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**DEVELOPMENT OF INCOME FOLLOWING SICKNESS  
ABSENCE FROM THE WORKPLACE OR LONG-TERM  
UNEMPLOYMENT, AND AMONG INDIVIDUALS WITH  
MULTIPLE SCLEROSIS**

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# Development of income following sickness absence from the workplace or long-term unemployment, and among individuals with Multiple Sclerosis

## THESIS FOR DOCTORAL DEGREE (Ph.D.)

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Till Matilda och John



## ABSTRACT

The overall aim of this thesis was to gain knowledge of how reduced work capacity due to morbidity is associated with subsequent individual economic outcomes and how different components of the Swedish welfare system were used to cover individual economic loss. This was investigated in four empirical studies using population-based Swedish register data for individuals in working ages in the time period 1995 to 2011. The four studies were based on the Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA), linked with register data from the Swedish Social Insurance Agency and the National Board of Health and Welfare.

In Study I, transitions between three labour market states over a period of 15 years among individuals who initially (1995) had no or limited income from work were studied. This state was defined as “jobless” and consisted mostly of individuals on long-term unemployment. The three studied states were; 1) “Jobless” (i.e., the inclusion criteria), 2) “Self-sufficient” (main income from work), and 3) “Disabled” (main income from the Swedish sickness insurance system). Fifteen years later, more than half of the study population were mainly self-sufficient (i.e., their main income was from work) whereas a smaller proportion were dependent on benefits from the unemployment office or sickness insurance benefits. The results indicated a health selection in transitions from “jobless” to other states. Those with low morbidity were subsequently to a higher degree in paid work compared to those with high morbidity, who were more likely to be unemployed or on sickness insurance benefits. Transitions into paid work were higher in a period with decreasing nationwide unemployment. Finally, although socio-demographic characteristics, such as health status and nationwide unemployment were all significant factors, the individual’s preceding state was the best predictor of his/her subsequent labour market position.

In Study II, associations between being on compensated sickness absence (SA), with different diagnoses and different durations of absence, and the subsequent levels of individual disposable income were investigated. Compared to the reference group without a previous SA spell, those with a previous spell of SA had lower subsequent disposable income, 2–6 years after a SA spell. The differences were most pronounced for persons diagnosed with a mental diagnosis and for persons with longer spells of SA.

In Study III, incomes from work and from different social compensation systems were analysed among individuals with Multiple Sclerosis (MS), including the relation of these to the time following the initial MS diagnosis. Comparisons with a sample of individuals drawn from the general population without MS were then conducted, regarding sources and levels of income in the year 2010. The results indicated that MS patients were overrepresented, in relative and absolute terms, regarding health-related benefits and that they had lower levels of earnings. This was more pronounced the longer the elapsed time since the MS diagnosis. However, the welfare system provided considerable financial compensation.

MS patients’ earnings from ten years prior to and up to five years after the time of the first diagnosis were analysed separately in Study IV. The results showed increasing heterogeneity in the levels of earnings from one year before diagnosis until five years after diagnosis (end of study). The largest differences between the individuals with MS and the reference group – i.e., individuals without MS - were found for persons with lower levels of education and in less qualified types of occupations. Individuals with MS were also overrepresented in the usage of Swedish sickness insurance,

measured as the prevalence of insurance for temporary sickness absence from work and disability pension.

In summary, transitions from long-term unemployment into work were found to be negatively correlated to previous severe health problems. Further, compared with the alternative of not being on compensated sick leave, compensated SA was associated with a worse individual financial situation up to five years after the initial spell of absence. This was especially the case for persons whose SA was due to a mental diagnosis. For persons with a MS diagnosis and depending on the time elapsed since the initial diagnosis, the degree of the self-sufficiency of earnings from work varied greatly. With time an increasingly larger number received increased support from sickness insurance, i.e., sickness compensation for temporary sick leave and disability pension. Furthermore, a socio-economic gradient was identified among the MS patients. The earnings of individuals with MS with lower levels of education and employed in manual occupations were affected more negatively than those with higher levels of education and in white-collar occupations.

# SAMMANFATTNING

Avhandlingens övergripande syfte var att utöka kunskapen om hur nedsatt arbetsförmåga i samband med sjukdom eller skada påverkar individers efterföljande arbetsmarknadsutfall. Vidare undersöktes hur olika komponenter av det svenska välfärdssystemet ersatte eventuella ekonomiska förluster för individen. Det övergripande syftet undersöktes i fyra empiriska studier, baserat på populationsregister för individer i arbetsför ålder under tidsperioden 1995-2011. De fyra studierna baserades på datamaterialet "Longitudinell integrationsdatabas för Sjukförsäkrings- och Arbetsmarknadsstudier" (LISA), med länkade registerdata från Försäkringskassan och Socialstyrelsen.

I Studie I undersöktes individers övergångar mellan tre arbetsmarknadspositioner över en period på 15 år. Studiepopulationen bestod ursprungligen (år 1995) av individer utan eller med mycket begränsade inkomster från arbete, en arbetsmarknadsposition som definierades till "jobless" och mestadels bestod av långtidsarbetslösa individer. De tre arbetsmarknadspositionerna som studerades var 1) "jobless" (dvs. urvalsgruppen), 2) "Self-sufficient" (huvudsaklig inkomst från arbete), 3) "Disabled" (huvudsaklig inkomst från det svenska sjukförsäkringssystemet). Vid slutet av studien var mer än hälften av studiepopulationen i arbetsmarknadspositionen "self-sufficient" medan en lägre andel var i de två andra arbetsmarknadspositionerna. Resultaten indikerade en hälsoselektion för övergångar från "jobless" till de andra arbetsmarknadspositionerna. De med låg sjuklighet (uppmätt genom dagar med slutenvård) var till högre grad i arbete jämfört med de med högre sjuklighet, vilka hade en större sannolikhet för efterföljande arbetslöshet eller försörjning av det svenska sjukförsäkringssystemet. Övergångar till arbete var högre under perioder med minskande arbetslöshet. Slutligen, även om socio-demografi och generell arbetslöshet var signifikanta faktorer, hade individens föregående arbetsmarknadsposition högst förklaringsvärde för individens efterföljande arbetsmarknadsposition.

I Studie II undersöktes relationerna mellan att få ersatt sjukpenning (SJP), för olika diagnoser och olika durationer, med individens efterföljande disponibla inkomst. Jämfört med en referensgrupp utan tidigare SJP-fall, hade de med ett tidigare SJP-fall lägre disponibel inkomst 2-6 år efter det ursprungliga SJP-fallet. Skillnaderna var störst för individerna med psykiska diagnoser och med långa SJP-fall.

I Studie III undersöktes inkomst från arbete och från olika komponenter av socialförsäkringen för individer med multipel skleros (MS), samt relationen mellan dessa inkomster och tiden sedan MS-diagnos. Jämförelser i nivå och förekomst av de olika inkomstslagen under år 2010 gjordes med ett urval från den totala populationen utan MS. Resultaten påvisade att MS-patienterna var överrepresenterade, både i relativa- och absoluta tal, för de hälsorelaterade inkomstslagen samt hade lägre nivåer av förvärvsinkomst. Detta var tydligast för MS-patienter med längst tid sedan MS-diagnos.

MS-patienters förvärvsinkomst ifrån tio år före diagnos till fem år efter diagnos undersöktes i Studie IV. Resultaten påvisade en ökad heterogenitet i nivå av förvärvsinkomst från ett år innan diagnos till fem år efter diagnos (slut av studie). Den största skillnaden mellan individerna med MS och referensgruppen (individer utan MS) observerades bland individer med lägre utbildningsnivåer och i typer av yrken med lägre kvalifikationskrav. Individer med MS var också överrepresenterade i nyttjande av det svenska sjukförsäkringssystemet (SJP, sjuk- och aktivitetsersättning).

Sammanfattningsvis visade studierna i avhandlingen följande resultat: Övergångar från långtidsarbetslöshet till arbete var negativt korrelerade med tidigare allvarliga hälsoproblem. Vidare

observerades ett negativt samband mellan SJP och efterföljande disponibel inkomst upp till fem år efter det ursprungliga SJP-fallet. Detta var tydligast för SJP-fall med psykiska diagnoser. Bland individer med MS, graden av självförsörjning i samband med förvärsarbete varierade med den tid som gått sedan diagnosen fastställdes, där längre tid var korrelerat med ökat nyttjande av sjukförsäkring. Vidare observerades en socio-ekonomisk gradient i förvärsinkomst bland MS-patienterna, där de med lägre utbildningsnivåer och i typer av yrken med lägre kvalifikationskrav påverkades mer negativt än andra grupper.

## LIST OF SCIENTIFIC PAPERS

- I. Wiberg M, Marklund S, Alexanderson K. "Transitions Between Compensated Work Disability, Joblessness, and Self-Sufficiency: A Cohort Study 1997-2010 of Those Jobless in 1995". *Population Research and Policy Review*, 2017 January; 36(1), 85-107.
- II. Wiberg M, Friberg E, Palmer E, Stenbeck M. "Sickness absence and subsequent disposable income: A population-based cohort study". *Scandinavian Journal of Public Health*, 2015 June; 43: 432-440.
- III. Wiberg M, Friberg E, Stenbeck M, Alexanderson K, Norlund A, Hillert J, Tinghög P. "Sources and level of income among individuals with multiple sclerosis compared to the general population: A nationwide population-based study". *Multiple Sclerosis Journal*, 2015 November; 21: 1730-1741.
- IV. Wiberg M, Friberg E, Palmer E, Tinghög P, Alexanderson K, Hillert J, Stenbeck M. "Earnings among multiple sclerosis patients compared to individuals without multiple sclerosis, in total and for different educational levels and types of occupations – a longitudinal population-based cohort study". *Manuscript*.

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## LIST OF ABBREVIATIONS

COD	Cause of Death Register
DP	Disability pension
ICD	International Classification of Diseases
LISA	Longitudinal Integration Database for Health Insurance and Labour Market Studies
MIDAS	Micro Data for Analysis of the Social Insurance
MS	Multiple sclerosis
OLS	Ordinary Least Squares
OR	Odds ratio
PAR	National Patient Register
SA	Sickness absence
SIA	Swedish Social Insurance Agency

# 1 INTRODUCTION

Negative consequences due to poor health can be studied from different perspectives; for example, in terms of societal costs or individual well-being. This thesis focuses on how health status affects the individuals' economic situation. Its focus is twofold: The first is how poor health is associated with and economic self-sufficiency through own earnings. The second is how supplementary incomes from sickness insurance and various other social compensation systems in the Swedish welfare system cover the gap when full earnings are reduced due to morbidity.

Throughout working life there can be periods when an individual is unable to support him/herself through paid work. Temporary or permanently reduced work capacity due to morbidity is a prevalent cause for not working [1]. Negative associations between morbidity and various labour market outcomes (e.g., earnings, worked hours, and early exits from the labour market) have been observed in previous studies [2]. The Swedish sickness insurance system is designed to provide economic compensation for lost income from work due to morbidity. Income loss due to temporarily reduced work capacity can be compensated by sickness absence (SA), and permanently reduced work capacity can be compensated by disability pension (DP) [3]. Sickness insurance compensation has a direct impact on the individual's income and constitutes a considerable cost for society.

There are, however, different reasons for why an individual is not participating on the labour market to full extent. One could be that the individual's skills are not in demand on the labour market. In this scenario, the individual does not have a reduced work capacity due to morbidity but is available for paid work. The problem resides primarily with the labour market conditions. Unemployment compensation fills an important function as a temporary solution to facilitate a transition into paid work. Further, sickness insurance and unemployment compensation have been shown to be negatively correlated, using both macro [4-7] and micro data [4, 8, 9], thus indicating a possibility of transitions between the two insurance systems. In addition to SA and unemployment compensation, there are also other forms of social compensation (e.g., social assistance) that can be of relevance in attempts to capture the full effect of morbidity on individuals' subsequent economic situation.

