to explain although since they had on average relatively long spells of sickness (about 649 days), the high-income replacement rate could be part of explanation.

In the full sample, almost 39% had a musculoskeletal diagnosis. This proportion is even higher (about 51%) for those who exited with either full or partial disability. For the whole sample, and also across the exits, the lowest proportions are for people with a respiratory diagnosis or general symptoms.

Figure A1 shows the age distribution of the sample as a whole, while Figure A3 shows it by type of exit.



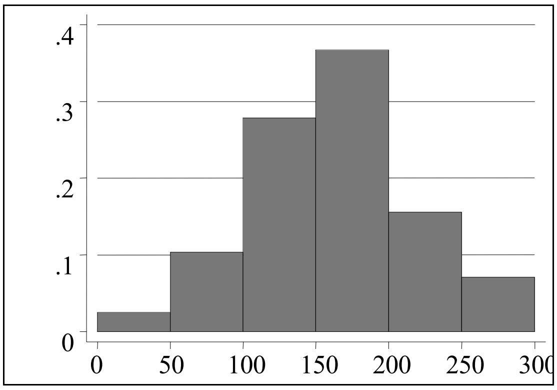


Figure A1 Age distribution

Figure A2 Earnings (1000 SEK)

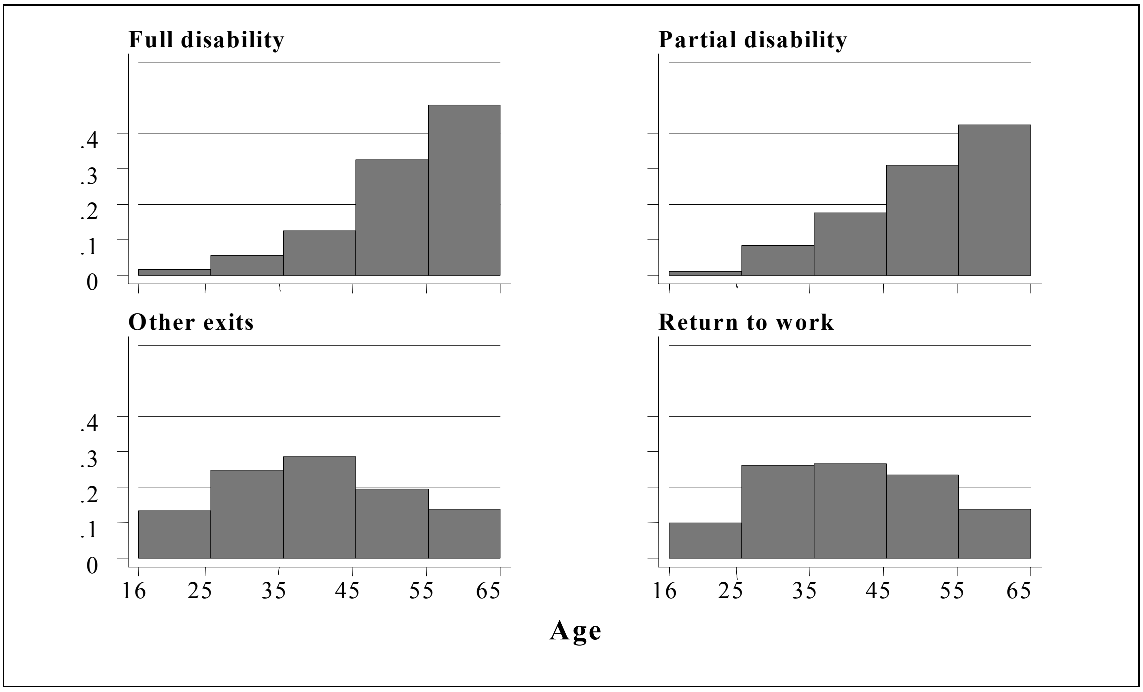


Figure A3 Age distribution by exit-state

Those who returned to work and those with "other exits" show age distributions for similar to that of the whole sample. Young people (16-25 years old) were the smallest group (less than 9%) of the whole sample (Figure A1). Almost 50% of those who exited into full or partial disability were 55-65 years old (Figure A3), while they were less than 20% of the full sample. We can thus expect that age will have a positive effect on exits into disability.

Figure A2 shows the distribution of annual earnings for the whole sample, adjusted to 1997 values, while Figure A4 shows it by type of exit.

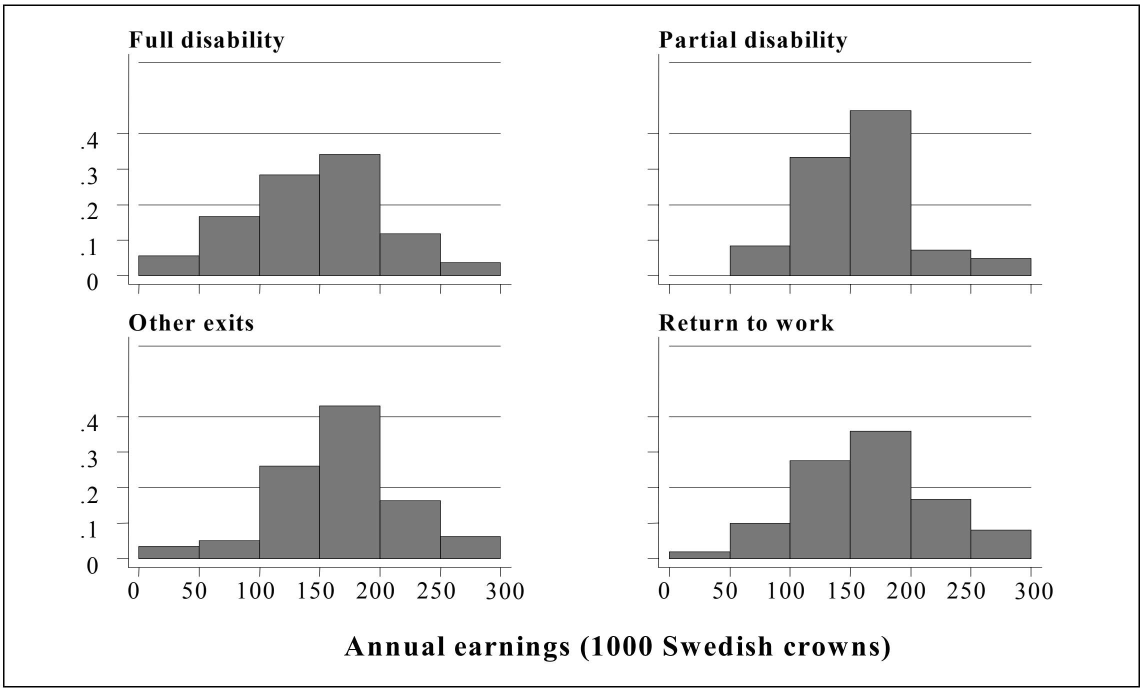


Figure A4 Earnings distribution by exit-state

Again the distribution for those who return to work seems most similar to that of the whole sample, although relative to the whole sample, it is skewed to the right, while the distributions of those with disabilities are skewed to the left. In other words, the proportions of people who exited into full or partial disability decreased with increasing earnings (approximately 24% of those who earned less than 100,000 Swedish crowns, but only 7% of those who earned more than 250,000); while conversely, the proportion of people who returned to work increased with earnings: from 69% of those who earned less than 100,000 Swedish crowns to 82% of those who earned more than 250,000. Note that persons with partial disability have higher earnings, and earnings of people who return to work are higher than those who have full disability.

Table A3 presents descriptive statistics for the first three spells by exit type. As noted earlier with respect to spell 1, people who returned to work had, on average, much shorter spells. The proportion of people who return to work decreased from 75.8% (after the first spell) to 63.4% (after the second spell), and to 62.5% (after the third spell). Similarly, the proportions for those who exited into full disability fell, while the proportions for those who exited into partial disability did not change very much from the first to the third spell.

Table A3 Descriptive statistics for the duration of the first three long-term sickness spells by exit type

Exit type	N	%	Median	Mean	Std. Dev.	Min	Max
LS1→W	2021	75.80	109	179.73	202.59	60	1999
LS1→FD	338	12.68	608.5	711.57	377.85	76	2311
LS1→PD	97	3.64	664	791.46	479.91	60	2338
LS1→O	210	7.88	464	649.49	618.77	61	3096
LS2→W	755	63.40	114	175.70	179.85	60	1696
LS2→FD	114	10.48	514	568.42	302.57	115	1632
LS2→PD	34	3.12	525	576.35	263.75	186	1259
LS2→O	185	17.00	267	420.58	372.81	64	1904
LS3→W	258	62.46	130	187.24	171.74	60	1309
LS3→FD	40	9.69	519	528.42	254.35	62	1091
LS3→PD	13	3.15	504	499.61	262.06	167	928
LS3→O	102	24.70	315	401.11	322.69	60	1620

Note: *LS*1 = the first spell of long-term sickness, *LS*2 = the second, *LS*3 = the third; W = return to work, *FD* = full (temporary or permanent) disability benefit, *PD* = partial (temporary or permanent) disability, and *O* = other (non-working) exits.

The proportion of those who had “other exit” increased from less than 8% (after the first spell) to 17% (after the second), and then to almost 25% (after the third spell). This is probably explained by the fact that this category includes all censored spells.

Appendix 3 Duration analysis

Table A4 Test of equality over strata

Strata	DF	Test		
		Log-Rank	Wilcoxon	-2Log(LR)
Sex	1	**7.35**	**8.95**	**10.4**
Age	3	**71.63**	**92.17**	**91.58**
Education	2	**16.83**	**31.41**	**19.06**
Exit type	3	**943.77**	**780.02**	**1257.49**
Marital status	3	<u>9.96</u>	<u>11.07</u>	**15.55**

Note: **Bold -**significant at less than 1%, and <u>underline</u>- significant at the 5% level.

Table A5 Test of proportionality

Maximum Likelihood Analysis of Variance

Source	DF	Chi-Square	Pr > ChiSq
Intercept	3	1739.29	<.0001
Time	**3**	**549.07**	**<.0001**

Analysis of Maximum Likelihood Estimates

Effect	Parameter	Estimate	Standard Error	Chi-Square	Pr > Chi-Square
Intercept	1	3.886	0.129	895.53	<.0001
	2 (2|1)	0.314	0.146	4.58	0.0324
	3 (3|1)	-1.136	0.209	29.38	<.0001
Duration	4 (4|1)	-0.005	0.000	402.45	<.0001
	5 (2|3)	0.000	0.000	1.88	0.1706
	6 (4|3)	0.001	0.000	4.89	0.0271

Parameter 2 is the beta-coefficient for the contrast between type 1 (return to work) and type 2 (full disability) indicates that the hazard for full disability increased much more rapid than the hazard for return to work. Excepting parameter 5 (that is a contrast between type 3 and 2), all other parameters are significant, which means that proportionality can be rejected for all pairs of two hazard types.

Table A6 Competing risks model for exit destinations (the distribution of waiting time is reported in parentheses)

Variable	Return to work (exponential)			Full Disability (gamma)			Partial disability (gamma)			Other exit (Weibull)		
	β	SE	exp (β)	β	SE	exp (β)	β	SE	exp (β)	β	SE	exp (β)
Intercept	**6.99**	0.12		**8.06**	0.20		**8.12**	0.27		**7.01**	0.14	
Female (CG: Male)	**-0.13**	0.05	0.87	**-0.15**	0.09	0.86	-0.12	0.10	0.88	**0.19**	0.05	1.21
Age-group (CG: <36 years)												
36 – 45 years	**0.29**	0.06	1.33	**0.31**	0.11	1.37	-0.02	0.21	0.98	0.08	0.11	1.09
46 – 55 years	**0.47**	0.07	1.60	**0.62**	0.12	1.85	-0.31	0.19	0.73	**-0.37**	0.10	0.69
56 – 65 years	**0.86**	0.08	2.37	**0.73**	0.13	2.07	**-0.68**	0.19	0.50	**-0.82**	0.10	0.44
Citizenship (CG: Swedish born)												
Foreign born	0.10	0.09	1.11	-0.15	0.13	0.86	0.21	0.20	1.24	**0.06**	0.10	1.06
Naturalized Swede	0.07	0.08	1.07	-0.16	0.13	0.86	0.20	0.22	1.22	-0.22	0.09	0.81
Married	**-0.08**	0.05	0.92	-0.10	0.09	0.91	0.00	0.10	1.00	-0.10	0.05	0.90
Educational Level (CG: Low)												
Medium	**-0.12**	0.05	0.89	-0.12	0.09	0.89	0.00	0.12	1.00	**0.22**	0.07	1.24
High	**-0.18**	0.08	0.84	**-0.30**	0.14	0.74	0.13	0.21	1.14	**0.40**	0.14	1.49
Earnings*	**0.00**	0.00	1.00	**0.00**	0.00	1.00	0.00	0.00	1.00	**0.00**	0.00	1.00
Regional Unemployment	**0.04**	0.02	1.04	0.03	0.04	1.03	-0.02	0.04	0.98	**0.06**	0.02	1.06
Year when the spell started												
1986	**-1.31**	0.08	0.27	**-0.38**	0.14	0.68	**-0.27**	0.14	0.76	-0.09	0.08	0.91
1987	**-1.23**	0.09	0.29	**-0.45**	0.15	0.64	-0.06	0.16	0.94	**-0.17**	0.08	0.84
1988	**-1.06**	0.09	0.34	**-0.57**	0.14	0.57	0.15	0.20	1.16	**-0.16**	0.09	0.85
1989	**-1.11**	0.10	0.33	**-0.98**	0.14	0.37	**-0.38**	0.17	0.69	**0.18**	0.11	1.20
Diagnoses (CG: Musculoskeletal)												
Cardiovascular	0.11	0.10	1.12	-0.10	0.18	0.91	-0.06	0.15	0.94	**0.14**	0.08	1.16
Respiratory	0.11	0.15	1.12	0.04	0.25	1.04	-0.20	0.21	0.82	-0.04	0.14	0.96
Mental	-0.06	0.08	0.94	-0.18	0.13	0.84	-0.03	0.16	0.97	**-0.20**	0.08	0.82
Gen. symptoms	**-0.49**	0.11	0.61	-0.17	0.21	0.84	0.51	0.44	1.66	0.23	0.18	1.26
Injuries & poisoning	**-0.60**	0.07	0.55	-0.03	0.17	0.97	-0.04	0.20	0.96	**0.24**	0.12	1.27
Other diagnosis	**-0.47**	0.06	0.63	**-0.67**	0.10	0.51	0.05	0.15	1.05	-0.10	0.07	0.91
Scale	1.00	0.00		0.56	0.02		0.60	0.11		0.47	0.03	
Shape							0.46	0.26		0.69	0.14	
Events	2021			338			97			210		
Right censored values	645			2328			2569			2456		
Log likelihood	-3841.98			-562.31			-258.35			-479.87		

Note: * in thousands of Swedish crowns; **Bolds** indicate significant at the 10%-level.