The rates of recovery from different diseases have a broad distribution, as mirrored by the difference in the duration of SA for various diagnoses [10]. It can therefore be difficult to infer results from general morbidity to a specific diagnosis and vice versa. It can be more fruitful to examine the data for distinctions between types of diseases that are chronic, and those that are not. Having a chronic disease can lead to reduction in work capacity and is therefore likely to result in less ability to provide for oneself economically solely through work and increase long-term dependence on both health care and income support such as compensated SA and eventually a transition to a DP. The likelihood of this is even greater if the chronic disease is progressive and/or where the onset of the disease is common in

working ages. Multiple Sclerosis (MS) is a chronic neurologic disease which has both these attributes [11], and two of the studies presented in this thesis are based on this example. Research on long-term effects of MS on subsequent labour outcomes is, however, still scarce, which enhances the importance of the results of these new studies.

In the following, the areas covered in this thesis are discussed in greater details, referencing the literature.

## **1.1 SOURCES OF INCOME**

Individuals' sources of income change over the life cycle. The main source of income among most individuals in working ages is from paid work – i.e., earnings. However, throughout the working life individuals' earnings are often complemented by additional sources of income. The likelihood of receiving these complementing (or, sometimes replacing) sources of income are sometimes influenced by the individual's health status, either directly or indirectly. An individual's level and sources of income can be used to describe his or her labour market situation.

There is, however, limited research performed using several types of economic outcomes. Different sources of income, especially earnings and income compensation from the social insurance system are often, by design, negatively correlated with each other. Therefore, it is important to take several types of income into consideration when analysing individuals' economic situations. This is particularly important in countries with comprehensive social security systems, such as Sweden. The studies in the present thesis analyse the associations between reduced work capacity due to morbidity and subsequent individual economic outcomes and how well different components of the Swedish welfare system cover lost earnings associated with morbidity.

## **1.2 HEALTH AND INCOME**

Individuals' incomes are studied in different academic fields and with different approaches [12]. For example, the determinants of earnings are studied in labour economics, where the wage rate is often viewed as being determined by the individual's productivity, as valued on the labour market. Individual productivity is viewed in terms of the individual's human capital, which encompass genetic inheritance, education, skills acquired through training and experience on the job and health status. The latter is particularly relevant in the context of this thesis, which studies the effects of poor health on individuals' supply of labour. In addition, research on how the level of financial compensation in different compensation systems affect behaviour in terms of incentives/disincentives is the standard economic approach on this topic [2, 8, 13]. In the sociological research tradition, more emphasis is put on contextual explanations instead of individual economic behaviour as in the economic tradition. Incomes are here commonly used to describe individuals' resources, often in terms of disposable income, in relation to others, aiming to describe socio-economic groups. In public health, there is a long tradition of research on risk- and protective factors for different diseases, comparing individuals in different socio-economic strata. For

example, studies have shown that the risk of acquiring so called “welfare diseases”, connected to poor nutritional and exercise habits is higher for individuals in low and even middle-income households. Also, awareness, and access to information on factors of importance for personal health maintenance is known to differ between socio-economic groups. The common denominator of all these three fields is the idea that studying individuals’ income is informative for acquiring knowledge of relevance for explaining differences in individuals’ life situations.

The possible direction of causation between poor health and income has been debated [12, 14-17]. In summary, the association between health and income is dual, health affects income, but income also affects health. For this reason, it is beneficial to bring together the insights from different research traditions.

### **1.3 ANALYSING SEVERAL SOURCES OF INCOMES**

As individuals can qualify for welfare benefits from different channels, studies of welfare systems are complex and there is often a negative correlation between different compensation systems, where receiving compensation from one component of the welfare system limits the possibility of receiving compensation from another component. Studying one compensation system, without taking other compensation systems into account, creates a risk for incorrect conclusions about the individual’s labour market and economic situation.

Depending on the aim of the study, different sources of income can be appropriate (e.g., earnings in studies on self-sufficiency). It can, however, be argued that in the ideal situation, studies on a welfare system should include all sources of incomes and the different components of the welfare system in question. However, to simultaneously study all possible sources of incomes is difficult in practice – both in terms of complex statistical methods required but also in terms of data availability. Different strategies have been used to deal with the stated complexity. For example, based on the individual’s main annual income, for example earnings, or compensated SA, individuals have been categorised into mutually exclusive groups [18, 19]. Such categorisation does, however, result in somewhat broad categories, and multiple incomes in a single year are not shown. A different approach is to use durations in different compensation systems to calculate transitions between different compensation systems and work. This strategy has been used in several recent publications from Denmark and Norway – both with similar welfare systems as Sweden [20-23]. In the present thesis, a combination of these two strategies was used to analyse transitions between several labour market states over a time period including both economic ups- and downturns.

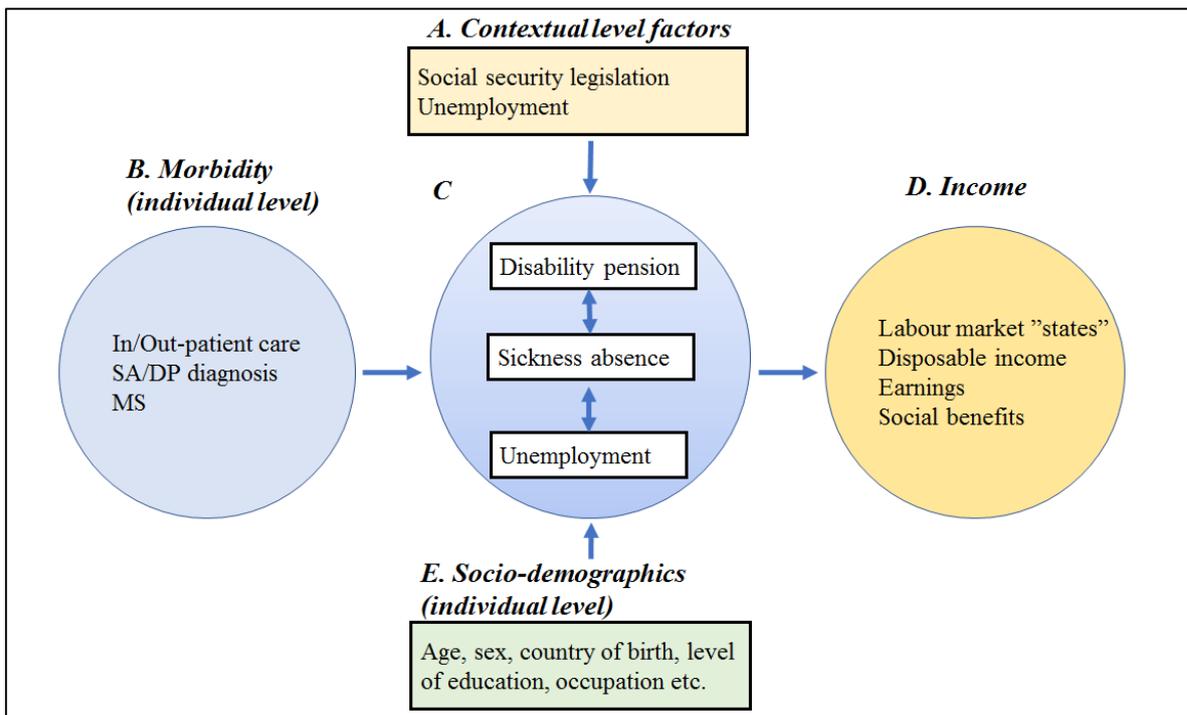
An alternative third strategy to analyse individuals’ sources of income separately is to analyse their disposable income, or their *equivalent* disposable income. Equivalent disposable income includes most information about an individuals’ economic situation, including household composition, although not informative with respect to the individual’s composition of income sources, and is often used to describe an individuals’ economic welfare situation. Even when an individual’s earnings decrease, for example due to the inability to work full-time, this can

be compensated by earnings of another member of the household. Whereas earnings are specifically work-related – equivalent disposable income includes all types of incomes in an entire household, and is more representative of the individual’s overall welfare [24]. Information on earnings and disposable income are both informative, from different perspectives, for individuals’ economic situations, and for this reason both are instrumental in the studies included in this thesis.

## **1.4 CONCEPTUAL FRAMEWORK**

A schematic representation of this thesis is presented in Figure 1. The figure centres on how receiving income from the sickness insurance system or unemployment benefits is associated with subsequent various forms of income. Both individual level and contextual level factors are likely to be influential in the estimating of such associations. It is also likely that these individual level and contextual level factors interact with income from the sickness insurance system or unemployment benefits, in which some factors can be protective from some forms of negative effects, whereas other factors could be enhancing. Furthermore, the factors in the central position in the figure: DP, compensated SA, and unemployment benefits, could be internally associated. The individual level factors can also affect the individual’s earnings, without the involvement of either the sickness insurance system or the unemployment insurance (not shown in figure).

This yields a complex relationship, with many different possible pathways and interactions. The studies in this thesis aimed to describe some specific parts of the associations presented in the figure. In Study I, associations between unemployment (“C” in figure) and subsequent labour market states (D) were analysed. Further, nationwide levels of unemployment (A) and how individuals' utilization of inpatient care (B) affected these associations were also analysed. In Study II, associations between sickness absence (C) and subsequent disposable income (D), and how this differed between different sick listing diagnoses (B) were investigated. In Study III associations between having MS (B) and different sources of incomes, summed and separately, were analysed. Further, compensation from the sickness insurance system (C) in different times since the initial MS diagnosis was considered. Similarly, in Study IV, earnings before and after MS diagnosis, by levels of education or types of occupations (E), were investigated. Furthermore, part and full time compensation from the sickness insurance system (C) were analysed in Study IV.



**Figure 1.** Overview of the conceptual structure of the thesis.

## 1.5 THE SWEDISH WELFARE SYSTEM

The Swedish welfare system includes a number of publicly financed compensation systems which are designed to provide economic security for both working and non-working individuals of different ages. In general, the systems redistribute resources between individuals with different levels of incomes and between different stages of the life cycle (e.g., from those in working ages to old-age pensioners) and from the self-sufficient to those who, for example, due to health problems, cannot be in paid work. The overall system of Swedish social benefits encompasses both insurance – for loss of earnings or the absence of earnings capacity – and other social benefits. Eligibility for insurance and other benefits is based on certain life events. A first group of events consist of events associated with giving birth and caring for children, e.g., child allowance, and parental leave in conjunction with child birth. Secondly, there are benefits based on the “loss of income” principle, where lost income, due to morbidity or unemployment is compensated to a ceiling. Most employees have additional insurance on top of the ceiling for the public benefits through a centrally negotiated labour occupational scheme. The third group consists of means tested benefits targeted at individuals with low levels of income to ensure a minimum acceptable standard of living. The social insurance and other social benefits Sweden are an important part of the overall welfare system, which also encompasses universal, publicly funded health care, schooling, etc. For working-age persons, the public benefit systems are, with some exceptions, centrally administrated by the Swedish Social Insurance Agency.

## 1.6 SICKNESS ABSENCE AND DISABILITY PENSION

The Swedish sickness absence compensation system covers temporary work incapacity due to morbidity, including absences caused by workplace accidents. In most cases, the first 14 days of a sick-leave spell are covered by the employer, with one (uncompensated) waiting day at the onset. SA from day 15 is covered by the national social insurance scheme which replaces about 80% of the income and a possible supplement of another 10% from an occupational insurance scheme, which about 90% of employees have. Incomes over a certain ceiling are, however, not compensated. The ceiling is annually calculated by Statistics Sweden. In 2010, about one third of the Swedish population, ages 20-64, had earnings above this ceiling, and as a consequence they were not fully insured in terms of the public sickness insurance system [25]. On the other hand, most are covered above the ceiling in the public system by an occupational scheme.

A disability pension (DP) can be granted to individuals with permanent, or for the foreseeable future, reduced work capacity due to morbidity. The replacement rate for DP is about 64% of lost earnings, or at a lower guaranteed flat rate level. The financial compensation is thereby compared to SA. Both SA and DP can be granted at four levels – 25, 50, 75 or 100% (i.e., full time) of ordinary working hours where at least 25% of the work capacity need to be reduced to be eligible for either compensated SA or DP [3]. Part-time SA enables work in the remaining time and can be used in several ways. For example, part-time SA can be granted from the start of the SA spell or at the end of a full-time spell as a part of a labour market reintegration [26]. Part-time absence can also be beneficial for the individuals in terms of remaining in part-time work and thereby lower risk of, for example, social isolation which could otherwise be a negative side-effect of the absence [27, 28].

Further, it should be noted that granting of both SA benefits and DP is on the basis of the individuals work capacity – the underlying morbidity are in themselves not the basis for compensation [3]. This means that, depending on the type of work the individual has, the same type of temporary or permanent disability can in some cases lead to a compensated spell of absence but not in other cases.

In Sweden and in other OECD countries, musculoskeletal diagnoses and mental diagnoses are presently the two most common diagnosis groups for granting SA [3, 10]. Notably, in recent years there has been an increasing trend of higher proportions of individuals on SA due to mental (often stress-related) diagnoses, a trend which has been especially pronounced among women [29, 30]. Further, spells due to mental diagnoses are often of long duration [29]. Subsequent labour market outcomes for individuals on SA due to a mental diagnosis are thereby likely to be negatively affected.

Previous research has identified several risk factors for receiving compensated SA. In a systematic review, it was summarised that individuals with lower levels of education, in higher age groups, and women were overrepresented among the individuals with

compensated SA [4]. Further, the association between higher age and SA is likely due to higher risks of morbidity in higher ages [4]. In Sweden, SA is more common among women than among men [29]. High domestic responsibility, and thereby a higher work burden, has been suggested to be a contributing factor for this difference [31, 32]. Further, individuals' level of education is often used as an indicator for socio-economic position, and which type of work the individual is currently working in, or alternatively has access to. In general, higher levels of education are associated with lower levels of SA – possibly due to higher flexibility over working hours or higher control over work tasks. Besides individual level factors, studies have also shown that contextual factors can be of importance, for example working in occupations which require more manual labour can increase the probability of receiving SA. This could be due to the degree of physical activity, but also the degree of control over work situation [4]. Further, the risk factors for receiving SA have also been shown to be risk factors for being granted DP [33-37].

Level of SA (measured as mean number of SA days/insured) has varied over time in Sweden. Associations between nationwide level of unemployment and level of SA have been observed in some countries [4-7]. Different explanations have been discussed regarding increasing or decreasing levels of nationwide unemployment. In periods of higher levels of unemployment, when available jobs are scarce, the individual's qualifications and health status could be more important – leading to a situation where it is harder to get a new job or to change jobs for those with a history of SA. Inversely, in times when demand is higher for workers from the labour market – there are more possibilities for employment, also for those with previous SA (i.e., a health selection on the labour market). An alternative, but not necessary contradictory, theory is that in times of economic downturns workers are more afraid to lose their jobs and are therefore less prone to show signs of lower productivity, e.g., by refraining from SA.

## **1.7 MULTIPLE SCLEROSIS AND WORK DISABILITY**

Severe chronic disease has been shown to be associated with poverty [38-41]. Welfare systems aim to provide security and help all individuals to achieve “life goals” - regardless of health status. Those with chronic diseases are possibly a particularly vulnerable group for which such ambitions can be especially difficult to achieve. Compared to individuals with temporary morbidity, many of the chronic ill are likely, depending on the severity, to be in need of both economic support and health care for the remaining part of their life. Further, age at onset varies between chronic diseases. If the onset is in working ages (or before normal labour market debut) there is a risk of adverse effects on the individual's opportunities on the labour market, an effect that would persist until end of working life – especially if the disease is progressive. It could also prevent a work debut completely. MS is an example of a chronic disease of the central nervous system, which often debuts in working ages of 20-50 years, and is often progressive in nature [11]. The present thesis includes two studies based on individuals with MS (hereafter “MS patients”) living in Sweden.

In a study of MS prevalence in Sweden 2008, it was found that the Swedish nationwide prevalence of MS was about 189/100,000 and that this was high compared to estimated prevalence's worldwide [42]. Since MS affects the central nervous system, the disease can cause both physical and cognitive disorder [11]. MS often progresses in bouts, in which several different patterns ("phenotypes") have been identified [43]. These phenotypes differ in, for example; time between bouts, age of onset, and disability at onset [44-47].

Progression of the MS is thereby heterogeneous. However, less is known regarding how having MS affects individuals' subsequent possibilities for self-sufficiency, and how this differs between MS patients. To gain generalizable knowledge on this requires long-term follow-up of a large number of MS patients. Most MS-related research is, however, based on data from specific clinics – in which such long-term analyses can be difficult to achieve.

Register-based research is a promising alternative. However, to date, register-based studies regarding MS patients' labour market outcomes are still few. There are, however, exceptions. For example, using Swedish register data, it has been shown that MS patients have high usage of the Swedish sickness insurance system for extensive periods of time [48, 49]. Further, two studies based on Danish register data, found a higher risk of unemployment, early exits from the labour market, and slower growth in disposable income among MS patients compared to a reference group from the general population. Also, this difference was observed already in the years before being diagnosed with MS [50, 51]. Further, for MS patients, it has also been suggested that the type of work (mainly: physical vs. non-physical) is of importance for the possibility of remaining in paid work [52-54]. Results from empirical studies analysing such effects are, however, limited.

As mentioned above, there are within-group variations among individuals with MS. That being said – studying a specific diagnosis, here MS, likely results in *less* within-group variation than analysing a group with various types of morbidity. This, in conjunction with a chronic disease with onset in working ages, makes MS of interest in studies on how a welfare system supports a continuation of working life.

## **1.8 POSSIBLE NEGATIVE EFFECTS OF BEING ON SICKNESS ABSENCE**

For individuals with reduced work capacity due to morbidity, being on compensated SA can provide an opportunity to recover lost work capacity and facilitate a return to work. Research has, however, shown negative associations between SA and subsequent labour market outcomes [4]. For example, in Sweden, being on longer spells of SA has been shown to be associated with a less favourable development of future earnings [55-58] or, being financially supported by other components of the social insurance system [18, 19]. A more detailed description of studies considering potential negative effects of being sickness absent on subsequent labour market outcomes is presented in Table 1.

Different potential mechanisms behind the observed negative associations between SA and individuals' subsequent labour market situations, beyond the underlying morbidity, have been discussed. For example, time away from the work-place could create a distancing from the

work-place and to fewer career opportunities or a loss of a social context which could enhance existing health-related problems. Further, having a history of SA can cause the individual to become more risk adverse resulting in less mobility on the labour market (e.g., less prone to change work place), thus forgoing the potential wage increase which is often associated with job change. Among individuals with a history of SA, it has been shown that those with higher labour market mobility were also more likely to remain on the labour market for a longer period than others [59]. This is a potential explanation of lower growth in earnings among those with previous SA – also for those remaining on the labour market [59, 60].

These effects could also be influenced by discrimination on the labour market, where employers are hesitant to hire individuals with a history of SA [55, 61-63]. The observed increased risk for unemployment could also reflect a social stigma concerning individuals with for example mental diagnoses as well as a more general employer concern vis á vis individuals they think could be prone to high SA [64-67]. Many diseases are chronic or of a reoccurring nature, especially musculoskeletal and mental disorders which increase the risk of subsequent SA [18, 61]. There is a parallel branch of research regarding unemployment where it has been shown that accumulated durations of unemployment are associated with a lower probability of returning to work [68]. Further, several studies have shown that long-term SA is associated with higher probabilities for subsequent early exit from the labour market with a disability in terms of a DP [62, 69-71].

**Table 1.** Studies of sickness absence and sources of income.

Author, year, country	Study design, data, study period	Exposure	Outcome	Results
Aittomäki et al., 2012, Finland [72]	Cohort study, register data, 1993-2006	SA (all) and low economic resources	SA and small economic resources	Two-way associations between SA and low economics resources.
Andersen, 2010, Denmark [57]	Cohort study, register data, 2000-2003, 2002-2005	Duration of all SA spells	Earnings	Negative associations between both short and long term SA and subsequent earnings
Andren, 2007, Sweden [73]	Cohort study, random sample from register data, 1986-1991	SA (>59 days)	RTW, DP (full or partial), other exits	Full or partial exits due to DP more common after long spells of SA.
Andren et al., 2008, Sweden [58]	Cohort study, register data, 1983-1988	SA (>59 days)	Earnings and hourly wages.	Negative associations between previous SA and subsequent earnings. The effect was through fewer worker hours rather than lower wage rates
Backhans et al., 2005, Sweden [65]	Cohort study, survey and register data, 1981-1999	SA (all), by duration and diagnosis	Social relations, labour market attachment, economic situation	Negative association between SA and the studied outcomes
Bryngelson, 2009, Sweden [64]	Cohort study, survey and register data, 1991-2000	SA (>59 days)	Social exclusion (measured by questions on cash margins and social contacts)	Negative association between SA and subsequent economic recourses and social conditions
Carlsen et al., 2012, Denmark [74]	Cohort study, register data, 2001-2009	SA (all) among cancer survivors	Transitions between: RTW, stay in SA, unemployment, or early retirement	About three in four were in employment at the end of follow-up. Socio-demographics were not associated with SA or RTW
Floderus et al., 2005, Sweden [66]	Cross-sectional, survey data, 2001.	SA (12-18 months)	Consequences on daily life	Negative effects (e.g., on leisure activities, and well-being) more prevalent than positive effect. Women experienced more positive effects than men
Hansen, 2000, Sweden [56]	Cross-sectional, survey and register data, 1991-1992	SA (all)	Wages	For women, short term SA was associated with wage loss. For men, no effect was found
Helgesson et al., 2015, Sweden [75]	Cohort study, register data, 1993-2008	SA (>59 days)	SA, DP, death, unemployment, and income from work	Increased risk for SA, DP, death and lower subsequent earnings
Hesselius, 2007, Sweden [63]	Cohort study, register data, 1998-1999	SA (all), by duration and incidence	Unemployment	Both longer duration and increased number of spells of SA was associated with subsequent unemployment
Hultin et al., Sweden, 2012 [61]	Cohort study, survey and register data, 2002-2007	SA (<30 days), and number of SA spells	SA, DP and unemployment	Repeated spells of SA increased risk (adjusted for health status) for long-term SA.