Appendix 4 Multinomial logit model

Table A7 Hausman's test for assumption "Independence of Irrelevant Alternatives"

Alternative	n	Hausman	df	p
Return to Work	645	15.89	38	0.9994
Full Disability	2328	-12.01	38	1.0000
Partial Disability	2569	-2.18	39	1.0000
Others	2456	0.64	37	1.0000

Table A8 Multinomial logit results for various exits from sickness spells, compared to the alternative “return to work”

Variables	Full Disability						Partial Disability						Other exits					
	Coef.	Std.	RRR	Std.	ME	Std.	Coef.	Std.	RRR	Std.	ME	Std.	Coef.	Std.	RRR	Std.	ME	Std.
Female (CG: Male)	**-0.61**	0.19	**0.55**	0.10	**-0.005**	0.00	-0.04	0.27	0.96	0.26	0.000	0.00	**-0.61**	0.19	**0.55**	0.10	**-0.005**	0.00
Age-group (CG: <36 years)																		
36 – 45 years	0.57	0.33	1.76	0.58	0.005	0.00	**0.97**	0.49	**2.64**	1.30	0.005	0.00	0.57	0.33	1.76	0.58	0.005	0.00
46 – 55 years	**1.71**	0.31	**5.55**	1.73	**0.015**	0.01	**1.52**	0.48	**4.56**	2.20	**0.009**	0.00	**1.71**	0.31	**5.55**	1.73	**0.015**	0.01
56 – 65 years	**2.93**	0.32	**18.73**	5.98	**0.025**	0.01	**2.61**	0.49	**13.63**	6.64	**0.015**	0.01	**2.93**	0.32	**18.73**	5.98	**0.025**	0.01
Citizenship(CG: Swedish born)																		
Naturalized Swede	0.03	0.34	1.03	0.35	0.000	0.00	-0.36	0.52	0.70	0.37	-0.002	0.00	0.03	0.34	1.03	0.35	0.000	0.00
Foreign born	**0.82**	0.32	**2.28**	0.73	**0.007**	0.00	-0.18	0.57	0.84	0.48	-0.001	0.00	**0.82**	0.32	**2.28**	0.73	**0.007**	0.00
Married	-0.01	0.19	0.99	0.18	0.000	0.00	-0.23	0.26	0.80	0.20	-0.001	0.00	-0.01	0.19	0.99	0.18	0.000	0.00
Educational Level (CG: Low)																		
Medium	**-0.54**	0.23	**0.58**	0.14	-0.005	0.00	0.03	0.30	1.03	0.31	0.000	0.00	**-0.54**	0.23	**0.58**	0.14	-0.005	0.00
High	**-0.83**	0.42	**0.44**	0.18	-0.007	0.00	-0.16	0.52	0.85	0.44	-0.001	0.00	**-0.83**	0.42	**0.44**	0.18	-0.007	0.00
Earnings*	**-0.04**	0.01	**0.97**	0.01	**-0.003**	0.00	-0.02	0.01	0.98	0.01	0.000	0.00	**-0.04**	0.01	**0.97**	0.01	**-0.003**	0.00
Earnings Loss*	**0.03**	0.01	**1.03**	0.01	**0.000**	0.00	0.01	0.01	1.01	0.01	0.000	0.00	**0.03**	0.01	**1.03**	0.01	**0.000**	0.00
Regional Unempl.	-0.05	0.07	0.95	0.07	0.000	0.00	0.08	0.10	1.09	0.11	0.001	0.00	-0.05	0.07	0.95	0.07	0.000	0.00
Duration of sickness spell (CG: 60-90 days)																		
91-180 days	**1.31**	0.80	**3.72**	2.97	0.011	0.01	-1.02	1.24	0.36	0.45	-0.006	0.01	**1.31**	0.80	**3.72**	2.97	0.011	0.01
180-366 days	**1.75**	0.80	**5.73**	4.59	**0.014**	0.01	1.24	0.95	3.47	3.29	0.007	0.01	**1.75**	0.80	**5.73**	4.59	**0.014**	0.01
> 366 days	**3.07**	0.87	**21.59**	18.87	**0.025**	0.01	**2.96**	1.18	**19.35**	22.76	0.016	0.01	**3.07**	0.87	**21.59**	18.87	**0.025**	0.01
Year when the spell started																		
1986	**-0.98**	0.26	**0.38**	0.10	**-0.008**	0.00	-0.58	0.34	0.56	0.19	-0.003	0.00	**-0.98**	0.26	**0.38**	0.10	**-0.008**	0.00
1987	**-0.68**	0.27	**0.51**	0.14	**-0.006**	0.00	**-0.94**	0.40	**0.39**	0.16	-0.005	0.00	**-0.68**	0.27	**0.51**	0.14	**-0.006**	0.00
1988	**-0.64**	0.29	**0.53**	0.15	-0.005	0.00	**-1.42**	0.50	**0.24**	0.12	-0.008	0.00	**-0.64**	0.29	**0.53**	0.15	-0.005	0.00
1989	**-1.54**	0.35	**0.21**	0.08	**-0.014**	0.01	-0.29	0.42	0.75	0.31	-0.002	0.00	**-1.54**	0.35	**0.21**	0.08	**-0.014**	0.01
Diagnoses (CG: Musculoskeletal)																		
Cardiovascular	-0.13	0.30	0.88	0.26	-0.001	0.00	0.05	0.39	1.05	0.41	0.000	0.00	0.04	0.37	1.04	0.38	0.003	-0.13
Respiratory	0.29	0.50	1.34	0.67	0.002	0.00	0.80	0.57	2.22	1.27	0.004	0.00	0.53	0.52	1.70	0.87	0.032	0.29
Mental	**0.51**	0.27	**1.67**	0.46	0.004	0.00	0.12	0.41	1.13	0.46	0.001	0.00	**0.47**	0.26	**1.60**	0.42	0.029	**0.51**
Gen symptoms	-0.32	0.62	0.73	0.45	-0.003	0.01	-0.73	1.08	0.48	0.52	-0.004	0.01	0.35	0.43	1.41	0.61	0.022	-0.32
Injuries & pois.	**-1.09**	0.37	**0.34**	0.13	**-0.009**	0.00	-0.52	0.49	0.60	0.29	-0.003	0.00	-0.34	0.32	0.71	0.23	-0.020	**-1.09**
Other diagnosis	-0.01	0.25	0.99	0.24	-0.001	0.00	-0.32	0.38	0.73	0.28	-0.002	0.00	**0.87**	0.21	**2.40**	0.50	**0.054**	-0.01
Intercept	**-2.55**	0.94			**-0.019**	0.01	**-4.62**	1.29			-0.024	0.01	**-3.67**	0.54			**-0.225**	**-2.55**

Note: *in thousands of Swedish crowns; **Bolds** indicate significant at the 5%-level, underlines -significant at the 10%-level; RRR means the relative risk ratio, ME denotes marginal effects, and CG is the comparison group.

Table A9 Multinomial logit coefficients and marginal effects for various exits from long-term sickness spells compared to the alternative "return to work", by gender

	Men				Women			
Variables, by exit type	**Coef.**	**Std. Err.**	**ME Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**ME Coef.**	**Std. Err.**
Full Disability								
Age-group (CG: <36 years)								
36 – 45 years	0.76	0.46	0.009	0.01	0.32	0.46	0.002	0.00
46 – 55 years	**2.22**	0.44	**0.025**	0.01	**1.20**	0.43	0.007	0.00
56 – 65 years	**2.98**	0.45	**0.034**	0.01	**2.71**	0.44	**0.016**	0.01
Swedish Born	-0.28	0.33	-0.003	0.00	-0.44	0.36	-0.002	0.00
Educational Level (CG: Low)								
Medium	-0.37	0.32	-0.004	0.00	**-0.77**	0.34	-0.005	0.00
High	0.12	0.71	0.001	0.01	-0.91	0.55	-0.005	0.00
Earnings (1000 SEK)	**-0.05**	0.01	**-0.001**	0.00	**-0.04**	0.01	**0.000**	0.00
Earnings Loss (1000 SEK)	**0.04**	0.01	**0.001**	0.00	**0.03**	0.01	**0.000**	0.00
Regional Unemployment (%)	0.01	0.09	0.000	0.00	0.18	0.11	0.001	0.00
Sick > 1 year	0.00	0.45	-0.001	0.00	**2.45**	0.47	0.014	0.01
Spell starts in 1986	**-0.70**	0.31	-0.007	0.00	-0.45	0.35	-0.002	0.00
Spell starts in 1987	**-0.77**	0.32	-0.008	0.00	0.33	0.32	0.002	0.00
Musculoskeletal	0.16	0.33	0.002	0.00	-0.24	0.31	-0.001	0.00
Cardiovascular	0.16	0.42	0.002	0.00	-0.78	0.55	-0.004	0.00
Mental	**0.82**	0.43	0.009	0.01	0.28	0.44	0.002	0.00
Injuries & poisoning	-0.77	0.54	-0.008	0.01	**-1.19**	0.60	-0.006	0.00
Intercept	-0.45	0.70	-0.004	0.01	**-2.31**	0.68	-0.013	0.01
Partial disability								
Age-group (CG: <36 years)								
36 – 45 years	**2.21**	1.10	0.012	0.01	0.28	0.59	0.002	0.00
46 – 55 years	**2.80**	1.09	0.016	0.01	**0.77**	0.56	0.005	0.00
56 – 65 years	**4.06**	1.08	0.023	0.01	1.51	0.59	0.009	0.01
Swedish Born	1.82	1.05	0.010	0.01	-0.46	0.46	-0.002	0.00
Educational Level (CG: Low)								
Medium	0.18	0.46	0.001	0.00	-0.09	0.40	-0.001	0.00
High	1.42	0.80	0.008	0.01	-1.20	0.81	-0.007	0.01
Earnings (1000 SEK)	**-0.03**	0.01	**0.000**	0.00	**-0.03**	0.01	**0.000**	0.00
Earnings Loss (1000 SEK)	**0.02**	0.01	**0.000**	0.00	**0.03**	0.01	**0.000**	0.00
Regional Unemployment (%)	0.16	0.13	0.001	0.00	0.15	0.14	0.001	0.00
Sick > 1 year	1.26	0.82	0.007	0.01	**1.92**	0.68	0.011	0.01
Spell starts in 1986	-0.17	0.45	-0.001	0.00	-0.09	0.42	0.000	0.00
Spell starts in 1987	-0.34	0.47	-0.002	0.00	-0.81	0.53	-0.005	0.00
Musculoskeletal	-0.15	0.47	-0.001	0.00	0.41	0.47	0.003	0.00
Cardiovascular	-0.38	0.61	-0.002	0.00	0.83	0.67	0.006	0.00
Mental	0.18	0.68	0.001	0.00	0.41	0.65	0.003	0.00
Injuries & poisoning	-0.18	0.69	-0.001	0.00	-0.39	0.87	-0.001	0.01
Intercept	**-6.66**	1.74	**-0.037**	0.02	**-3.54**	0.97	-0.020	0.01

Variables, by exit type	Men				Women			
	Coef.	**Std. Err.**	**ME Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**ME Coef.**	**Std. Err.**
Other Exits								
Age-group (CG: <36 years)								
36 – 45 years	-0.10	0.36	-0.007	0.02	0.17	0.26	0.011	0.02
46 – 55 years	0.15	0.37	0.006	0.02	**-0.63**	0.32	**-0.044**	0.02
56 – 65 years	-0.18	0.42	-0.013	0.02	0.03	0.34	0.000	0.02
Swedish Born	-0.18	0.34	-0.011	0.02	**-0.68**	0.25	**-0.046**	0.02
Educational Level (CG: Low)								
Medium	-0.07	0.31	-0.004	0.02	0.36	0.23	0.025	0.02
High	0.68	0.57	0.037	0.03	0.20	0.33	0.014	0.02
Earnings (1000 SEK)	**-0.01**	0.00	**0.000**	0.00	**-0.01**	0.00	**0.000**	0.00
Earnings Loss (1000 SEK)	**0.01**	0.00	**0.001**	0.00	**0.01**	0.00	**0.001**	0.00
Regional Unemployment (%)	-0.07	0.10	-0.004	0.01	-0.14	0.10	-0.009	0.01
Sick > 1 year	**1.26**	0.49	**0.069**	0.03	**1.18**	0.37	**0.078**	0.03
Spell starts in 1986	**-1.24**	0.39	**-0.068**	0.02	<u>-0.52</u>	0.29	**-0.035**	0.02
Spell starts in 1987	**-1.12**	0.38	**-0.061**	0.02	-0.43	0.27	-0.029	0.02
Musculoskeletal	<u>-0.60</u>	0.35	<u>-0.033</u>	0.02	**-0.80**	0.24	**-0.054**	0.02
Cardiovascular	-0.14	0.48	-0.008	0.03	**-1.41**	0.67	**-0.095**	0.04
Mental	0.08	0.42	0.004	0.02	-0.41	0.32	-0.028	0.02
Injuries & poisoning	-0.59	0.42	-0.032	0.02	**-2.07**	0.74	**-0.139**	0.05
Intercept	**-1.40**	0.66	<u>-0.075</u>	0.04	**-1.18**	0.44	**-0.077**	0.03
LR chi2(48)	793.28				829.88			
Log-likelihood	-585.62				-707.41			

Note: There are fewer variables than in Table 4 because of the smaller number of observations. **Bolds** -significant at the 5%-level, <u>underlines</u> -significant at the 10%-level. Except the continuous variables (earnings, earnings loss and regional unemployment), when a comparison group (CG) was not mentioned, the group with the given characteristic was compared to the group without this characteristic.

Paper V

FIRST EXITS FROM THE SWEDISH LABOR MARKET DUE TO DISABILITY*

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Abstract

The number of disability exits has been increasing in recent years, raising questions both about the well being of affected individuals, and about how to finance the related disability pensions. Using a longitudinal database owned by the Swedish National Social Insurance Board, this study analyzes the risk to exit into disability at a certain age, assuming that people remained in the labor force until that age. The estimates show that it was more than 7% higher for each 100 days of sickness, but was lower with each additional sickness spell. It was also higher for increments of 1% in the regional unemployment rate. These results suggest that more resources should be allocated for prevention, improving working conditions and designing the tasks of each job so as avoid overuse of employees working capacity.

Key words: disability pension, sickness spells, long-term sickness, single risk and competing risks models.

JEL Classification: I12, J14, J26, J28.

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1 Introduction

Working people are often exposed to physical, chemical, biological, and psychosocial factors that can cause short-term and/or long-term health problems, many of which could be prevented or controlled. Many of these people may end up with a disability.[69] Disability (and working capacity justifying a disability benefit) may also result from a number of diseases, injuries, or disorders that affect the visual, hearing, locomotor, or mental functions. Disability can affect people of all ages, it diminishes life quality, and it increases the need for care and support from family and community members, as well as from health and social services. "Disability dependence" occurs when, for these reasons or others, employees do not return to work, although they may be capable of doing so. Instead, they become economically dependent on public or private financial support.

In Sweden, although substantial public attention has focused on training and rehabilitation, labor market entry and placement of disabled workers, the problem of employees leaving the labor market early due to disability has received far less recognition. Nowadays, however, with an increasingly aging population *and* a declining working-age population, disability has become a major public policy issue not only in Sweden, but in many other countries as well. In addition to the aging issue, this attention is also explained by the increasing size of the population on disability benefits, and by an implicitly lower level of economic output and foregone tax revenue. Furthermore, exit with disability may not be the best choice for an individual, due to the likelihood that it leads to inactivity, which itself may not be good for health. Therefore it is important to learn more about labor market exits into disability. Given that in Sweden any person aged 16 to 64 is entitled to a disability pension when faced with a reduction of working capacity, it is useful to learn more about *the age of the first exit* from the labor market due to disability and circumstances surrounding exit.

[69] The complexity of the disability phenomenon is in part pictured by the evolution of its definition over time, which is presented in the Appendix.

The goal of this paper is to analyze the individual and labor market characteristics, determining the risk that a person will exit from the labor market at a certain age, conditional that (s)he has remained in the labor market until that age. The analysis uses two longitudinal samples from the *LS database,* which is owned by the Swedish National Social Insurance Board.[70] The exit decision is estimated within a duration framework on the basis of both single risk and competing risks models.

The study is organized as follows: *Section* 2 reviews previous studies, while *Section* 3 discuses the various pathways to early exit from the labor market in Sweden. The theoretical framework is presented in *Section* 4, and the data is described in *Section* 5. *Section* 6 presents the econometric specification, while *Section* 7 presents the results. *Section* 8 summarizes and draws conclusions.

2 Previous studies

The literature on the economics of disability is not very old. Berkowitz and Johnson (1974) is one of the first contributions of economists on analyzing disability. Earlier contributions are to be found in sociology and psychology [e.g., Nagi (1965, 1969a, b) and Haber (1967)]. Since this time there have been many studies concerning the work activities and economic well being of the working-age population with disabilities.

The economic approach to disability can take diverse forms, usually starting from the loss of working capacity, and related productivity loss, and then focusing on various aspects of exit, including economic relations with employers, social insurance officers, program administrators, and household members.

The survey of Haveman and Wolfe (2000) discusses the main lines of economic research, addressing the issues of economic status and behavior of the working-age population with disabilities. Bound and Burkhauser (1999) review the behavioral and redistributive effects of transfer programs targeted on working people with disabilities. They also review the literature on the labor supply behavior of people with disabilities

[70] Actually, all data in this paper are from the Swedish National Social Insurance Board.

and how it is affected by disability program characteristics. They focused primarily on the United States, but also include programs in Sweden, the Netherlands, and Germany.

Economic factors may be important in determining disability. European evidence shows that higher wages or earnings decrease the incentive to withdraw from the labor force (Blau and Riphah, 1999), while US data show contradictory results (Bound and Burkhauser, 1999).

Disability benefits can be imperfectly targeted, and high benefits can be a vehicle availed by employees and in some systems indirectly by employers to subsidize early retirement. Therefore, it is useful to estimate the effects of potential disability benefits on labor force participation, since the magnitude of such effects is not yet clear from previous research. This brings into question the roll of health in modeling exits from the labor force. For example, the "debate" among Parsons (1980a, 1980b, 1984, 1991), Haveman and Wolfe (1984), and Bound (1989, 1991), pointed out a potential heterogeneity bias in the model specification, the estimation method, and the approach for controlling for health. Both the specification of the model and the data available and used in analyzing the effects of potential disability benefits on labor force participation are clearly important for the results.

Another important factor is the type and variety of disability programs available. Burkhauser and Haveman (1982) presented a comprehensive description of American public programs targeted on (largely older) workers with some identifiable health problems.[71] Aarts and De Jong (1992, 1996) have compared the performance of the Dutch social security system, in terms of participants, expenditures, and distributional impacts, with systems in other Western economies (Sweden, Germany, and the United Kingdom in the1996 study, and even more countries in 1992: Denmark, France, the United States, Japan, and more). They found that high disability benefit expenditures even in countries with policies in place to facilitate rehabilitation, provide public-sector jobs, subsidize private employers, and allow partial pensions to encourage employment. They found that incentives mattered, and not just economic incentives faced by workers

[71] They referred to this set of programs as "U.S. disability policy".

with chronic conditions, but also those faced by employers, by disability adjudicators, and by those offering services to workers with disability.

There have been few studies on disability exits from the labor market in Sweden.[72] Summarizing their findings, it seems that, there were three groups of independent variables that influenced the exit into disability: demographic variables (e.g., Berglind, 1977, and Hedström, 1980); labor market variables (e.g., Berglind, 1977; Hedström, 1980; and Wadensjö and Palmer, 1996); and health variables (e.g., Berglind, 1977; Hedström, 1980; and Månsson et al., 1994, 1996). This was not always the case fowever. For example, Wadensjö and Palmer (1996) found that the increasing rate of disability since 1960 is largely a result of changes in other factors than health. These other factors were mainly related to the labor market, but there were also changes in rules (e.g., Wadensjö, 1985, 1996; and Hansson-Brusewitz, 1992), and changes in benefit level and other economic incentives (e.g., Hansson-Brusewitz, 1992; Wadensjö and Palmer, 1996; and Palme and Svensson, 1997).

The present study aims to reexamine the previous findings for Sweden using a new database and examine the data in an attempt to gain information about the factors affecting disability exits, by estimating the risk of exiting into disability at any given age.

3 Exits into disability from the Swedish labor market and related facts

In Sweden, people aged 16 to 64 are eligible for a permanent or temporary disability pension, at full or partial rate (3/4, 2/3, 1/2 or /14)[73] if their working ability is completely or partially lost due to poor health. The disability pension consists of the basic pension and the income-related ATP supplement.[74]

[72] Berglind (1977); Hedström (1980); Wadensjö (1985, 1996); Hansson-Brusewitz (1992); Månsson et al. (1994, 1996); Wadensjö and Palmer (1996); Palme and Svensson (1997).

[73] The rates of 3/4 and 1/4 were introduced in 1993.

[74] ATP (allmän tilläggspension) is the national supplementary pension scheme.

Even though Swedish social policy intends to encourage employers to provide an optimal work environment at all working places, statistics show in both absolute and relative terms, for both men and women, a steady increase in the number of *all* early exits from the labor market since 1960, and not only of the exit into disability. Even though the focus is on exit into disability, for a complete picture of the alternatives faced by individuals Table 1 shows all pathways to early exit from the Swedish labor market during the period covered in this study.[75]

To be entitled to a disability pension, a physician must certify that the individual's capacity to work is reduced by at least 25%. If the individual's working capacity is reduced by at least 25% but not 50%, (s)he is eligible for a 25% disability pension; if reduced by at least 50% but not 75%, (s)he is eligible for a 50% pension; for full pension, working capacity must be completely lost.

Table 1 Pathways to early exit from the Swedish labor market

Pathway	Characteristics
Poor health	People can leave the labor market with a disability pension granted on the basis of a medical diagnosis and a judgment that this reduces work capacity. The sickness cash benefit is higher than the disability pension, so there are economic incentives for individuals to take this pathway and remain in it as long as possible, before a permanent exit.
Occupational injury	A person who leaves the labor market by this route is compensated for up to 100% of earnings loss.
Unemployment	From July 1972, workers 63 and over (lowered to 60 from July 1974) could receive a disability pension *without a medical reason* (called a disability pension "for labor market reasons") if they finished their compensation rights from unemployment, and could not find another job. This pathway was terminated in 1991.
Guarantee pensions	Since 1991 when the disability pension for labor market reasons was terminated, firms can lay off older workers through a guarantee pension (that the firm generally buys from a private insurance company) financed with separate funding.
Early retirement	Since July 1976, when the retirement age was lowered to 65 (from 67), it has been possible to receive a reduced old-age pension from the age of 60. The reduction factor is 0.5% per month.
Part-time pension	There have been different schemes for combining part-time work with a part-time pension: a) half early retirement pension; b) 2/3 or 1/2 disability pension; and c) a partial pension scheme launched in July 1976 for those aged between 60 and 65.

[75] This study analyses mainly the *health* pathway, but some cases in our database resulted from work injuries or long-term unemployment (see Table 1).