**SA:** Sickness absence, **DP:** Disability pension, **RTW:** Return to work.

**Table 1.** Studies of sickness absence and sources of income (continued).

Author, year, country	Study design, data, study period	Exposure	Outcome	Results
Hultin et al., Sweden, 2012 [62]	Cohort study, survey and register data, 2002-2007	SA (>30 days)	DP and unemployment	Increased risk (adjusted for health status) of both unemployment and DP
Markussen, 2012, Norway [55]	Cohort study, register data, 2001-2006	SA (all)	Earnings	Lower subsequent earnings among those on SA
Pedersen et al., 2012, Denmark [20]	Cohort study, register data, 2004-2008	SA (all)	Transitions between: work, unemployment SA, and DP	SA was associated with subsequent transitions towards lower work presence
Pedersen et al., 2016, Denmark [76]	Cohort study, survey and register data,	SA due to (self-reported) mental or other health problems	RTW	Longer spells of SA and lower probability of RTW among those with mental health problem compared to other health problems
Wikman et al., 2012, Sweden [18]	Cohort study, register data, 1995-2008	SA (>6 months)	Cohort 1: Main source of income. Cohort 1-3: RTW	Negative association between SA and RTW, stronger in cohort 3 compared to cohort 1 and 2
Virtanen et al., 2006, Finland [69]	Cohort study, employment records and register data, 1997-2000	SA (>15 days)	Job termination, unemployment, DP	Stronger association between work termination and unemployment among women in temporary employed in the public sector
Øyeflaten et al., 2014, Norway [23]	Cohort study, patient journals and register data, 2001-2005	SA (all)	Transitions between: Work, SA (full/partial), medical- and rehabilitation allowance, DP (full/partial)	Increased probability of DP among blue-collar workers, women, and other than mental or musculoskeletal diagnoses. Mental diagnoses were associated with full SA

**SA:** Sickness absence, **DP:** Disability pension, **RTW:** Return to work.



## **2 GENERAL AND SPECIFIC AIMS**

The overall aim of the present thesis was to gain knowledge on how reduced work capacity in association with morbidity influence individuals' subsequent economic outcomes and how different components of the Swedish welfare systems are used to cover individuals' economic loss. Four empirical studies were conducted to investigate the overall aim.

### **2.1 SPECIFIC AIMS**

#### **2.1.1 Study I**

To explore transitions between different labour market states among individuals who initially had low or no income from work, and how these transitions were affected by the individual's health status, individual characteristics, and the general demand for work in the labour market.

#### **2.1.2 Study II**

To investigate individuals' economic welfare after a spell of sickness absence, and the extent to which there is variation related to the duration or the diagnosis of the initial spell of sickness absence.

#### **2.1.3 Study III**

To analyse the composition of sources of incomes, in terms of prevalence and magnitude, among individuals diagnosed with Multiple Sclerosis. A second aim was to investigate if the composition of incomes differed with regards to the amount of time that had elapsed since diagnosis.

#### **2.1.4 Study IV**

To examine how having Multiple Sclerosis affects individuals' income from work and compensation from the sickness insurance systems and also to investigate if this differed between socio-economic groups, related to education and type of occupation.



### 3 METHODS

Methods used in the four studies included in the thesis are summarised in Table 2.

**Table 2.** Overview of the four studies.

	<b>Study I</b>	<b>Study II</b>	<b>Study III</b>	<b>Study IV</b>
<b>Research questions</b>	How is transition between labour market states affected by the individual's health status and the general labour demand among individuals with no/low income from work?	How does SA affect the individual's subsequent economic welfare? If so – does it differ by length of SA or between types of diagnoses?	Do MS patients' earnings and different types of social benefits differ with time since MS diagnosis?	How does MS affect individuals' income from work and use of the sickness insurance systems, and does this differ between socio-economic groups?
<b>Design</b>	Cohort study, piece-wise time periods	Cohort study, matched controls	Cross-sectional, matched controls	Cohort study, matched controls
<b>Follow-up period</b>	1997-2010	2007-2010	2010	2003-2006 (-10, +5)
<b>Study population; n</b>	Residents of Sweden 1995 with low/no income from work, aged 20-40 (n=638,622)	Residents of Sweden 2005, aged 30-54, excluding individuals with prevalent SA or DP (n=286,280)	Residents of Sweden 2010, aged 21-64 (n=83,874)	Residents of Sweden 2004, aged 30-54, excluding individuals with prevalent MS (n=10,137)
<b>Type of data/ Data sources/ and level of information</b>	Register data. LISA, MiDAS, PAR, COD. Micro data	Register data. LISA, MiDAS, PAR, COD. Micro data	Register data. LISA, MiDAS, PAR. Micro data	Register data. LISA, MiDAS, PAR, COD. Micro data
<b>Outcome</b>	Labour market status (mutually exclusive); Self-sufficient, Disabled, Jobless	Disposable income (individualised from household income)	Earnings, Compensated SA, DP, Disability allowance, Social assistance, Unemployment benefits	Sum of earnings and student allowance
<b>Diagnoses included</b>	All	Cancer, Circulatory, Injuries, Musculoskeletal, Mental, and all	MS	MS
<b>Factors included</b>	Sex, age, educational level, country of birth, previous inpatient care, general unemployment levels	Sex, age, educational level, country of birth, living area, living with partner, number of children, diagnosis of SA spell, duration of SA spell, extent of SA spell, previous earnings, previous in- and specialised outpatient care	Sex, age, educational level, country of birth, living area, geographical area, family situation	Sex, age, educational level, type of occupation, country of birth, living area, year of MS diagnosis
<b>Statistical analysis</b>	Descriptive statistics, multinomial logistic regression	Descriptive statistics, OLS regression	Descriptive statistics, non-linear mixed regression	Descriptive statistics, Tobit regression

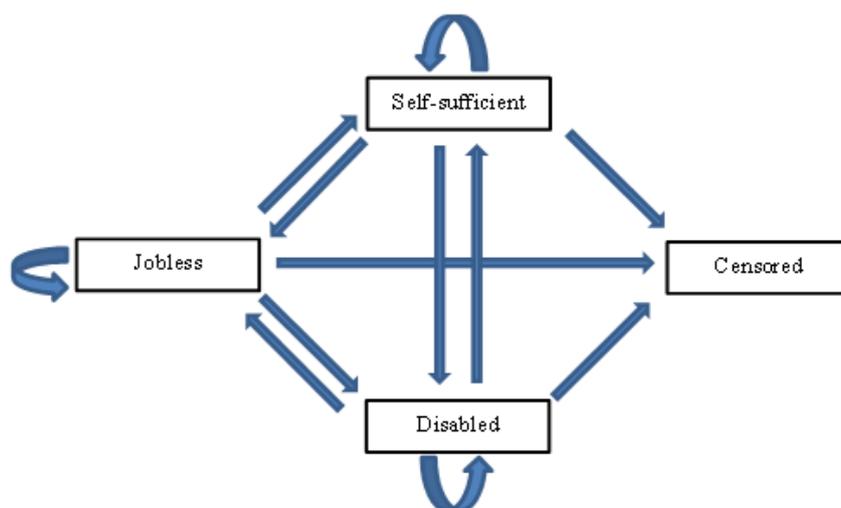
**SA:** Sickness absence, **DP:** Disability pension, **LISA:** Longitudinal Integration Database for Health Insurance and Labour Market Studies, **MiDAS:** Micro Data for Analysis of the Social Insurances, **PAR:** National Patient Registry, **COD:** Cause of Death Register, **OLS:** ordinary least squares, **MS:** Multiple Sclerosis.

### 3.1 DESIGN AND STUDY POPULATION

#### 3.1.1 Study I

Study I was based on all individuals living in Sweden on 31 December both in 1994 and 1995, aged 20-40 (n=2,514,459). Based on the individual's main source of income, each individual was annually (1995-2010) categorised into a labour market position, which was referred to as "state". The following states were identified: 1) low/no income but available for work: "jobless", 2) having main income from work: "self-sufficient", 3) not available for work due to morbidity: "disabled", and 4) individuals who had died or had emigrated were classified as old-age pensioners were censored: "censored". Since the study design required information on the individual's state in the previous period, no re-entries were possible for those that were censored.

Individuals in the first category (i.e., low/no incomes but available for work) in 1995 were included in the study (n=638,622). Transitions between, and within, these states were thereafter analysed during years of high (1997, 2005, 2010) and low levels (2001, 2008) of national unemployment (Figure 1).



**Figure 2.** Model for transitions between the four states jobless, self-sufficient, disabled, or censored (absorbing state). Transitions were determined in 1997, 2001, 2005, 2008, and 2010. All were jobless at the start of the study in 1995.

#### 3.1.2 Study II

Study II was based on all individuals living in Sweden on 31 December both in 2004 and 2005, aged 30-54. Individuals with an incident spell of SA for full time that lasted longer than 14 days in 2005 were considered to be exposed. In cases when the same individual had multiple SA in 2005, the longest spell was used. Propensity-score matching (1:1) was used to create a comparable reference group. The matching was performed using information on socio-demographics in 2005, on inpatient care, on specialised outpatient care, and for

earnings in 2001-2004. Individuals granted a partial or full DP in 2004 or 2005 were excluded from both groups prior to matching. The exposed and non-exposed constituted the study population (n=286,280). The outcome, equivalent disposable income, was compared between the exposed and non-exposed populations annually during the period of 2007-2011.

### **3.1.3 Study III**

Study III was based on all individuals living in Sweden on 31 December both in 2009 and 2010, aged 21-64 in 2010. Nationwide registers (MiDAS and PAR) were used to identify individuals with MS and their year of diagnosis, based on the International Classification of Disease (ICD) [77]. The first occurrence of a MS diagnosis (ICD 9: 340, ICD 10: G35) was used for inclusion of individuals in the study population (n=13,979). The year of diagnosis was used to create four sub-categories of MS patients (<2005, 2005-2007, 2008-2009, 2010). Based on socio-demographics among the MS patients in 2010, propensity score matching (1:5) was used to create a reference group (n=69,895). The sources of income analysed were: earnings, DP, SA compensation, disability allowance, unemployment compensation, and social assistance. All measures of income data were from 2010.

### **3.1.4 Study IV**

Study IV was based on all individuals living in Sweden on 31 December 2004. The first occurrence of a MS diagnosis (ICD 9: 340, ICD 10: G35) in nationwide registers (MiDAS and PAR) was used to identify individuals with MS and the year the diagnosis was established. Individuals diagnosed with MS in 2003-2006 aged 30-54 were included in the study population (n=2,553). Based on the year of diagnosis, these individuals were categorised into four panels (2003, 2004, 2005, 2006). For each panel, based on the distribution of sex and age among the MS patients, references were added using stratified matching (1:3). The outcome, earnings (including a student allowance where applicable), was analysed from ten years prior to diagnosis and extending until five years after the diagnosis.

## **3.2 DATA SOURCES**

All four studies were based on individual level data acquired from the following nationwide Swedish registers.

### **3.2.1 Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA)**

The Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA) is administrated by Statistics Sweden. LISA contains annual information on socio-demographics, labour market indicators and incomes from both work and from various social insurance and other public social systems, for individuals in ages above 16 who live in Sweden 31 December every year. The database contains yearly data from 1990 and onwards [78]. In all four studies, information on socio-demographics and incomes were obtained from LISA.

### **3.2.2 Micro Data for Analysis of the Social Insurance (MiDAS)**

The database Micro Data for Analysis of the Social Insurance (MiDAS) is administrated by the Social Insurance Agency and contains detailed individual information, including start- and end dates for spells of SA and for DP. MiDAS contains data from as early as 1994, however diagnoses in conjunction with compensated SA spells are available from 2005 and onwards.

In Study II, MiDAS was used to identify individual SA spells and diagnoses to categorize the exposed group and spell duration [79]. In Studies III and IV, MiDAS was used to identify individuals diagnosed with MS.

### **3.2.3 National Patient Register (PAR)**

The National Patient Register (PAR) contains nationwide information on both inpatient and specialised hospital based outpatient care. The PAR register includes the date of admission/discharge, the main- and potential secondary diagnosis for the admission (using ICD codes). The register is administered by the National Board of Health and Welfare. Information on inpatient care is available from 1964, but with full coverage from 1987, whereas data on outpatient care is available from 2001 [80].

In Study I, grouped number of days of previous inpatient care was used to control for individual differences in health status for each transition. Similarly, in Study II, both the grouped number of days of inpatient care and the grouped number of outpatient care visits were used to match references to the exposed group.

In Study III and IV, PAR was used to identify individuals diagnosed with MS by observing the first registered MS diagnosis, starting in 1987 and 2001 for inpatient care and outpatient care, respectively. In Study IV, individuals with diagnosed MS were also identified through the outpatient surgery register, available in the years 1997-2000.