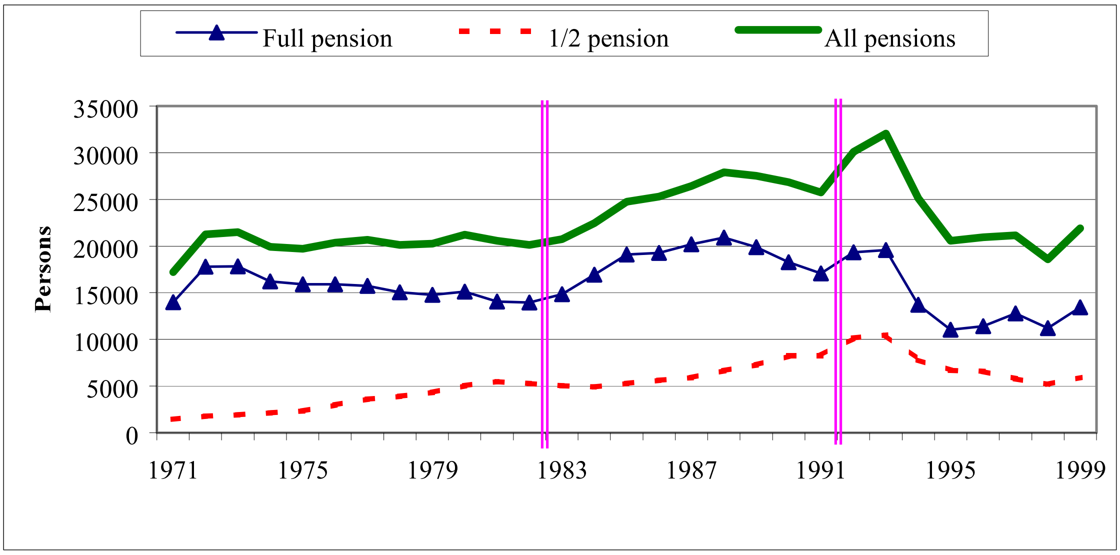
If capacity to work is reduced for a long period but not necessarily permanently, the individual is entitled to a *temporary* disability pension. This is determined with the help of a medical evaluation, and is sometimes difficult to decide. It is therefore not surprising that published statistics in Sweden often do not distinguish between permanent and temporary disability, but they always distinguish if they are full or partial. It is not easy to find an explanation of why the permanent and temporary disability pensions are not distinguished in official statistics, however this way of reporting seems to provide the best way to distinguish exits due to disability from other pathways to early exits from the labor market. Additionally, temporary and permanent disabilities kept together offer information about "lost" working capacity, and not about the "hope" of recovery, which besides could be "biased".

Figures 1 a) and b) show the flows of women (a) and men (b) from the labor market with full or partial disability benefits during the period 1971-1999, where our period of study, 1983-1991, is set off by vertical lines.[76]

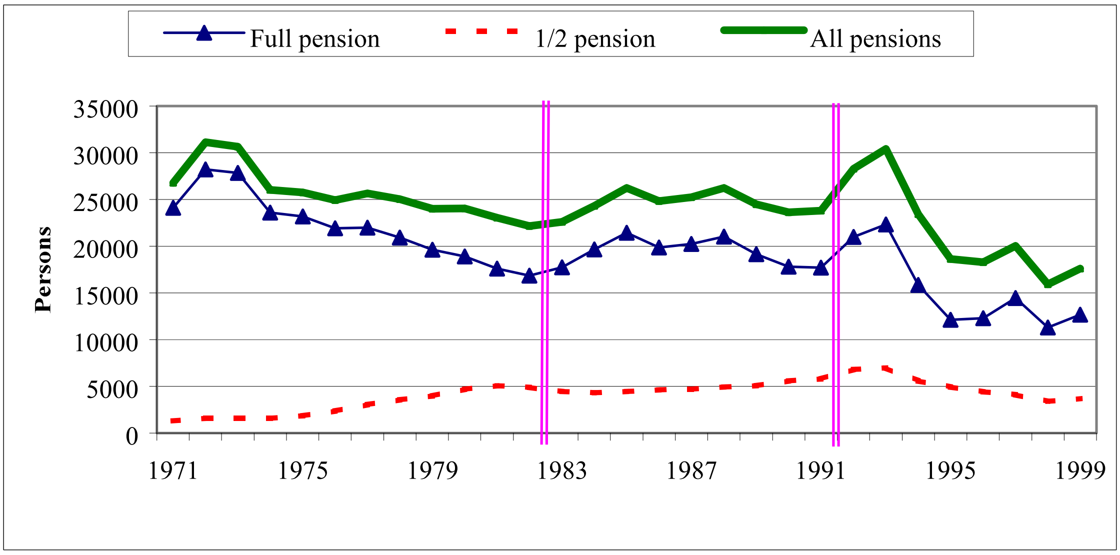
Since 1986, more women than men have exited earlier from the labor market with a disability benefit. This could be the result of increasing rates of women participating in labor force since the end of 1960s. The high number of benefits granted around 1993 is explained by an administrative "drive" to move a large stock of employees on long-term sick leave, and judged not being suitable for rehabilitation, to permanent disability pensions. After the peak year in 1993, the level decreased considerably, due to stricter rules, which led to both a decrease in the number of employees on long-term sick leave, and more restrictive requirements for disability.

When disability exits are compared between women and men, it seems, as we have already noted, that starting with the mid-1980s there were more women than men who exited the labor market due to disability. However, if a more detailed analysis is done (Figures 2 and 3), it is found that this is in general true *only* for partial disability.

[76] The Swedish National Social Insurance Board (RFV) is the *source* of data for entire paper.



a)Women



b)Men

Figure 1 New disability grants, women and men, 1971-1999

Figure 2 shows the difference between women and men by the type of disability pension (full and partial), and for the *all* types of disability pensions, while Figure 3 shows the difference between women and men, for the number of pensions, full-benefit equivalents.

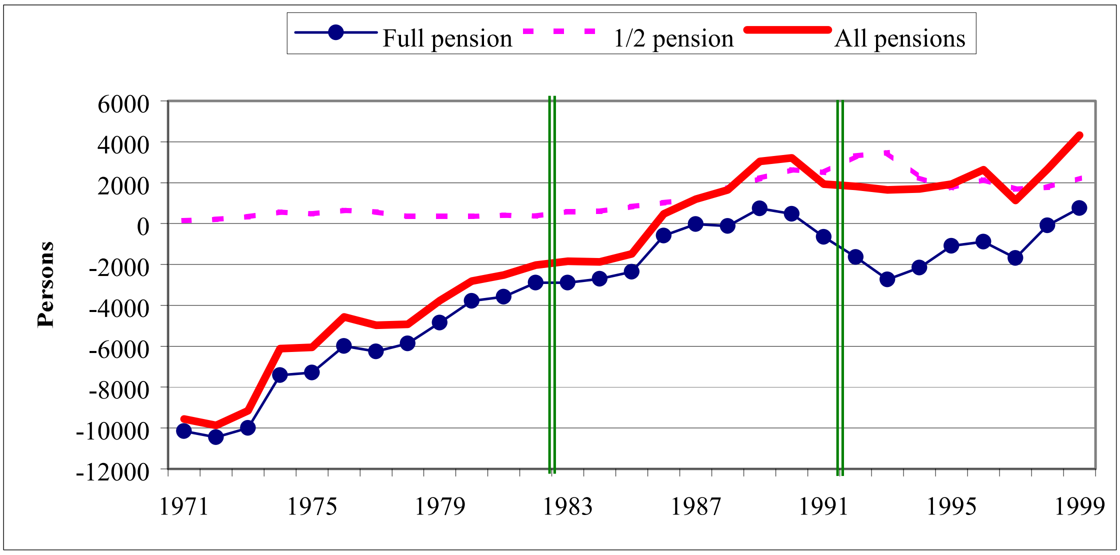


Figure 2 Differences between women and men: new disability pensions, 1971-1999

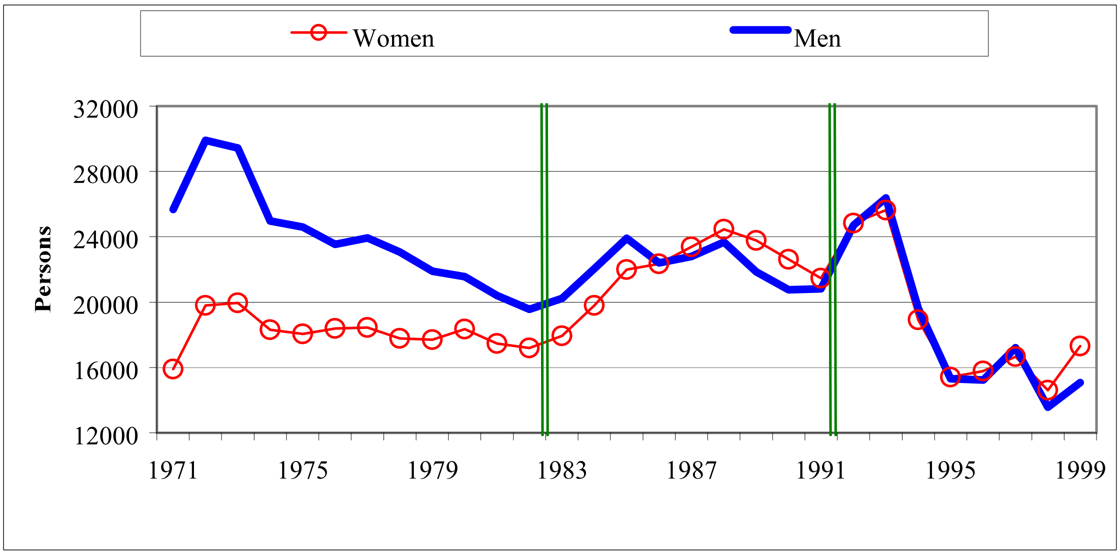


Figure 3 New disability pensions, full-benefit equivalents, women and men, 1971-1999

Can we conclude from the previous figures that women are more or less disability prone than men, wish to work more than men, or that women have better or worse health than men? Definitively not, but we should reconsider this problem more carefully, especially nowadays when the statistics show that women are recorded long-term sick more often than men. First, we should be more careful with these statistics, which show numbers of compensated days regardless if they are “full” or “partial”. Then, we should analyze the link between the (new) “detailed” statistics and the exits from the labor market due to disability, and find out how big is the percentage of those women with partial disability recorded long-term sick.

4 Theoretical framework

The social insurance system is built in such way that it gives employees whose working capacity is (or may be considered to be) reduced due to sickness or injury a choice between various early-exit pathways from the labor market. The important *point* is that people have a choice. When choosing a *temporary* or *permanent* early exit from the labor market, employees are assumed to maximize their lifetime utility. The choice alternative *j* for an employee after a long-term sickness can be return-to-work, partial disability or full disability, and full or partial early retirement with the old-age system from age 60. The employee optimization problem is then

(1) $$\max_{S,P,F,R} \int_a^D u(C_t, L_t) e^{-d(t-a)} dt$$

subject to

(2) $$\int_W^S Y_t e^{-d(t-a)} dt + \mu_1 \int_S^P Y_t e^{-d(t-a)} dt + \int_P^F Y_t^{PD}{}_t e^{-d(t-a)} dt + \mu_2 \int_F^{ER} Y_t e^{-d(t-a)} dt +$$
$$+ \mu_3 \int_{ER}^R Y_t e^{-d(t-a)} dt + \int_R^D Y_t^P e^{-d(t-a)} dt - \int_W^D C_t e^{-d(t-a)} dt \geq 0$$

where the employee's utility function *u* depends on employee consumption (C_t), and leisure (L_t); *W* is the date of beginning to work; *S* is the beginning of a sickness absence, when the employee gets a sickness benefit that is based on the replacement rate μ_1 and expected annual earnings (*Y*); *P* is the beginning of a partial disability period, when the employee gets a partial disability pension *PD* plus salary for any work done (Y^{PD}); *F* is the beginning of a full disability period, when the employee gets a full disability benefit (*FD*) that is based on the replacement rate μ_2 and expected annual earnings (*Y*, which are the earnings of the previous year); *ER* is the first day of a full or partially reduced early old-age retirement period, when the employee gets a pension (Y^P) with a reduction (μ_3); *R* is the first day of the old-age retirement period, when the employee gets a pension (Y^P) that is related to lifetime earnings, work experience and work characteristics; and *D* is the day when the person dies. The employee's decision point is age a, d is the discount rate including survival probabilities, and $0 < \mu_i \leq 1$, where i =1, 2 and 3. The model is presented in a "simplified" form, assuming different spells of work and sickness "sum" up under the same integral.

The exit from the labor market due to disability is not completely an individual decision, as it is conditional on a medical evaluation, as well as a work capacity evaluation of a social insurance officer. Additionally, we will assume that financial and psychological dependence may negatively affect employees who become disabled. Thus the decision to exit with a disability pension may be difficult to accept. Employees who suffer from a chronic sickness, for example, may find themselves in a gray area, where they would qualify for a disability pension, but could continue to work. It will be assumed, then, that the individual decision is made on the basis of *actual* utility given the financial resources. Given the financial resources provided by the disability pension, the decision may be *for disability* if the employee values more leisure and/or "psychic gains" that do not relate to the job or work environment, or *for work* (s)he enjoys work and/or can cope with the work environment, derives utility from the social network related at work, and related factors, such as the structure of a fixed schedule.

Conditional on the recuperation of at least part of the (initial) loss of working capacity, losses created by exit into disability may cause great problems for both persons with reduced work capacity (disable employee) and employers. The "disabled" people would not necessarily be better off by deciding to be out of the labor market when they still have working potential. Their inactive life would not necessarily improve their health status. They may become less happy, and, for sure, less wealthy than before exit. The reason why they are out of the labor force is their health status, and they should receive more help with respect to this. "Letting" them exit the labor market does not solve their problem, but offering them the opportunity of working *some* hours in a favorable environment, would increase their present and expected wealth (additional earnings from work), and it would have a positive effect on the employers' side (compensation payments and the expense of hiring and training replacements).

5 The data

The data, which come from the Long-term Sickness (LS) database owned by the Swedish National Social Insurance Board, include longitudinal information for about 4500 people on personal characteristics, earnings, sickness history (from 1983) and rehabilitation history (from 1986), and all exits from the labor market (i.e., including information before the period of observation, which started in January 1986). There are two random samples. One (IP) is representative for the national register of the insured population, aged 20 to 64 during 1986-1991. The second (LSIP) is essentially the same as the first, except that everyone had at least one sickness spell of at least 60 days during the period 1986-1989 (i.e., this sample is representative for the subpopulation of insured who have been recorded as long-term sick at least once). The last sample is larger: The IP sample includes about 1800 persons, while the LSIP sample one includes about 2700 persons. Both samples are analyzed here, allowing us to draw conclusions about slightly different populations: the insured population as a whole and the insured population with long-term sickness history.

It was possible during the period examined to exit with a permanent or temporary disability (granted for up to 3 years at a time). Those who exited received a permanent or temporary (disability) pension at 1/2, 2/3, or full rate. Those who continued to work (1/2 or 1/3) might later also qualify for sickness cash benefit (if sick), or for further disability pension, but only *first exits* are analyzed here. Because only sickness history since 1983 was known, all those who had exited the labor force due to disability before 1983 (50 persons in the IP sample, and 67 in the LSIP sample) were excluded, which of course introduces a potential for selection bias.

Tables 2 shows descriptive statistics for the analyzed samples by disability pension status, reported at *exit date*, which is either the actual date of first exit, or the end of the observation period (December 31, 1991) for those who had not exited.

Table 2 Descriptive statistics by individual at "exit" date, IP and LSIP samples

Variable	No exit		Full disability		Partial disability	
	IP	LSIP	IP	LSIP	IP	LSIP
	1680	1926	74	461	42	239
Gender (1=woman, 0=man)	0.50	0.58	0.46	0.48	0.60	0.54
Marital status (1=married, 0=single)	0.52	0.54	0.51	0.60	0.62	0.58
Married women	0.27	0.34	0.27	0.30	0.31	0.31
Citizenship						
Swedish born	0.88	0.85	0.70	0.83	0.95	0.87
Naturalized Swedes	0.05	0.07	0.16	0.09	0.02	0.07
Foreign born	0.07	0.09	0.14	0.09	0.02	0.07
Educational level						
Low	0.47	0.56	0.85	0.83	0.66	0.74
Medium	0.36	0.34	0.11	0.13	0.24	0.20
High	0.17	0.10	0.04	0.04	0.10	0.06
Age groups						
18-35 *years*	0.33	0.33	0.07	0.07	0.05	0.07
36-45 *years*	0.29	0.29	0.09	0.11	0.10	0.18
46-55 *years*	0.24	0.24	0.31	0.33	0.31	0.30
56-65 *years*	0.14	0.14	0.53	0.49	0.55	0.45
Age	41.99	42.11	53.35	52.33	53.62	51.93
	(10.89)	(10.94)	(9.57)	(8.88)	(8.11)	(9.38)
Earnings*, 1000 SEK	169.80	164.79	113.60	141.06	96.60	112.04
	(95.08)	(63.34)	(93.10)	(76.40)	(61.32)	(66.34)
Regional	2.37	2.34	2.68	2.50	2.58	2.22
unemployment rate (%)	(1.19)	(1.19)	(1.57)	(1.30)	(1.25)	(1.21)
Sickness spells before exit	9.18	14.15	3.36	4.33	5.17	5.09
	(9.79)	(11.28)	(4.73)	(4.94)	(6.70)	(6.84)
Sickness spells after exit			0.08	0.12	4.79	5.63
			(0.49)	(0.88)	(8.61)	(7.91)
Sickness days before exit	119.27	459.33	537.77	741.74	564.69	654.20
	(237.48)	(418.02)	(422.45)	(416.92)	(495.24)	(478.48)
Rehabilitation type						
Vocational	0.03	0.19	0.12	0.21	0.38	0.30
Medical	0.01	0.08	0.14	0.18	0.19	0.16

Note: Earnings are adjusted to constant values using the 1997 CPI. *Italics* indicate dummy-groups.

The proportions of women and men who did not exit before the end of the observation period were almost the same in the IP sample, whereas in the LSIP sample more women than men did not exit. This difference could be explained by the fact that, on average, women work part time more often than men, and given economic incentives and other factors related to disability, it could be more difficult for them to decide to exit. Being recorded long-term sick, allowed them to accumulate compensation that qualified them for a better pension latter on. It can also be explained by assuming that part-time work, which is more frequent for women, provides an alternative to leaving the work force with disability when there is a mismatch between job demands or work environment and individual health and/or capacity.

Compared to the no-exit group of the IP sample, the LSIP sample's no-exit group also has more naturalized Swedes and foreign-born people, more days and spells of sickness, and they participated more often in a rehabilitation program. There are also more married people, and more married women. People with medium and higher education are presented in higher proportions for the no exit group of IP than LSIP. In both samples the proportions of people with low education who exit into full (83-85%) or partial disability (66-74%) were much higher compared to the other educational levels. The average age of the first exit was higher in the IP sample than in the LSIP sample for all types of exit, which can be explained by the better health status of people in the IP sample.

As expected, the averages of both sickness spells before exit and compensated days of sickness, were much higher for the LSIP sample (working-age insured people with LT sickness) than for the IP sample (all working-age insured people): "No-exits" in the LSIP sample averaged about 51 compensated days of sickness per year (over the period 1983-1991), whereas those in the IP sample averaged about 13 days.

Except for the "no-exit", the average annual earnings of exit people of each pension category in the LSIP sample were higher than in the IP sample. This might happen because the IP sample contains people who did not work at all, whereas everyone in the LSIP sample must have worked in order to qualify for a sickness benefit.

The exits into full and partial disability differ between them, and in general, they are different for the two samples. For those who exited with a full benefit, the proportions of naturalized Swedes, of foreign-born people, and of those aged 56-65 were higher for IP sample than for LSIP. Otherwise, the proportions (i.e., the mean values for age-groups dummies) were higher for LSIP than IP.

For exits with partial disability, the proportions of married, of Swedish born, and of those aged 50-65 were higher for IP than for LSIP. The same was the relationship for those who participated into vocational, or medical rehabilitation.

6 The econometric specification

We assume people make rational choices under uncertainty in a given risky environment and these choices both determine the hazard of exit, and the change in it over time. According to Lancaster (1990), if we could observe the hazard function of a number of people living in the same risky environment and using the same decision making policy, or operating in environments and using policies which differ in *known* ways, we could confirm or refute the theory of their behavior and determine parameters that could be interpreted according to economic theory.

Our aim is to estimate the hazard of exit, which is the risk that a person will exit at a certain age due to disability, assuming that (s)he has remained in the labor force until that age. The model outlined above and the data allow for various types of early withdrawal from the labor force. Therefore, the exit decision will be estimated within a duration framework using both *single risk* and *competing risks models*, where the latter describes duration models in which an individual spell may terminate via more than one outcome.

Competing risks must be mutually exclusive and collectively exhaustive[77] for the models to be transition specific. So, considering the event of exiting from the labor force, and possible explanations for doing so: One may exit partially or totally at any age (i.e., 16-65 in Sweden) because of reduced working capacity (exits analyzed by this study), and from age 60 also exit without reduced work capacity. Therefore the models used here analyze the time until a transition-specific event, treating alternative transitions as censored, and so there is a different analysis for each transition specific risk or event.

Survival curves are useful for preliminary examination of the data, for computing the probabilities of survival, and for evaluating the fit of the regression models. Since the survivor function gives a complete account of the survival experience of different

[77] The risks must be completely different from one another in that either one or the other can happen, but not both, at the same time.

groups, we test the null hypothesis that the survivor functions are the same for two [H_0: $S_1(t) = S_2(t)$ for all t] or more groups.

Given public concerns about increasing disability rates it could be helpful to learn more about the factors that lead to health problems, considering all possible sources: genetics, the working environment, the characteristics of an individual's job task, the individual's social integration, the impact of family circumstances, culture, technical change, etc. Unfortunately, this kind of information has not been available for this study, but relatively good instruments were available for the mentioned factors (i.e., dummies for citizenship - accounting for cultural impact, social integration, and even working conditions; the number of sickness spells and rehabilitation dummies - accounting for work environment and working conditions). Therefore, the impact of those factors on exit due to disability is estimated next semiparametrically using the Cox proportional hazard model (Cox, 1972). This model evaluates treatment, diagnostic, or predictive factors to determine the magnitude and significance of their effects on population survival or failure time. It is assumed that the hazard function can be factored into a function of time and a function of variables related to the sickness spell and the individual, and so it is set up a model for the conditional probability of exiting due to disability:

(3) $h(t; x_i) = h_0(t)\exp(\beta x_i)$,

where β represents the coefficients to be estimated, and $h_0(t)$ is an unknown function of time. The expression $h_0(t)$ gives the hazard function for the standard set of conditions, $x = 0$.

The advantage of the semiparametric approach is that it does not make any assumption about the underlying distribution of "waiting times", and it leaves $h_0(t)$ parametrically unspecified. The model asserts that the effect of the explanatory factors on the hazard rate (the risk of the occurrence of an event, such as exit from the labor market, at any point in time) is multiplicative and does not change over time. So, if the hazards of exiting were proportional, the corresponding proportion between the cumulative integrated hazards would be the same, and plots of the logarithm of the cumulative hazards corresponding to values differing by the same measure should be parallel. This allows examining the proportionality assumption graphically by using the survival estimates.

The extension of the standard single risk model to two or more independent exit destinations, i.e. the independent competing risks model (Lancaster, 1990), implies that the log-likelihood can be split into the sum of its risk-specific hazards. In such a model, observations that exit differently (i.e., 1/2 or 2/3 disability pension) from the analyzed exit (i.e., full disability pension) are treated as censored. Therefore, maximizing the likelihood for a total competing risks model is equivalent to separately maximizing the likelihood for each exit type (*j*), as in

$$\textbf{(4)}\ \ln L_j = \sum_{i=1}^{N_j} \ln h_j(t_i) - \sum_{i=1}^{N} \int_0^{t_i} h_j(u)du\,,$$

where N_j is the number of uncensored observations, i.e. exits to state *j*, and *N* denotes the total number of observations, i.e., exits to *all* states, plus non exits.

As it was already mentioned, not all the information needed was available for this study; therefore some instruments were used instead. Additionally, an unobserved heterogeneity term should be considered, but this requires strong assumptions especially when more than one exit destination is considered.[78] In the next step, first exits from the labor market due to disability were studied using a *frailty model*, were the frailty represents the total effect on survival of the covariates not measured when collecting information on individual subjects. The model used is the so-called shared frailty model, an extension of the proportional hazard regression model, which assumes that the hazard rate for the j^{th} subject in the i^{th} group, given frailty (w_i), is of the form

$$\textbf{(5)}\ h_{ij}(t) = h_0(t)\exp(\sigma w_i + \beta' x_{ij})\,,$$

where $h_0(t)$ is an arbitrary baseline and σ is the coefficient for the frailty term (w_i). When σ is zero, this model reduces to the basic proportional hazard model (3).

[78] Two approaches have typically been adopted in the empirical literature. The first involves introducing a random disturbance term in each of the cause-specific hazards (Katz and Meyer, 1990), requiring the assumption of independence across terms. The second approach assumes a disturbance term common to all cause-specific hazards, or terms proportional to each other (Flinn and Heckman, 1982; Pickles and Davis, 1985). Narendranathan and Stewart (1993) argue that introducing possible misspecifications through the unobserved heterogeneity term could bias the results of interest. In particular, they argue that there is no reason for any resulting distortions to be less serious than those caused by ignoring unobserved heterogeneity.

7 Estimation results and discussion

The economic model specified above takes into account several forms of exit with benefits. In this study we focus only on exits due to disability. "Waiting time" until the first exit from the labor market due to disability was "measured" in years of age, because both the a) age when people started to work, and b) their working history were not in the data. Nevertheless, even if these data were available, we will still prefer the years of age because: 1) the employees' productivity may fall bellow what (s)he is paid, creating an incentive for the employer to "push" them on the direction of exit, and perhaps to lose interest in helping them; 2) the employees working capacity may decline due to a number of factors (i.e., the work environment/tasks are no longer as suitable; the employees' physical capacity may deteriorate due to a long absence of sufficient physical activity; health can become poorer; skills may become outdated, and the willingness or capacity to accommodate to change lower; they may desire more leisure, etc.). Therefore, exit alternatives may look more attractive at different ages, regardless of when people started to work. On the other hand, a long working career itself may be a factor of increasing importance with increasing age. At any given age, the hazard of exiting for those who did not exit earlier was estimated both nonparametrically and semiparametrically.

7.1 Nonparametric results

Figures 4 a) and b) show the survival and hazard functions for first exit from the labor market for women and men from age 30 for the IP sample. Figures 5 a) and b) show the same functions for the LSIP sample.[79]

For the IP sample, the survival rate for both men and women decreased slowly until about age 55, when there was a marked increase in the rate of exit from the labor force; for the LSIP sample, this increase started several years earlier (i.e., about age 49).

[79] There were few exits before age 30.

After age 55, women in the LSIP sample had a higher hazard of exit than men; this was not the case for the IP sample. The difference seems clearly to be attributable to the different health status of the samples: Previous long-term sickness seems often to be a precursor of earlier exit. The clear decrease in survival for both samples around age 60 is probably related to the "standard" economic (behavioral) explanation: A natural decrease of the employees' productivity by age, an increasing probability that the employee's working capacity declines with age, perhaps poor adaptation to technical change, and a higher preference for leisure are some of the factors that explain best the increasing hazard around 60.