### **3.2.4 Cause of Death Register (COD)**

The Cause of Death register (COD) was established in 1952 and is administrated by the National Board of Health and Welfare. The register contains detailed information, including date and cause of death with ICD codes for all registered deaths among Swedish residents [80]. In Study I, II, and IV, COD was used to identify individuals in the study population who had died during the follow-up.

## **3.3 EXPOSURES**

### **3.3.1 Labour market situation**

In Study I, labour market situations, in four categories, were repeatedly measured at five pre-determined time points over a period of 15 year among individuals initially on long-term unemployment (more than 180 days) or with limited incomes. Individuals' labour market situation changed over time and for this reason, the groups of individuals in each of these

categories differed at each time-period. All states were compared to each other. The derivation of the different states is described in more detail under the heading “Outcomes”.

### **3.3.2 Sickness absence**

In Study II, the exposure measure of SA was defined as an incident spell of SA with full extent and a duration of at least 15 days during 2005. Using ICD codes [77], SA diagnoses were categorised as: Cancer (C00-C97), Circulatory (I00-I99), Injuries (S00-S99, T00-T98), Musculoskeletal (M00-99), Mental disorder (F00-F99), and “other” (remaining diagnoses, including spells without a registered diagnosis). The duration of the SA spells was categorised as follows: 15-29, 30-89, 90-179, >179 days.

### **3.3.3 Multiple sclerosis**

In Study III and Study IV, individuals diagnosed with MS were analysed. Identification was based on their first registered MS diagnosis (ICD 9: 340, ICD 10: G35) in PAR or MiDAS. In Study III, patients with prevalent MS during 2010 were included in the study population (i.e., regardless of the time that had elapsed since the diagnosis). In Study IV, patients with incident MS diagnosis in 2003-2006 were included in the study population whereas individuals diagnosed with MS prior to 2003 were not included in the study population.

## **3.4 EXPLANATORY VARIABLES**

### **3.4.1 Socio-demographic factors**

Information on socio-demographic characteristics was included in all four studies to adjust for potential systematic differences between groups. In Study III and Study IV the results were stratified with regard to socio-demographics. Further, in Studies II, III, and, IV socio-demographics were used for the purpose of identifying a comparable reference population that had not experienced the exposure (described in further detail under heading “Statistical analysis”).

Age was included in all studies – both as a covariate and in the selection of the study population. Note that the number of analysed years prior to and after exposure differed between the four studies in the thesis. To ensure that all individuals were in economically active ages throughout the follow-up periods studied, a baseline age was set, although these baseline ages differed between the four studies: Study I (20-25, 26-30, 31-35, 36-40), Study II (30-37, 38-45, 46-54), Study III (21-24, 25-34, 35-44, 45-54, 55-64), Study IV: (30-34, 35-39, 40-44, 45-49, 50-54).

Sex was also included in all four studies.

Information about the individual’s household composition was included in Study I and Study II. In Study II, information regarding whether the individual was living with a spouse/partner or not (yes/no) and the number of children living at home (age <20) was included both at baseline as well as during the follow-up period for changes from the baseline values. In Study

III the individual's family composition (based on whether the individuals were living with a spouse/partner and having children under 20 years old living at home) was used to define the following four categories: 1) Spouse/Partner, no children, 2) Spouse/Partner, with children, 3) Single, no children, 4) Single, with children.

The highest level of attained education was included in all four studies. Level of education was categorised according to: lower, upper secondary, higher education [78].

In Study IV, annual information on individuals' type of occupation was included. Based on the level of specialised skill, a type of occupation normally requires that all occupations are categorised in a hierarchical order. The categorisation is used by Statistic Sweden and includes ten mutually exclusive groups [78]. In Study IV, these ten categorised were combined into five categories based on degree of physical demands: 1) Manager, 2) Office work, 3) Manual labour, 4) Unknown workplace (registered as working but no information on workplace) and, 5) No work (no registered work place). Individuals in the armed forces were excluded due to low number of observations and insufficient information to justify combination into one of the other types of occupational groups. In Study IV, type of occupation was measured both at the baseline year and in the year of follow-up.

In Studies II, III, and IV the population density of the municipality of residence was, in accordance with a definition set by Statistics Sweden, categorised into three groups: small, medium, and large [81]. In Study III, the geographical regions of Sweden were, in accordance with Eurostat's Nomenclature of Territorial Units for classification level 2 (NUTS1), categorised into: East, South/West, and North [81].

Country of birth was also included in all four studies. In studies I and IV country of birth was used as a binary variable: born in Sweden (yes/no). In Study II born in Sweden (yes/no) and years since immigration were used for those born outside of Sweden. In Study III the following four categories were used: born in Sweden, other Nordic countries, other EU25 countries, and other countries.

### **3.4.2 Health care consumption**

In Study I, the number of inpatient days was categorised (categorisation: 0,  $\leq$ median,  $>$ median) in the two years prior to the respective year of measurement (for example: in analysis of 2005, days of inpatient care in 2003-2004 were considered). In Study II, the same categorisation of inpatient care was used in matching a reference group to those who had experienced the exposure (i.e., SA in 2005). Specialised outpatient care, as a binary variable, was also used in the matching in Study II. For a more detailed description of the matching process see the section "Statistical analyses".

The number of days of inpatient care and number of visits in specialised outpatient care were calculated based on all hospital admissions except for normal child birth (ICD 10: O80), conditions for new-born/foetus originating the perinatal period (ICD 10: Chapter 16), and visits with health care (mainly observations, ICD 10: Chapter 21). The rationale was that

admissions due to these diagnoses are not necessarily informative for the individual's health status.

### 3.4.3 Period specific factors

Study I and Study IV included covariates aiming to separate time-specific effects. In Study I, the study population attributes were revised five times over a period of 15 years. The time points for evaluation were chosen to contrast high and low nationwide levels of unemployment, with the aim of accounting for job availability, i.e., the general demand for labour, and, thereby, to identify potential differences in health selection from long-term unemployment into work. In Study IV, the year of MS diagnosis (2003-2006) was included in the analyses to make it possible to account for possible time-dependent variations (e.g., diagnostic procedures and treatment methods).

## 3.5 OUTCOMES

### 3.5.1 Labour market situation

In Study I, yearly labour market positions (i.e., "states") were analysed from 1995 through 2010. These states aimed to describe individuals' proximity to the labour market and degree of economic autonomy. The states were defined based on individuals' main source of income in every year in conjunction with a classification from Statistics Sweden which indicated whether an individual was considered to be working or not in the corresponding year. These states were mutually exclusive and were derived through two steps; first by categorisation into 11 groups [18] and then collapsed into four states. See Table 3.

**Table 3.** Classification of states, all jobless at start of study, 1995.

State	Initial 11 groups
Jobless	1) Long-term unemployed, 2) Social assistance, 3) Minimal income
Self-sufficient	4) Working, 5) Long-term parental benefits, 6) Student allowance
Disabled	7) Disability pension, 8) Long-term sickness absence
Censored (absorbing state)	9) Old-age pension, 10) Dead, 11) Emigrated

The categorisation was based on the number of days of compensation from different social insurance programs (parental leave, registered unemployment, SA, and DP). If the annual sum of compensated days was more than 180 days within each type of compensation, the individual was categorised to that group. There was, however, no information about the number of days for the means-tested social assistance (re-determined monthly), for student

allowances (usually per term), or old-age pension. Therefore, those with more than half of their annual disposable income from either of these sources were categorized as social assistance recipients, students, or old-age retirees, respectively. In contrast to Study II, in which, equivalent household disposable income was analysed, Study I used individuals' actual disposable income for categorisation when the number of days was unavailable. The rationale was that Study I aimed to describe the individual's labour market position – not their economic welfare. Thereafter, the four analysed states were (initial categorises in parenthesis): 1) “Self-sufficient” (working, parental leave, student), 2) “Job-less” (long-term unemployed, social assistance, no/low income), 3) “Disabled” (SA, DP), and 4) “Censored” (death, emigration, or old-age pension).

### **3.5.2 Disposable income**

The outcome studied in Study II was the level of annual equivalent household disposable income in the time period 2007-2011. Equivalent disposable income is the sum of all sources of income within the household, minus taxes paid, with specific weights for a second adult and one, two, or more children living at home (implicitly assuming that resources are shared within the household). The consumption weights (during the years studied in present thesis) underestimate the proportion of co-habiting households (that are neither married nor have children together) [78]. Also, Statistics Sweden sets negative values of disposable income to zero. Therefore, in Study II, only positive values of disposable income were considered.

### **3.5.3 Earnings**

Levels of earnings (i.e., income from work) were analysed in Study III and Study IV. In the Swedish sickness absence insurance system, the first period of a SA from employment (often day 2-14) is paid by the employer. This amount could not be disentangled from the individuals' total income from work, and was thus included in the definition of earnings. In Study III, levels of earnings were based on a single year (2010) whereas in Study IV earnings were analysed over a period of 16 years (10 years before the initial MS diagnosis until five years after). To limit the risk of underestimating younger individuals' income generating ability, income in the form of student allowances was added to the individual's earnings.

### **3.5.4 Social insurance compensation systems**

In Study III, levels of income from five components of the welfare system were also analysed: DP, compensated SA, a disability allowance (“handikappersättning”), unemployment compensation, and social assistance. In Study III, these five types of incomes were analysed both jointly and separately.

## **3.6 STATISTICAL ANALYSES**

Statistical methods are often used to discover and substantiate potential differences between groups, while adjusting for individual heterogeneity due to individual characteristics that are not of primary interest in the analysis. In this thesis, statistical methods can be categorised in

relation to the phase of the analytical procedure: 1) those used to create the study population and, 2) those used to perform the analysis. These are discussed separately here.

### **3.6.1 Creating a comparison group**

There are several different strategies for differentiating between individual heterogeneity. One such approach is to select a specific reference group, which resembles the exposed group in terms of observable variables, from a larger group of potential reference individuals. Due to the large number of observations in the registers such approach is highly feasible in register-based research.

In Study II, III, and IV, the reference group was selected using socio-demographic characteristics to resemble the exposed group. In Studies II and III individual matching was used to identify an unexposed reference group. This was accomplished by using propensity score matching [82]. There was a considerable difference in number of individuals in the exposed groups in Study II (n=143,140) and Study III (n= 13,979). For this reason, different numbers of matched references were chosen to create the reference groups (Study II: 1:1, Study III: 1:5).

In Study II, the estimated propensity scores were based on socio-demographic characteristics included in the LISA database (sex, age, level of education, living with partner/spouse, number of children living at home, type of living area, born in Sweden or number of years since immigration for those born outside of Sweden) in the year of exposure, 2005. Information from 1-4 years prior (i.e., 2001-2004) to the year of exposure was also included in the estimation of propensity scores (categorised: days of inpatient care, visits in outpatient care, levels of earnings, SA). In Study III, socio-demographic characteristics (age, sex, level of education, type of living area, geographical region, country of birth) in the year of inclusion (2010) were used to estimate the propensity scores. In both studies, the propensity scores were obtained using logistic regression to estimate the probability of belonging to the exposed group. Also, in both Study II and Study III, the estimated propensity scores were evaluated using balance scores before and after matching [83]. Further, in Study III, the rationale for obtaining a matched reference group was performed to provide comparable descriptive statistics between those with MS and those without MS. In Study II, the objective of the matching procedure was to limit the influence of events happening before the year of exposure, and thereby increase the likelihood that the observed outcomes could be contributed to the specified exposure (i.e., SA) rather than pre-exposure events.