Figures 6 a) and b) show the plots of survival and hazard functions by marital status for the IP sample, while Figure 7 a) and b) show them for the LSIP sample. In the LSIP sample, married people generally "survived" longer than did singles, and this was also true in the IP sample until age 59, after which singles "survived" longer. This suggests that being single is a risk factor for younger people and for those with a history of long-tem sickness. It can also be the case that people with poorer health, social status and education, have a greater risk of not finding (keeping) a partner. Economic incentives could also play a role: For example, for some married people (mainly men), even if they have reduced working capacity, the fact that their work is the main source of family income may make a disability pension an undesirable choice. On the other hand, some single people are widowed, and those born before 1945 had the possibility to combine a disability pension with a survivor pension, thus increasing their economic incentive for exit.[80] Other factors, such as injuries, but also psychological disorders, are an important cause of early exit of young people, who are often singles.

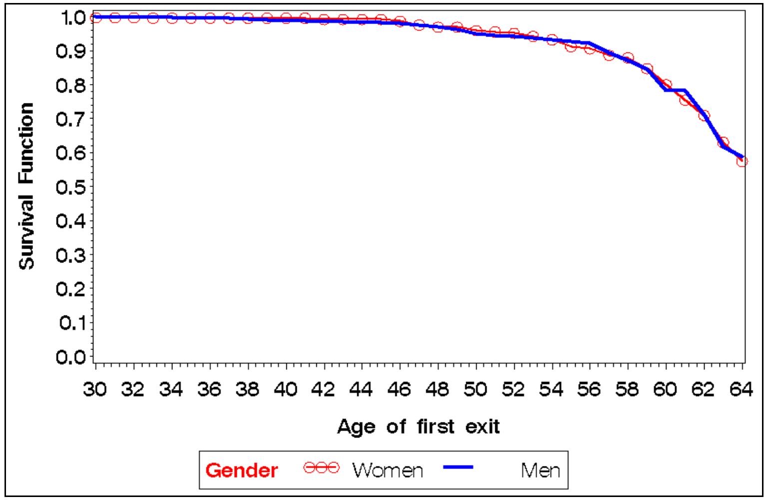
Figures 8 a) and b) show the survival and hazard functions by citizenship for the IP sample, while Figures 9 a) and b) show them for the LSIP sample. For both samples, Swedish born people "survived" longest, followed by naturalized Swedes and then

[80] Survivor's pension comprises adjustment pension, special survivor's pension, widow's pension and child pension. Adjustment pension is payable to women/men under age of 65 whose husband/wife died after December 31st 1989. This pension is payable the first year after the spouse's death, and can be extended if there are children under the age of twelve in the family.

foreign-born persons. For the IP sample these differences become clear for persons in their late forties (about 47 years), and about ten years earlier (about 37 years) for the LSIP sample. This result may have been caused by a difference in working conditions and work characteristics, but it could also be caused by other unobserved factors, such as health capital, as well as cultural and social aspects.

Figure 10 shows log-log survivor functions for the two samples by pension rate. Since the log-log survival functions are almost parallel, we can conclude that the hazards of exit with different disability pensions are proportional, which means that *if* the hazard of exit with a full pension changes with time, the hazard of exit with one-half or two-thirds pension changed proportionately.

Figure 11 shows the corresponding smoothed hazard functions. Again, we can see that the hazard of *early* exit was higher for the LSIP sample than for the IP sample. In the IP sample, the hazard of exit with a full pension increased dramatically at about age 50, and shortly thereafter for partial pensions, while in the LSIP sample, there were no such clear "break-points". Instead there was a steady increase starting much earlier. The difference seems clearly explained by the different health status of the samples. In other words, previous long-term sickness seems often to be a "precursor" to earlier exit.

a) 

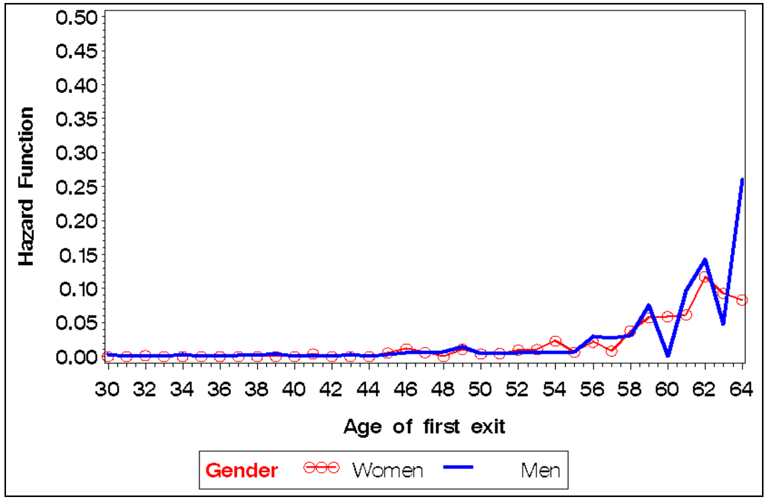
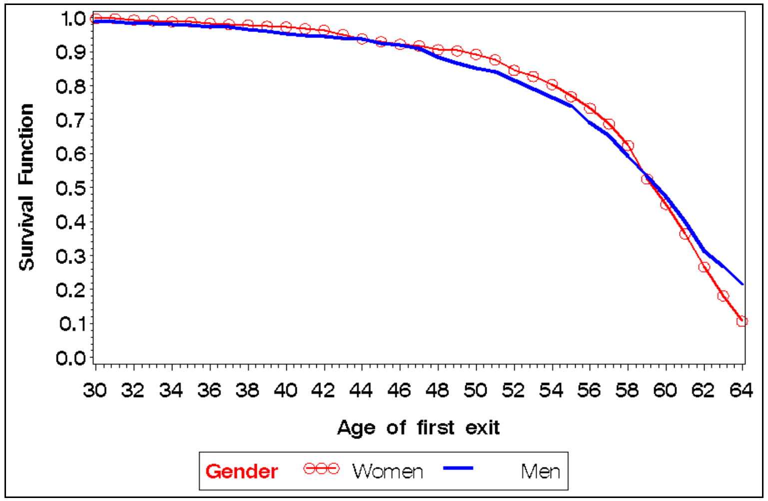
b) 

Figure 4 Plots of survival (a) and hazard (b) functions by gender; IP sample.

a) 

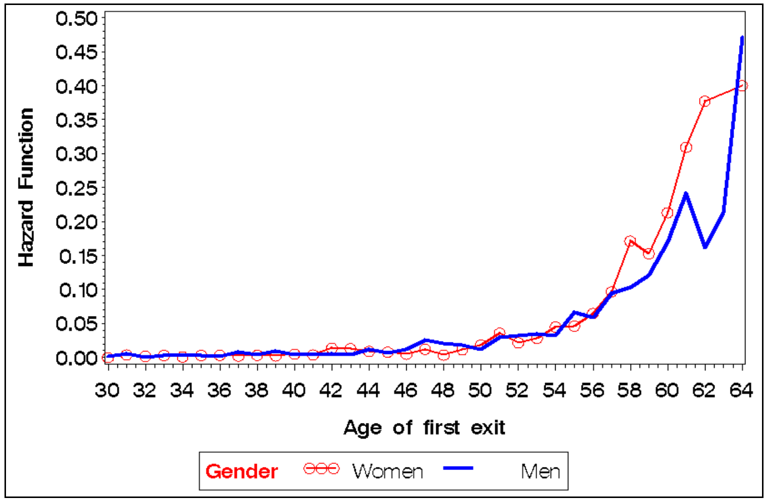
b) 

Figure 5 Plots of survival (a) and hazard (b) functions by gender; LSIP sample.

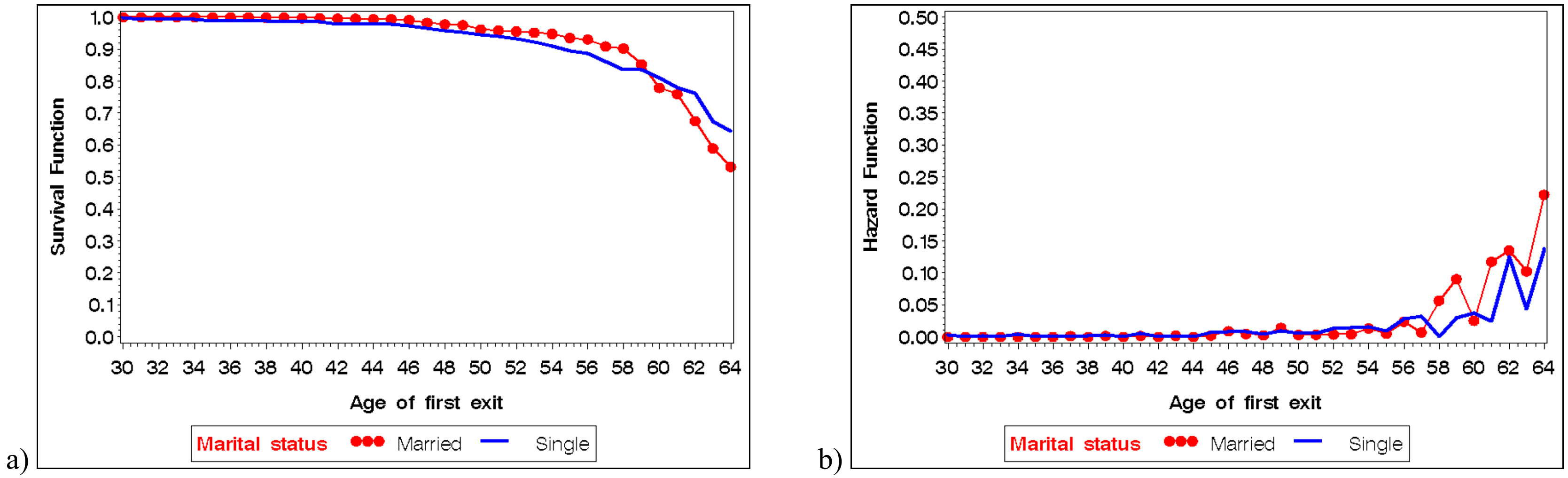


Figure 6 Plots of survival (a) and hazard (b) functions by marital status; IP sample.

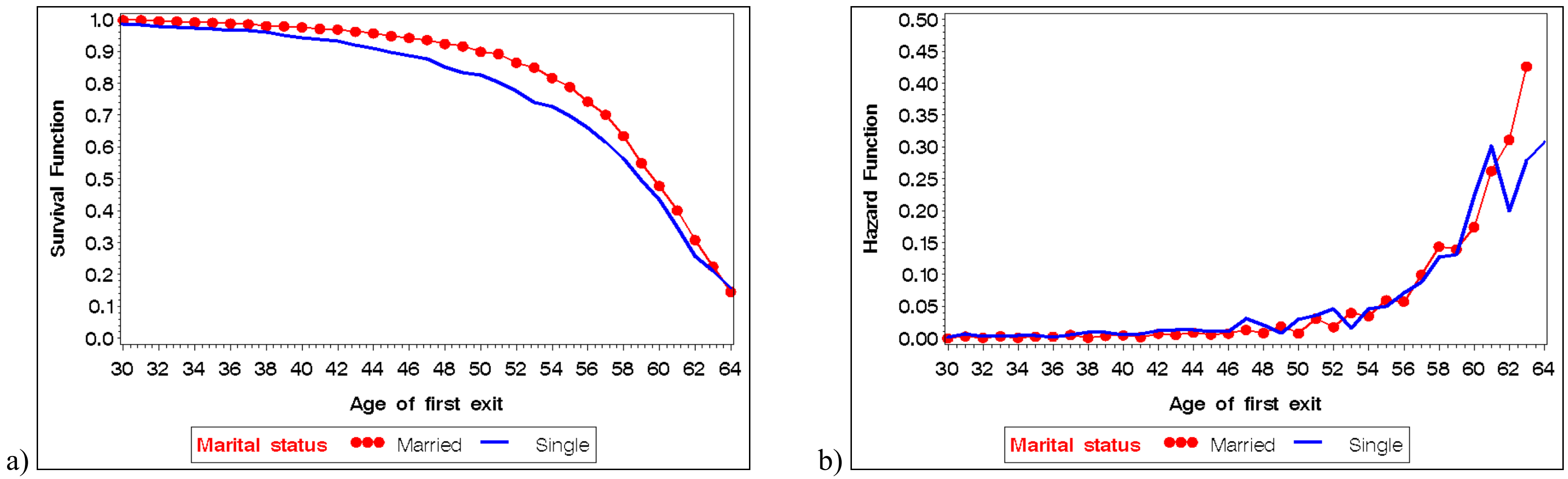
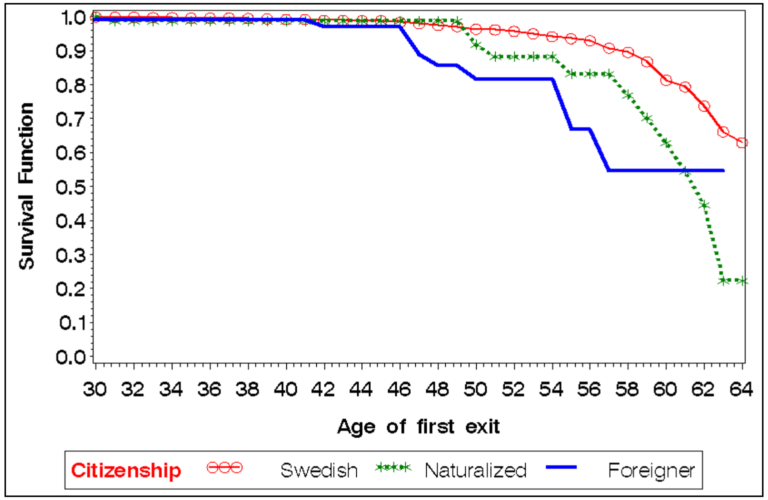