In Study IV, a different type of matching technique was used. In this study, a group level matching procedure was used instead. Previous research, including the results from Study III, has shown that the sex and age distribution of the incidence of MS in the population of MS individuals differs from that of the general population. For this reason, a reference group was randomly selected (1:3) using stratified matching based on the distribution of sex and age among the MS patients, thereby creating the same distribution, in terms of sex and age, among the MS patients and the matched references.

### **3.6.2 Models and statistical tests**

Another common method for limiting the problem of individual heterogeneity is to use observable variables in regression models. This section describes the different techniques that were used in the studies included in this thesis.

In Study I, multiple outcomes were repeatedly measured over a period of 15 years (1995-2010). This created a multitude of possible pathways. To enable interpretations of the complex material, auto-regressive multi-nominal logistic regression was applied [84]. Repeated observations for a given individual were considered independent. This was based on the assumption that when information of the previous state was included in the model itself, earlier states beyond previous states would encompass no additional information for the following states. The outcomes of the multi-nominal logistic regression were presented as odds ratios. Further, using specific illustrative cases, the odds ratios were also recalculated as probabilities.

In Study II, ordinary least squares (OLS) were used to compare the levels of equivalent disposable income between the exposed and unexposed groups, 2-6 years after the year of exposure. Logarithmic transformation was used on the outcome variable. The results were therefore interpreted as percentage differences between the two groups. The analyses were conducted for the entire exposed group vs. the unexposed group, and also including sub-categories of the exposed group (by diagnosis and duration of the SA spell, respectively).

In Studies III and IV, levels of income were analysed (Study III: earnings, DP, compensated SA, disability allowance, unemployment compensation, social assistance, Study IV: earnings, including student allowance when applicable). In contrast to disposable income, a considerable proportion of the individuals in the study populations did not have the studied type of income (i.e., zero income). This is sometimes referred to as a “zero inflated” variable. Several alternative methods have been suggested for analysing such zero-inflated outcomes – or more generally “clustered outcomes” (not necessarily at zero) [85]. Using an OLS-regression on zero-inflated outcomes could for example result in negative predicted values. Moreover, in Study III, five propensity score matched reference individuals were included for each specific MS patient. This could have introduced intergroup correlations within each matched group. For this reason, and the zero-inflated outcomes, a repeated non-linear mixed model, which treated zeroes differently from the positive values, and corrected for intra-group correlation was therefore used [86]. Similarly, in Study IV, Tobit regressions were used to handle the zero-inflated outcome [87]. Due to the group-based matching (sex and age) it was assumed that adjustments for intra-group correlations were not needed in the analyses. Furthermore, in both Study III and Study IV, differences between the MS patient and the references in mean levels of incomes were tested using two-sided t-tests.

### **3.7 ETHICAL CONSIDERATIONS**

This thesis was part of the Insurance-Medicine-All-Sweden project at the Karolinska Institutet, the Division of Insurance Medicine. All micro data used was made anonymous,

with the linkage between randomly assigned individual numbers and the actual Swedish national personal numbers was held at Statistics Sweden. Also, data analyses were performed on site and without possibility of remote access.

This project was approved by the Regional Ethical Review Board, Stockholm, Sweden (dnr: 2007/762-31, 2009/1917-32, 2009/23-32, 2011/806-32).



## 4 RESULTS

The main results of the four studies indicate that having reduced work capacity due to temporary or chronic morbidity, are likely to have long-term consequences for the individual's subsequent labour market outcomes. In Study I, examining transitions from long-term unemployment (>180 days in a single year) into work, a health selection was found, where those with a history of inpatient care tended to remain outside of work longer than others. In Study II, it was also shown that, being absent from work due to morbidity (>14 days) is associated with long-term negative effects on an individual's economic welfare. This was especially pronounced for individuals absent from work due to a mental diagnosis, but also in general irrespective of diagnosis for individuals with longer spells of SA.

Individuals with a chronic and often progressive disease, such as MS – the focus of analysis in Study III and Study IV, gradually increased with the passage of time for their dependency on compensation from the insurance systems. However, the degree of economic self-sufficiency, i.e., income from own earnings, varied greatly between individuals with MS, even when comparing individuals with the same number of years since the initial MS diagnosis. This was evidenced by a socio-economic gradient that was identified among the MS patients, where the income of those with lower levels of education and less qualified types of occupations were more adversely affected than the income of those with higher education and/or more qualified jobs.

The results are now presented in greater detail, one study at a time.

### 4.1 STUDY I

A majority (60.7%) of the “Jobless” in 1995 were “Self-sufficient” in 2010, about one in five were “Jobless” (17.2%) and about one in ten were in the state “Disabled” (10.1%).

The results also showed that individuals in the states “Self-sufficient” and “Disabled” tended to stay within these states (i.e., stable within-state transitions over time). This was not the case for the state “Jobless”. A large share of jobless individuals transitioned into work rather than into long-term SA or a DP, both of which were included in the state “Disabled”. However, jobless individuals with previous inpatient care before transition had a higher probability of transition into the state “Disabled” rather than into the state “Self-sufficient”.

The transition probabilities were significantly related to the socio-economic characteristics: sex, age, education, and country of birth. This indicates that socio-economic information is relevant for describing individual's subsequent labour market positioning. Nevertheless, considered over the entire time period, information on the individual's previous state was the most influential predictor of his/her subsequent labour market position (See Table 4). Further, the results showed that in period of lower levels of national unemployment,

transitions into the state “Self-sufficient” were higher. No distinct pattern was observed regarding transitions into “Disabled” in relation to nationwide levels of unemployment.

**Table 4.** Odds ratios (OR) and 95% confidence intervals (CI) for being in one of four states given the previous state-status, among all persons who were jobless in 1995 (n=638,622).

	<b>Self-sufficient (ref: Jobless) OR (95% CI)</b>	<b>Disabled (ref: Jobless) OR (95% CI)</b>	<b>Censored (ref: Jobless) OR (95% CI)</b>
Intercept	1.14 (1.14-1.15)	0.02 (0.02-0.02)	0.04 (0.04-0.04)
State in previous period (ref: Jobless)			
-Self-sufficient	9.88 (9.80-9.96)	2.64 (2.60-2.68)	1.22 (1.19-1.24)
-Disabled	1.53 (1.5-1.56)	49.37 (48.45-50.30)	2.51 (2.42-2.60)
Sex (ref: male)			
-Female	1.19 (1.18-1.19)	1.56 (1.54-1.58)	0.98 (0.97-1.00)
Age (ref: 20-25)			
-26-30	0.75 (0.74-0.75)	1.25 (1.23-1.27)	0.87 (0.86-0.89)
-31-35	0.64 (0.64-0.65)	1.45 (1.43-1.48)	0.77 (0.75-0.78)
-36-40	0.58 (0.57-0.58)	1.70 (1.67-1.73)	0.72 (0.7-0.73)
Education (ref: High School)			
-Lower	0.57 (0.56-0.57)	1.04 (1.03-1.06)	1.10 (1.08-1.12)
-Higher	1.48 (1.47-1.49)	0.83 (0.82-0.84)	2.06 (2.02-2.10)
Country of birth (ref: born in Sweden)			
Other country than Sweden	0.66 (0.65-0.66)	0.81 (0.80-0.82)	1.95 (1.92-1.98)
Inpatient care (ref: no inpatient care)			
- ≤Median	0.86 (0.85-0.87)	1.64 (1.61-1.67)	0.54 (0.52-0.56)
- >Median	0.65 (0.64-0.66)	3.13 (3.07-3.18)	1.34 (1.30-1.38)
Period unemployment rate (ref: 1995-1997 increasing unemployment)			
- 1997-2001 decreasing	1.44 (1.43-1.45)	5.73 (5.60-5.86)	2.80 (2.74-2.86)
- 2001-2005 increasing	0.82 (0.81-0.83)	5.93 (5.79-6.07)	2.31 (2.26-2.37)
- 2005-2008 decreasing	1.29 (1.27-1.3)	5.18 (5.06-5.31)	2.23 (2.17-2.29)
- 2008-2010 increasing	0.86 (0.85-0.87)	2.62 (2.55-2.69)	0.95 (0.92-0.99)

## 4.2 STUDY II

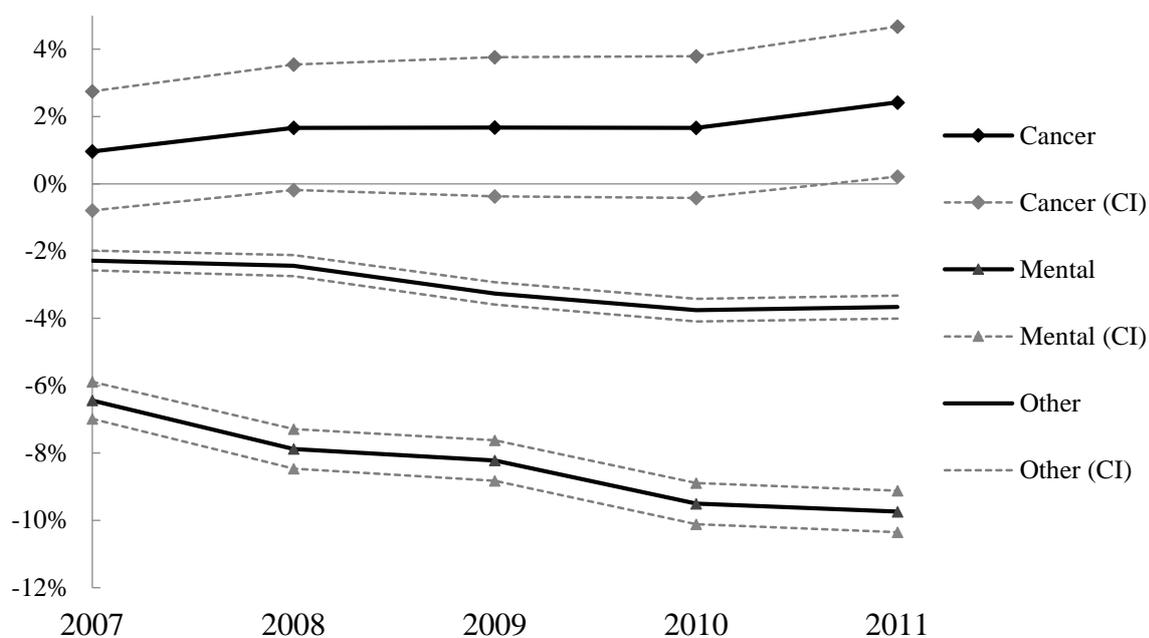
In Study II, two years after the initial spell of SA, the level of disposable income was 3.0% lower for the group with a previous spell of SA compared to the group without previous SA at the start of the study. The differences between the two groups continued to increase with time; and, at the end of the follow-up period (five years later) the disposable income in the entire group with previous SA was 4.7% lower than that for those with no previous spell of SA at the start of the study (See table 5).

**Table 5.** Estimated percentage differences in disposable income between individuals with sickness absence (SA) in 2005 and individuals without sickness absence in 2005 (n=286,280).

Categorization of exposure variable	Exposure variable (reference category: No SA in 2005)	Year of estimation				
		2007	2008	2009	2010	2011
<b>1) Binary</b>	- SA 2005	-3.0	-3.4	-4.1	-4.7	-4.7
<b>2) Diagnosis</b>	- Cancer	(1.0)	(1.7)	(1.7)	(1.7)	2.4
	- Circulatory	-1.6	-1.8	-2.9	-2.9	-3.0
	- Injuries	-1.5	-1.6	-2.1	-2.9	-2.6
	- Musculoskeletal	-3.4	-3.5	-4.2	-4.6	-4.4
	- Mental	-6.4	-7.9	-8.2	-9.5	-9.7
	- Other	-2.0	-2.1	-3.1	-3.6	-3.6
<b>3) Duration</b>	- 15-29 days	-1.2	-1.4	-2.1	-2.3	-2.2
	- 30-89 days	-2.2	-2.4	-3.3	-3.9	-3.9
	- 90-179 days	-5.9	-6.2	-6.9	-7.5	-7.4
	- >179 days	-12.5	-14.7	-15.1	-17.9	-17.8
	<i>N</i>	282,889	281,626	280,716	279,923	279,036

The diagnoses for the spells of SA during the inclusion/exposure year were categorized into six major diagnosis groups (see heading “Exposures”). The results were similar across these diagnosis group categories, with the two exceptions of cancer and mental diagnoses. This is visualised in Figure 2 where it is shown that disposable income decreased over time for all diagnoses except for cancer. The largest declines in disposable income were attributed to individuals whose SA was due to a mental diagnosis (7-10%).

The differences in disposable income over the five-year follow-up period increased with the duration of the initial spell of SA. At end of the follow-up period, those with the longest durations of SA (>179 days) when entering into the study had 17.8% lower disposable income compared to the group without SA in the year of exposure.



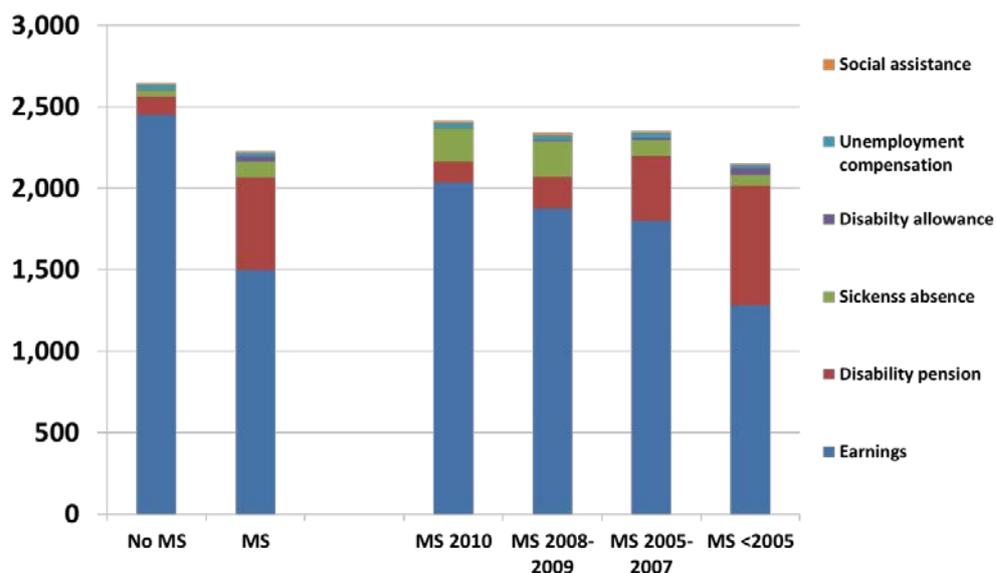
**Figure 3.** Percentage differences in equivalent individualised disposable income, adjusted for socio-demographic characteristics, for individuals diagnosed with cancer, mental diagnoses, and all other diagnoses compared to individuals without SA in 2005, 2007-2011. Estimated parameters and 95% confidence intervals (CI).

### 4.3 STUDY III

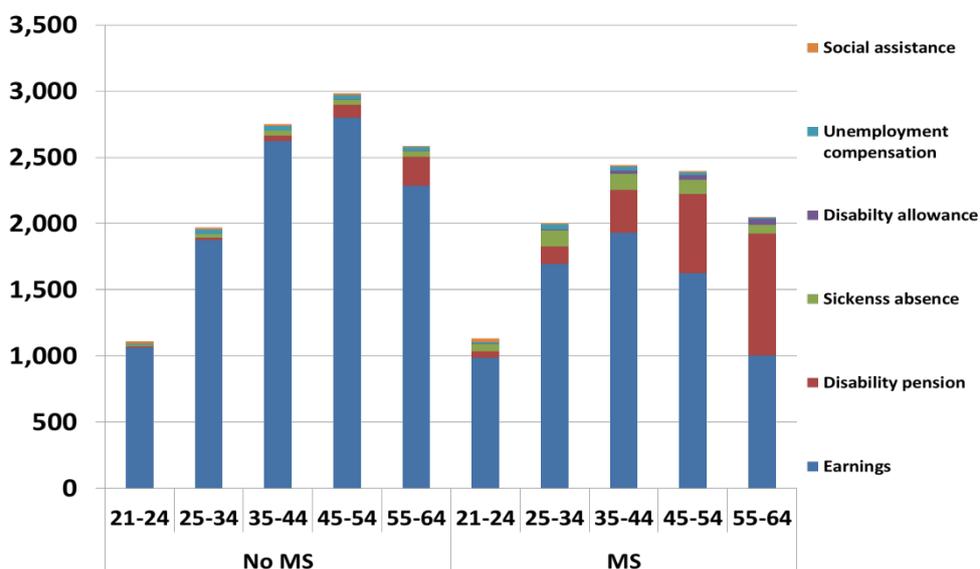
The results in Study III show that the average earnings among individuals with MS were lower than earnings in the reference group without MS. Both MS patients and those without MS received most of their income from earnings, while about a third of the total income among MS patients was from a DP or SA benefits. For MS patients, stratification by year of diagnosis showed that with an increasing number of years since the initial MS diagnosis, the proportion of earnings in total income decreased continuously, while the proportion of income from a DP increased (Figure 3).

For ages 21-34, the levels of income were similar for MS patients and those without MS, but the differences already apparent at that time were explained by the prevalence of compensated SA and/or a partial or full DP. However, at ages >34, those in the reference group had a higher level of combined income, with the prevalence of other income components than earnings increased markedly among the MS patients. Furthermore, mean earnings among the MS-patients were at their highest levels at ages 35-44, whereas the mean earnings of those without MS peaked at ages 45-54 (Figure 4).

When controlling for socio-demographic characteristics, MS patients diagnosed in 2010 had 15% lower earnings compared to those without MS, while MS patients diagnosed before 2005 had 38% lower earnings. Corresponding figures regarding summed social benefits were 33% and 130% higher for MS patients, respectively.



**Figure 4.** Average annual income for six types of incomes, for MS patients and matched references by and year of first MS diagnosis, in 100 Swedish crowns, 2010 ( $\approx 10.4$  Euro).



**Figure 5.** Average annual income for six types of incomes, for MS patients and matched references stratified by age-groups, in 100 Swedish crowns, 2010 ( $\approx 10.4$  Euro).

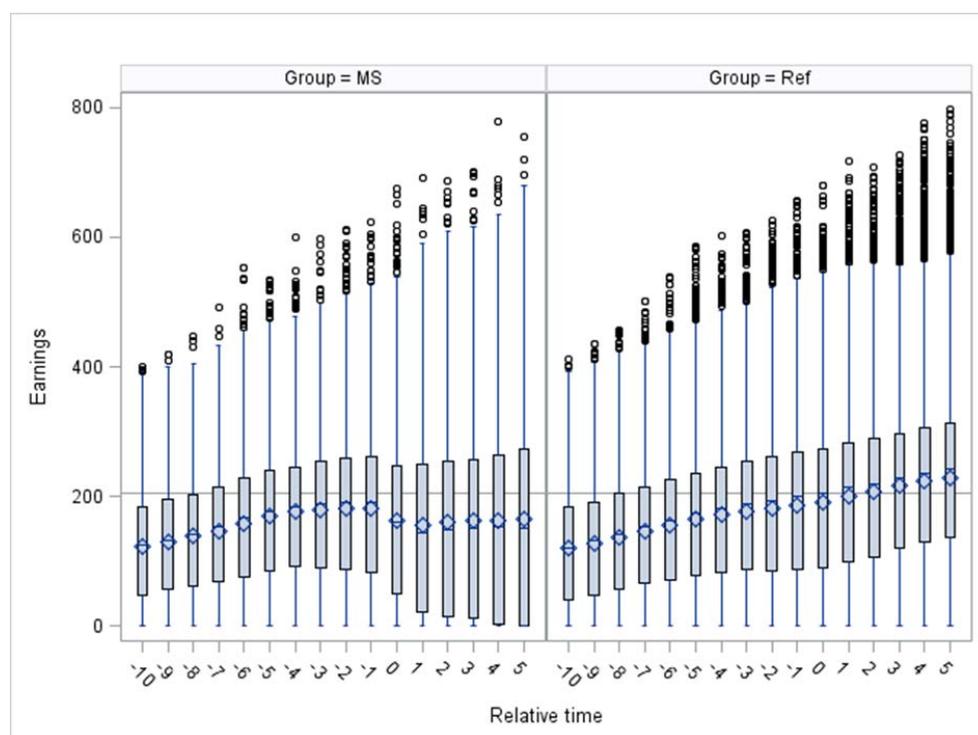
#### 4.4 STUDY IV

The results in Study IV show that MS patients, on average, have similar levels of earnings as the reference group until around one year prior to the MS diagnosis. Thereafter, the differences in levels of earnings between the MS patients and the reference group increased during the five year follow-up period. Also, a large dispersion in the levels of earnings was

observed among the MS patients that increased throughout the follow-up period, whereas a more stable development was observed for those in the reference group (see Figure 5).

At the end of the follow-up period, the largest (percentage-wise) differences in earnings between MS patients and those without MS were observed among those with lower education and less qualified types of occupations. Mean earnings among MS patients in the lower levels of education constituted 53% of that of their peer in the reference group without MS. Corresponding percentage for manual occupations were 67%.

During the year of the diagnosis of MS, 57% of the MS patients had at least one spell of SA compensated by sickness insurance system. Five years after diagnosis, about one in four MS patients had at least one such spell of SA. The percentage of MS patients receiving a DP was, however, increasing; from about 15% during the year of MS diagnosis to 46% five years later. About half of these, 46%, had a part-time DP.



**Figure 6.** Distribution (box-plots with whiskers) of Earnings, over time, among MS patients (n=2,553) and the reference group without MS (n=7,584), in 1,000 Swedish crowns. Year of MS diagnosis: Relative time=0.

## 5 DISCUSSION

The aim of this thesis was to gain more knowledge of how reduced work capacity caused by morbidity is associated with subsequent individual economic outcomes. To this end, in four studies, the economic outcomes after absence from work due to morbidity were analysed from different perspectives; those with temporary SA, individuals with a, often, progressive and disabling chronic disease, and economic outcomes for the long-term unemployed or persons with very low income, where morbidity is often at play. The overall results of the four studies are discussed below.

### 5.1 STUDY I: WORK, UNEMPLOYMENT, AND EARLY EXITS FROM THE LABOUR MARKET

How health status and the macro-economic situation affects the individual's opportunities on the labour market were analysed in Study I. This was investigated by measuring transitions between different labour market states over a period of 15 years among individuals who at the start of the study had no, or only limited income from work. Although socio-demographic factors, health status, and levels of nationwide unemployment were influential, the individual's most recent preceding state had the greatest predictive power on subsequent labour market status, indicating that these factors were already incorporated in the previous state. Such state dependency has also been found in studies on transitions between work, unemployment, usage of sickness insurance systems, using both Norwegian and Danish data [20-23].

Further, individuals who were mainly supported by the Swedish sickness insurance system tended to stay within this state over time. Since the state was defined through DP and long-term SA (which is a known risk factor for DP), this was to be expected. The stability of the state does, however, illuminate the effects of morbidity among young individuals (20-40 at start of the study) for an extensive time period. It is also possible that absence from work in itself created a distance from the labour market, from which a re-entry was increasingly difficult, i.e., that the inactivity hindered utilisation of potential work capacity. Individuals in the state "jobless" were less stable, and a high proportion tended to move into paid work in the earlier time periods. At the end of the study, a majority of the jobless did, however, stay within the state. A possible explanation could be that higher ages made those on long-term unemployment less attractive on the labour market, and not applicable for the sickness insurance system (i.e., SA and DP). A possible explanation of the outcomes for this group could be a cumulative negative effect of unemployment on individuals' subsequent opportunities for acquiring paid work [68].