Figure 7 Plots of survival (a) and hazard (b) functions by marital status; LSIP sample.

a) 

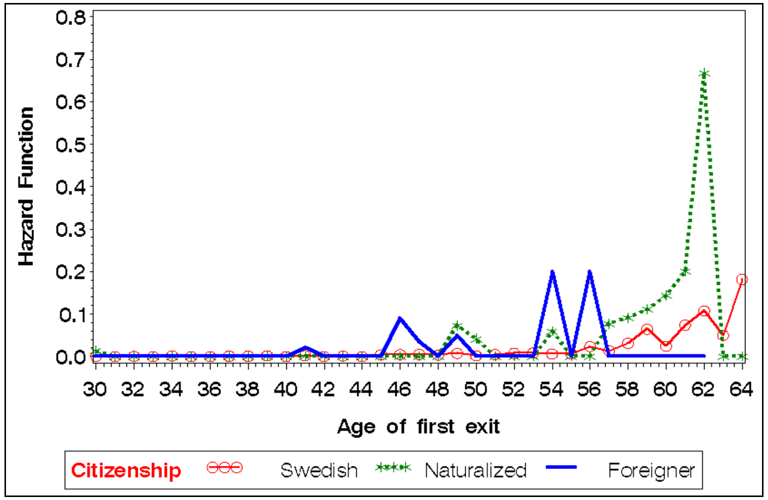
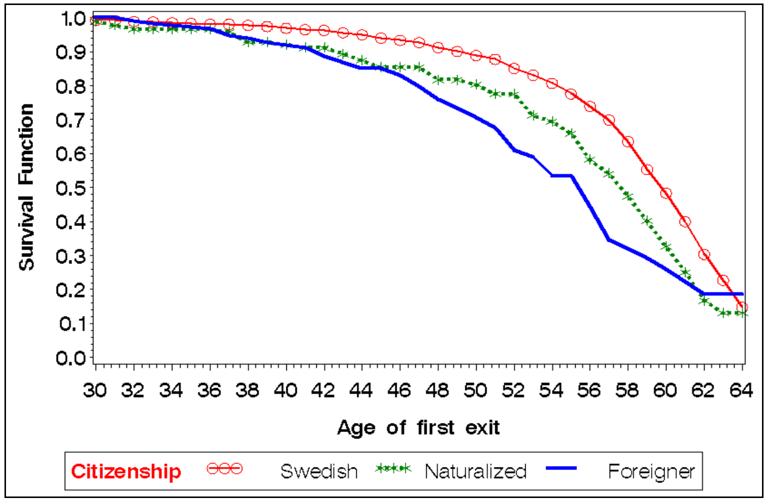
b) 

Figure 8 Plots of survival (a) and hazard (b) functions by citizenship; IP sample.

a) 

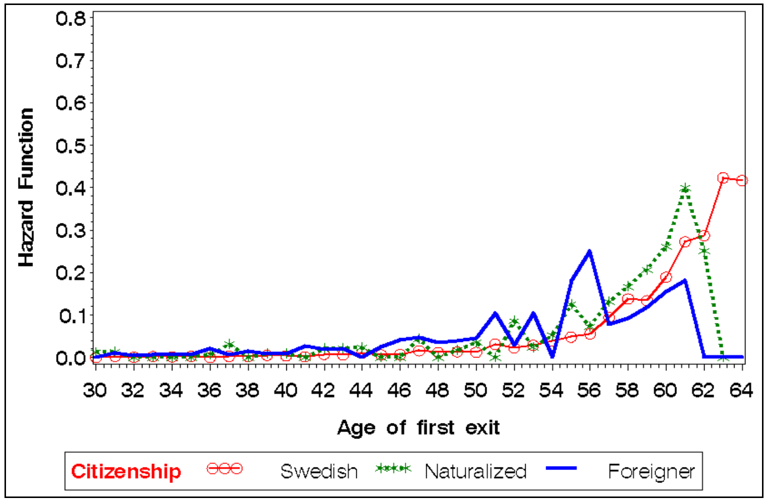
b) 

Figure 9 Plots of survival (a) and hazard (b) functions by citizenship; LSIP sample.

a) b)

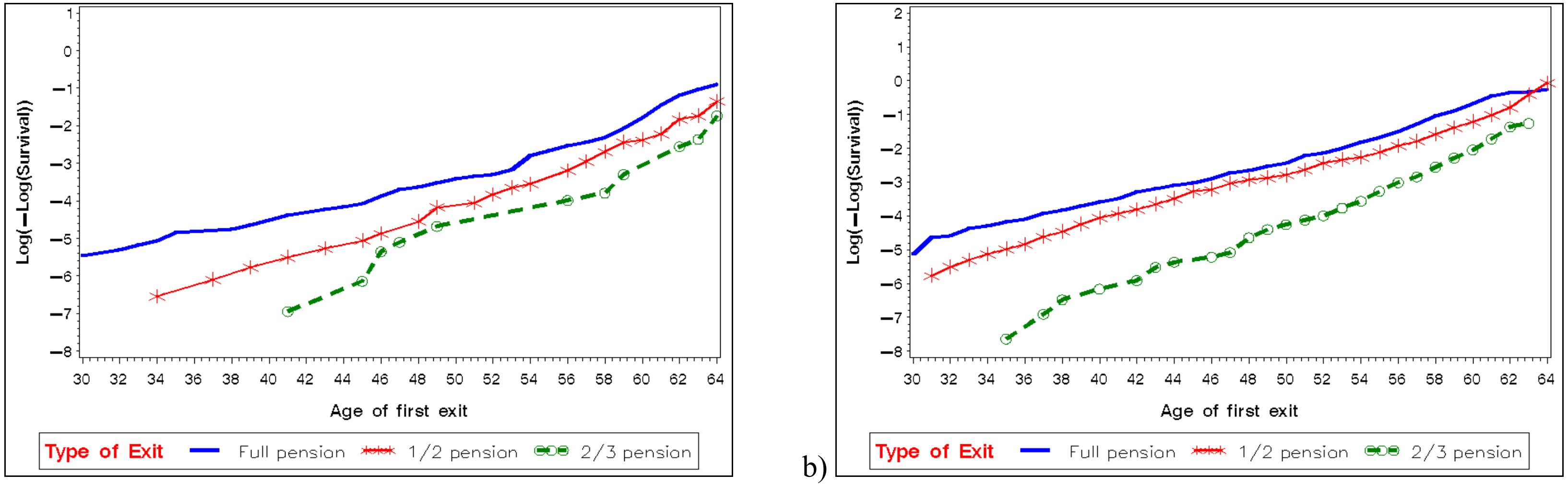


Figure 10 Log-Log survival plots- Exits with full or partial disability pension, IP (a) and LSIP (b) samples

a) b)

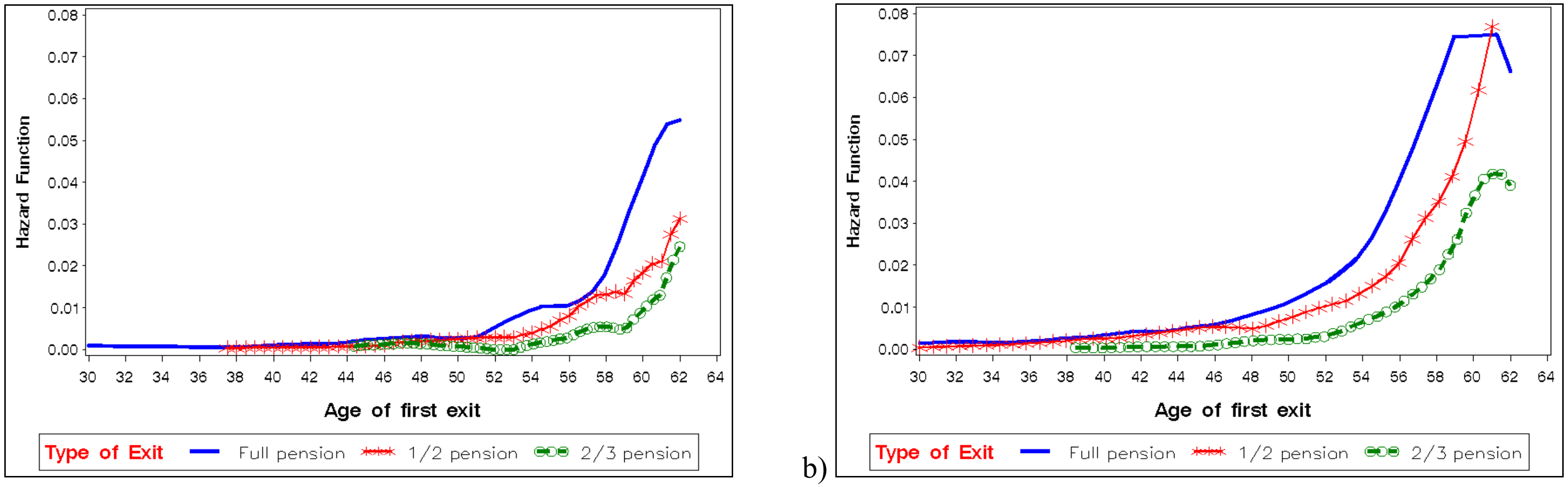


Figure 11 Smoothed hazard functions- Exits with full or partial disability pension

7.2 Semiparametric results

We will now look at whether the effects of covariates were the same or different across exit types, when analyzed with a Cox model for all types of exit, and separately for each type. Table 3 shows the estimates for the (general) IP sample, and for the (previous long-term sickness) LSIP sample. These are discussed separately.

For *the IP sample*, considering all exits together, except gender, marital status and educational level dummies, all other variables are statistically significant by conventional criteria. Naturalized Swedes were three times as likely as Swedish born people to leave the labor force earlier due to disability at any given age, while foreigners were about 5.13 times as likely at any age. citizenship may be a proxy for culture and attitudes toward work, as well as, human and perhaps health capital when starting working. Many of those who are not Swedish born immigrated to Sweden before 1973, during a period characterized mainly by an economically motivated migration. Given the health and human capital at that time (which not necessarily were the same as for Swedish born people), if they had jobs that required mainly (heavy) physical effort, the results here would not be unexpected.

Previous history of sickness in other spells mattered: For each one hundred days of previous sickness there was about a 25% increase in the risk of exit, but for each additional spell of sickness there was a decrease of 7.9% in the risk of disability exit.

Regional unemployment was also a significant push factor for exit: Each one percent increase in the regional unemployment rate was associated with about a 30% increase in the risk of exit due to disability.

Table 3 Semiparametric estimates for single-risk and competing-risks models of first exit due to disability, IP and LSIP samples

Variable	All exits			Full Pension			Partial Pension		
	β	Std Err	HR	β	Std Err	HR	β	Std Err	HR
IP-sample									
Women (CG: men)[a]	0.04	0.21	1.04	-0.07	0.26	0.93	0.29	0.35	1.34
Married (CG: unmarried)	-0.06	0.22	0.94	-0.28	0.28	0.76	0.49	0.38	1.63
Education level (CG: low)									
Medium	-0.01	0.27	0.99	-0.59	0.40	0.56	**0.75**	0.41	2.13
High	-0.25	0.42	0.78	**-1.10**	0.62	0.33	**0.92**	0.57	2.52
Citizenship (CG Sw born)									
Naturalized Swede	**1.12**	0.30	3.06	**1.71**	0.34	5.53	-0.55	1.02	0.58
Foreigner born	**1.63**	0.35	5.13	**2.25**	0.39	9.52	0.02	1.03	1.02
Rehabilitation type									
Vocational	**0.74**	0.30	2.09	-0.36	0.44	0.70	**2.06**	0.44	7.85
Medical	**1.13**	0.31	3.11	**0.93**	0.40	2.53	**1.69**	0.49	5.44
Sickness days before exit[b]	**0.23**	0.02	*25.60*	**0.29**	0.03	*33.00*	**0.14**	0.04	*15.00*
Sickness spells before exit	**-0.08**	0.02	*-7.90*	**-0.13**	0.03	*-12.50*	-0.03	0.03	*-3.40*
Earnings (1000 SEK)	**0.00**	0.00	*-0.30*	0.00	0.00	*0.00*	**-0.01**	0.00	*-0.90*
Regional unemployment	**0.27**	0.08	*30.50*	**0.36**	0.10	*42.60*	0.13	0.13	*14.20*
Testing H_0: BETA=0[*]									
Likelihood ratio	225.45			165.56			97.61		
Score	394.64			247.84			226.97		
Wald	251.07			154.31			115.23		
-2 Log-likelihood[c]	1289.9	1064.5		819.8	654.2		472.4	374.8	
Events| censored cases	116	1680		74	1722		42	1754	
LSIP-sample									
Women (CG: men)	-0.01	0.08	0.99	0.05	0.10	1.05	-0.08	0.14	0.93
Married (CG: unmarried)	**-0.20**	0.08	0.82	**-0.23**	0.10	0.79	-0.16	0.14	0.85
Education level (CG: low)									
Medium	-0.08	0.11	0.92	**-0.27**	0.14	0.76	0.23	0.17	1.26
High	**-0.41**	0.18	0.66	**-0.74**	0.24	0.48	0.20	0.28	1.22
Citizenship (CG: Sw born)									
Naturalized Swede	**0.52**	0.14	1.68	**0.66**	0.17	1.94	0.18	0.26	1.19
Foreigner born	**0.90**	0.15	2.46	**1.02**	0.18	2.77	**0.55**	0.27	1.73
Rehabilitation type									
Vocational	**0.59**	0.10	1.80	**0.27**	0.13	1.31	**1.12**	0.17	3.07
Medical	**0.64**	0.10	1.90	**0.67**	0.13	1.95	**0.55**	0.18	1.73
Sickness days before exit	**0.11**	0.01	*11.90*	**0.13**	0.01	*14.00*	**0.07**	0.02	*7.4*
Sickness spells before exit	**-0.09**	0.01	*-8.20*	**-0.10**	0.01	*-9.50*	**-0.06**	0.01	*-5.4*
Earnings (1000 SEK)	**0.00**	0.00	*-0.30*	0.00	0.00	*-0.10*	**-0.01**	0.00	*-0.8*
Regional unemployment	**0.06**	0.03	*6.10*	**0.13**	0.04	*14.10*	**-0.11**	0.06	*-10.5*
Testing H_0: BETA=0[*]									
Likelihood ratio	580.55			430.68			213.48		
Score	633.91			470.87			235.20		
Wald	598.76			438.53			221.36		
-2 Log-likelihood	8941.7	8361.1		5934.3	5503.6		3031.5	2818.0	
Events| censored cases	700	1926		461	2165		239	2387	

Note: The estimates in **bolds** are significant at the 10%-level. [*]For all models, the degrees of freedom (DF), is 12, and the chi-square statistic is significant beyond 0.001 level; [a] CG is the comparison group; [b] in hundred; [c] the first value for the case without covariates, and the second value for the case with covariates. *Italics* for hazard ratio (HR) indicate that for the continuous variables it had been recomputed as *phr* = 100*(*HR*-1).

When a distinction was made among different kinds of exit (i.e., full or part-time) in the IP sample, it was found that compared to people with lower education, higher education decreased the hazard of exit with a *full* disability pension, but increased hazard of exit with partial disability benefit. The first result can be attributed to investment in health, but also by different work environments and working conditions for persons with low and high education. The second result may indicate that it is easier for persons with higher education to remain in the workforce (at least partially).

Foreign-born people were about 9.5 times as likely as Swedish born to exit with a full disability pension, while naturalized Swedes were about 5.5 times as likely. This can be the result of different cultural background, and/or different health and human capital, but also it can be related to occupation, work environment and working conditions.

Being in a rehabilitation program (both vocational and medical) increased the probability of exit with a part-time benefit, but being in a vocational rehabilitation had no significant impact on exit with full disability. This may mean that participation in a rehabilitation program could be considered somewhat successful, in that some people can combine part-time work with partial benefit.

For *the LSIP sample*, when no distinction was made among different kinds of exits (i.e., considering all exits together), except dummies for gender and medium level of education, all other variables were statistically significant at the 10% level. The hazard of exit for married people was about 80% of the hazard of singles. The hazard of exit for higher educated people was about 66% of the hazard of lower educated people, and even lower (about 48%) for exits a with full benefit.

Naturalized Swedes were about 1.7 times as likely to exit due to disability as Swedish born people, while the foreign born were 2.5 times as likely as the Swedish born. These proportions were even higher for full benefits, and lower for part-time benefits.

Being in a rehabilitation program (both vocational and medical) increased the probability of exit: Those who participated in a vocational rehabilitation program were about 1.3 times as likely to exit with full benefit as those who had not, and about 3.07 times as likely to exit with a part-time benefit. Those who participated in a medical rehabilitation program were about 1.9 times as likely to exit with full benefit as those who had not, and about 1.7 times as likely to exit with a part-time benefit. It seems that vocational rehabilitation had a higher impact on the decision of part-time pensions, while medical rehabilitation had a higher impact on exits with full pension. This may be associated with likelihood for persons with more severe medical problems to require medical rehabilitation, whereas vocational rehabilitation provides a means to remain active at least part-time.

Previous history of sickness had significant effects on the hazard of exit: For each one hundred days of previous sickness there was about an 11.9% percent increase in the risk of exit, and even higher (about 14%) for full pensions, but lower (about 7.4%) for part-time benefits. On the other hand, each additional *spell* of previous sickness was associated with about a 8.2% decrease in the risk of exit. As we have seen in the descriptive statistics of the samples, persons with a previous history of long-term sickness often have a history of many spells. One possible explanation of this is that previous sickness spells give people the opportunity to recuperate, thus delaying or avoiding exit due to disability. This is a result that supports the belief that preventing and controlling the deterioration of the health capital of people would decrease the number of exits from the labor market due to disability.

Unemployment was again a significant push factor: Each one percent increase in the regional unemployment rate was associated with about 6.1% increase in the risk of exit, and even higher (14.1%) for full pension; and it was associated with about 10.5% decrease in the risk of exit with part-time benefit, which can be related to the fear of getting unemployed.

The likelihood-ratio chi-square statistic for the null hypothesis that the explanatory variables have *identical coefficients across destination types* is significant at well beyond the .01 level for both IP and LSIP samples, and therefore we reject the hypothesis.[81] These results suggested that the analysis must be done by exit type. In the

[81] The test was constructed by summing log-likelihood values for the model *with covariates* (multiplied by –2) for full and partial pensions and then subtracting this from the log-likelihood value for the model with covariates (multiplied by –2) for all types combined. There were 12 degrees of freedom, corresponding to the difference between the number of coefficients when models for the three types were estimated separate, and the number of coefficients when the model for all types together was estimated.

next step the frailty model was estimated by grouping the individuals by type of exit.

7.3 Estimation results for the frailty model

The gamma frailty model was fitted to the "single-risk" data (i.e., exit due to disability regardless of the pension type), which was grouped by the type of pension, and the coefficients were estimated by applying the Expectation Maximization (EM) algorithm. For the IP sample the EM algorithm could not find a higher value for the likelihood function than the one that corresponds to the model without frailty. Table 4 presents these results only for the LSIP sample. The unobserved heterogeneity variable is not significant by conventional criteria, but the gender variable is significant now (while in the model without unobserved heterogeneity it was not): Women were about 1.3 times as likely as men to exit due to disability. Nevertheless, even though unobserved heterogeneity was included in the model, marital status, citizenship, vocational and medical rehabilitation, sickness days before exit and regional unemployment rate still were highly significant estimates (not very different in size from the estimates of the model without unobserved heterogeneity). The educational dummies (considered as being good proxies for occupation, job characteristics and working conditions) were not significant by conventional criteria. Of course, if it had been available additional information, for example about occupation, job characteristics and working conditions, etc. would have been useful in analyzing labor market exits due to disability.

Table 4 Estimates of the frailty model. LSIP sample

Variables	Parameter Estimate	Standard Error	Hazard Ratio
Frailty	**4.80**	3.90	112.73
Women (CG: men)[a]	**0.23**	0.08	1.26
Married (CG: unmarried)	**-0.22**	0.08	0.80
Educational level (CG: lower)			
Medium	0.04	0.11	1.04
Higher	0.09	0.18	1.10
Citizenship (CG: Swedish born)			
Naturalized Swede	**0.32**	0.14	1.37
Foreigner born	**0.74**	0.15	2.10
Rehabilitation type			
Vocational	**0.52**	0.10	1.68
Medical	**0.59**	0.10	1.81
Sickness days before exit (100)	**0.07**	0.01	7.60
Sickness spells before exit	-0.01	0.01	-0.94
Earnings (1000 Swedish kronor)	**-0.00**	0.00	-0.12
Regional unemployment rate (%)	**0.08**	0.03	7.92
Kendall's tau	**0.70**		
-2 Log-Likelihood (without| with covariates)	5397.96	4671.72	

Note: The **bold** estimates are significant at the 1%- level; [a] CG is the comparison group; *Italics* for hazard ratio (hr) indicate that for the continuous variables it had been recomputed as phr = 100*(hr-1).

The results from this section show that there are differences between different types of exit into disability, and that the unobserved heterogeneity must be used when not enough information is available.

8 Summary and conclusions

The risk of exit due to disability at a certain age, conditional on having remained in the labor force until that age, was analyzed. After age 55, women in the LSIP sample had a higher hazard of exit than did men, but this was not the case for the IP sample. This difference indicates that more research should be done using different groups of people. From our duration analysis, we learned that if women were long-term sick, we would expect that they would exit into disability much faster than men. Therefore, one obvious proposal for policy would be that more resources should be allocated for preventing long-term sickness in general, but especially focus on the work environment for women.

It was also found that the hazard of early exit was lower for married people than for singles, while naturalized Swedes and the foreign born were more likely to exit earlier than Swedish born people. Participation in a vocational rehabilitation program increased the risk of exit with a partial disability, which could imply that rehabilitation was in a way efficient (in the sense that people are kept in the labor market). Those who were long-term sick and participated in a medical rehabilitation program were about 1.9 times as likely to exit with full benefit as those who had not, and about 1.7 times as likely to exit with part-time benefit, while those who participated in a vocational rehabilitation program were about 1.3 times as likely to exit with full benefit as those who had not, and about 3 times as likely to exit with a part-time benefit. For persons with more severe medical problems, this may be associated with likelihood to require medical rehabilitation, whereas vocational rehabilitation may provide a mean to remain active at least part-time.

Reducing the incidence and severity of disability in a population involves changes in the social and physical environment at work, changing attitudes towards what is required of especially older workers and what individuals should require of themselves in society, as well as changing individual performance (by improving physical capacity, learning new skills, being flexible enough to change tasks/jobs, etc.). Therefore, the health and educational systems should be developed in such a way to make it easier for individuals to achieve human and health capital that would allow them to reach a higher level of welfare. The development of strategies to reduce “disability dependence” thus requires detailed understanding of the underlying systems for rehabilitation and financial support, including the structure of the support and service system, the routes by which one enters it, and those by which one can exit, as well as the characteristics of the worker who becomes disabled.

More effort should be made to design flexible programs that can be adapted to individual needs. Making the alternative of returning to work more attractive, would reduce the economic burdens on society, and it would improve the quality of life and self-esteem of many employees who otherwise might have become disabled as well.

The decision to exit the labor market is an extreme alternative, and is not always the best alternative for the individual. On the other hand, even supposing that it is accepted that working some hours has a positive impact on individuals with health problems, it is difficult to match individuals with available jobs on the market. In such conditions, the process of integrating these people in the labor market becomes very complex, and it requires resources allocated on both sides: training and/or vocational rehabilitation of those individuals, and the improvement of the working conditions and rethinking the job tasks in general. Even with these improvements, disability will always be a very complex phenomenon that requires dynamic and flexible policies aimed to a better well being of the individuals themselves, and the welfare of society in general.

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Appendix The definition of disability

The World Health Organization made an attempt in 1980 to find a way out from the dilemma of a right term for disability by issuing the International Classification of Impairments, Disabilities, and Handicaps (ICIDH). “Disability” was defined as “any restriction or inability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being”. ICIDH was criticized as model of consequence of disease in the following years, and a new version, ICIDH-2, is currently being drafted. It differs substantially from the original one,[82] being *a classification of human health and disability*, systematically arranged according to somatic, psychological and social levels. Both a “medical model” and a “social model” have been proposed for understanding and explaining disability and health.[83] The medical model views disability as “a personal problem, directly caused by disease, trauma or other health condition, which requires medical care provided in the form of individual treatment by professionals”. The social model, on the other hand, views the disability mainly as “a socially created problem, and principally as a matter of the full integration of individuals into society”.

Under the medical approach, the management of the disability is aimed at cure or the individual’s adjustment and behavior change, while under the social approach, it is the collective responsibility of society at large to make the environmental modifications necessary for the full participation of people with disabilities in all areas of social life.

Medical care is viewed as the main issue, and at the political level the principal response is that of modifying or reforming healthcare policy, while environmental changes is viewed as an attitudinal issue, which at political level becomes a question of human rights.

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[82] ICIHD has moved away from its old focus on the impacts of diseases or other health conditions (the 1980’s “consequence of disease” classification) to a new focus on what constitutes health (today’s “components of health” classification).

[83] The term “model” here means an explanatory style or paradigm.