#### 5.1.1 Health selection and role of macroeconomic factors

Transitions between work, unemployment, and long-term dependence of various components of the transfer system have been discussed extensively in the literature, and different interpretations of underlying mechanisms have been considered. In Study I, the following interpretations were considered. Firstly, in times of economic prosperity the availability of

work is higher for all groups – including those with long-term unemployment. Secondly, it has also been proposed that in times of economic recessions, those with ill health, compared to those without such health problem, have a higher risk of losing their job but can return to work in times of economic upturns [63, 88-90]. The results from Study I indicated a health-related selection in transitions from “jobless” to “self-sufficiency”. Those with no previous inpatient care prior to joblessness were to a higher degree in subsequent paid work compared to those who had received inpatient care, who to a higher extent were supported by the sickness insurance system – long-term SA and, eventually, perhaps a DP.

In addition to this, one of the results of the study was that transitions into paid work were higher in times of decreasing unemployment. This result highlights the importance of considering both individual – and macro-economic factors in further attempt to understand the complex nature of transitions between unemployment, work, and early exits from the labour market into DP. This can be of importance in studies of long-term consequences of SA, where both individual level factors (set of skills and morbidity) and contextual factors (mainly availability of jobs) jointly influence the outcome (e.g., return to work).

## **5.2 STUDY II: SICKNESS ABSENCE AND ECONOMIC WELFARE**

In 2015 about 10% of the working population in Sweden had at least one spell of SA compensated by the Social Insurance Agency [3]. Sweden appears to be a part of a more general trend, in which rising proportions of the workforce are away from work with compensated SA, which is a growing concern all-over Europe [1]. SA can be seen as a non-medical treatment which provides an opportunity to recover from morbidity and return to the labour market. But, there can also be undesirable side-effects of SA [91]. For example, it is possible that longer periods of SA can affect individuals’ subsequent opportunities on the labour market in terms of wage growth [56, 58], opportunities for advancement, for mobility between employers [59, 60] and, generally, employability [63]. If present, all these factors would have a negative effect on the individual’s subsequent disposable income.

In Study II, it was found that SA was negatively associated with subsequent disposable income, in both SA spells due to mental and somatic diagnoses. An exception to this was observed for those on SA due to a cancer diagnosis. A possible explanation for this exception could be a health selection, in which persons with lower levels of disposable income were in lower socio-economic positions, and who had higher risk of mortality – possibly due to less health-care contacts. For individuals with mental diagnoses, economic outcomes were not only affected adversely, the decrease in disposable income was much greater than the average for persons with all the other diagnoses. In a study, by Stenbeck and Hjern (2007), which focused on the relation between inpatient hospital care and subsequent disposable income, similar results were observed in cancer and mental diagnoses [92]. There are several possible explanations to why individuals with SA due to mental diagnoses are more affected than others. One is social isolation combined with decreased activity on the labour market [64, 93]. Another is that stigmatisation for those with a history of mental diagnosis can result in difficulties to acquire a new job, even for those who are actively seeking work [65, 76].

Negative associations between economic welfare (measured by disposable income) and health-related exposures have been observed in several studies [92, 94-97]. The findings in Study II, are thus in line with previous research, and thereby provide further insight on morbidity's long-term negative influence on individuals' economic welfare.

Overall, the results from Study II imply a negative effect of SA on subsequent economic welfare – an effect which was not fully compensated for by the different components of the Swedish sickness insurance system. It should, however, be noted that this might simply reflect the individual's health status, which could be translated into lower productivity or a need to work fewer hours per week. The extent to which the negative association between SA and the subsequent development of disposable income is a result of poorer health or is connected to SA in itself could not be evaluated in the present study. There are established theories on how SA, in itself, has unintentional adverse side effects [91]. In practice, isolating the two effects is problematic as previous studies have discussed [61, 62, 91].

Given the underlying morbidity, in conjunction with that the replacement rates for lost earnings of less than 100% (in both the sickness insurance system and unemployment systems) the differences in the development of disposable income are to be expected. Study II does, however, indicate a magnitude in these differences and shows a differential effect among different diagnoses, where the difference for those with SA due to mental diagnosis was most prominent.

In Study II, diagnoses were categorised based on which chapter in the ICD-10 classification the specific diagnosis belonged to. However, it should be noted that the durations of SA spells varies within these ICD-chapters [10]. It is, thereby, likely that being on SA due to specific diagnoses within these chapters would have a different impact on subsequent labour market outcomes. Since the incidence of SA due to stress-related mental diagnoses are rising [29], future analyses for these specific diagnoses would be of interest.

### **5.3 STUDY III, IV: CHRONIC DISEASES, LABOUR MARKET PARTICIPATION AND IMPORTANCE OF THE WELFARE SYSTEM**

Two of the studies in this thesis have focused specifically on individuals with an MS diagnosis (Studies III and IV). The analyses show that the gap in economic self-sufficiency between individuals with MS and reference individuals without MS increases over time. Moreover, a large variation within the MS group with regards to economic self-sufficiency was observed. The studies show that MS patients are also clearly overrepresented in their usage of health-related sources of incomes: compensated SA, DP, and disability allowance (for persons with reduced functional capacity), whereas the differences between individuals with MS and those without were small for unemployment compensation and social assistance, where the latter being Sweden's income support of last resort.

For obvious reasons, most research regarding MS has been conducted in the field of medicine (e.g., diagnostic procedures and different treatments). The labour market situation of individuals with MS has also been studied, although often from a societal perspective in

terms of the total costs generated by this patient group (e.g., health-care consumption and loss of production) [98-101] . There are, however, a growing number of publications which have aimed to describe the effects of MS on labour market outcomes, from the individual perspective. Both Study III and Study IV contributed to this body of research by focusing on the development of the individual's ability to be economically self-sufficient, and need for income support from social transfer systems, in relation to the number of years that have lapsed since the MS diagnosis was established. Further, previous research has shown that unemployment is prevalent among MS patients [50, 52, 102-106]. Using continuous incomes (Study III, IV) and usage of part-time SA and DP (Study IV) could, potentially, be more informative for a gradual effect of MS on the individual's subsequent labour market outcomes.

### **5.3.1 Income compensation throughout working life**

In Study III, for MS patients, six sources of income were analysed – including social assistance and unemployment benefits. These two sources are informative of the individuals' labour market attachment: social assistance implies living in a household with very low income while unemployment compensation indicates that the individual is not currently economically self-sufficient but, nevertheless capable of working and is available for, and actively seeking, work on the labour market. For example, in Study III, the small observed differences in social assistance between MS patients and matched references indicate that the other components of the welfare system, especially the availability of universal compensation for absence from work due to morbidity, protects individuals with MS from being reliant on means-tested cash benefits to a higher extent than others.

A transition from income from earnings with a high prevalence of SA into increasing dependence on DP is likely to be due to the often progressive nature of MS, but also in conjunction with the design of the Swedish sickness insurance system. At onset, it is possible that the individual has full work capacity between bouts, for which temporary SA can be a solution during intermediate periods when it is not possible to work. As the disease progresses, however, partial and then full DP become more prevalent. This pattern of transition is supported by two other studies for Sweden [48, 107].

The Swedish benefit system's combination of part-time work with part-time insurance compensation for periods when work is not possible is especially important for those with a chronic disease, who have some work capacity, however not always for a full work week. And, not surprisingly, this is witnessed in the results in Study IV, where individuals with MS had higher rates of part- and full-time DP compared to those without MS. There are, however, also health-selection effects into work that need to be considered to complete the picture. Those with severe health problems are less likely to be in paid work, and are therefore less likely to receive compensation for lost earnings due to morbidity, for example, lost income compensated from the SA system.

### 5.3.2 The socio-economic gradient of labour market participation among individuals with MS

In Study IV, longitudinal analyses showed that the development of earnings following a MS diagnosis was very heterogeneous. There were large within-group differences in the development of mean earnings for those with a MS diagnosis with respect to age, level of education, and type of occupation. The largest differences in *absolute* terms between individuals with and without MS were observed for those with a low level of education and for those working as managers. However, the largest *relative* differences vis á vis the reference population were found among those with lower education. Similar results have been observed in other studies of the risk for unemployment among MS patients with lower levels of education [52-54, 105, 108, 109]. These socio-economic differences in labour market participation can be interpreted as an inability of the labour market to fully use the potential work capacity among MS patients with lower levels of education, rather than as a result of the individual's health status. If so, policy tools (e.g., supported vocational training) could potentially be used to extend these individuals' labour market participation.

Differences regarding the degree of physical demands a work requires are a possible explanation of persons with lower education were more affected by MS compared to persons with higher education. Other explanations are the difference regarding control over work hours and flexibility of work tasks [52-54]. These two explanations are, of course, not mutually exclusive and likely to depend on which (or several) of the wide array of symptoms of MS, physical and/or cognitive, an individual suffers from. Occupational setting is, however, a promising avenue for increasing knowledge of the underlying reasons for the elevated risk of early exits from the work force among individuals with MS - or more generally, among individuals with severe chronic diseases [52, 109]. Recognition and better understanding of the mechanisms behind the socio-economic gradient should be pursued in future studies to enhance our knowledge of conditions for remaining in the labour market for individuals with chronic diseases.

## 5.4 GENERAL DISCUSSION

Throughout this thesis, labour market outcomes over time were studied for different groups of individuals: the long-term unemployed, persons with SA from work, and individuals with a chronic disease, as exemplified here by MS. There are differences between these groups in terms of distance from the labour market and possibility of further career developments. For example, the long-term unemployed and those on SA receive unemployment and temporary compensation for SA, respectively. This was not necessarily the case for the MS patients, for whom the results from Study III and IV, indicate that a large proportion were in paid work. Furthermore, having a MS diagnosis is solely based on a medical evaluation, whereas being eligible for SA depends on both health status *and* the individual's work capacity in respect to current, or potential, work tasks. Taken together, however, the groups studied are informative of different marginalised groups' chances for remaining in work, or alternatively need of income from social compensation systems to support continued workforce participation.

Throughout the thesis, micro data on individuals' sources and levels of incomes were used in the analyses with the ambition to quantify how different aspects of health conditions affect the individual's possibilities for career development. Although there are distinct differences between incomes from, for example, social assistance and from unemployment compensation, the main aims of most policy tools are to facilitate self-sufficiency through work. Following that logic, the compensation systems can be seen as an administrative solution to such an endeavour. And, since a large component of the challenge is that presented by less than perfect health conditions, the different groups of individuals studied elucidate the heterogeneity in the need for economic compensation following health-related reduction of work capacity.

In a study by Bryngelson (2009), it was hypothesized that being on compensated SA could be the beginning of a process leading to increasing labour market marginalization [64]. Pedersen et al. (2012), reported results in line with this interpretation by showing that being on SA, was associated with different subsequent transitions that resulted in increasing the distance to the labour market [20]. This could be part of the explanation for the observed negative association in Study II between a history of SA and the development after a period of absence of disposable income. Further, it is also possible that other sources of income reflect different stages in a process that leads to diminishing participation on the labour market. In Study I, the careers of those with limited incomes (mainly long-term unemployed), were analysed. It is possible that being long-term unemployed is a stage of such a negative process. In Study I, this appeared to be the case – at least for those with previous health problems. A process leading to reduced labour market participation, involving several steps, different starting points should be considered e.g., both SA and long-term unemployment.

Further, an important role of the welfare system is to provide economic security for individuals with reduced work capacity due to morbidity. Most components of the Swedish welfare system do, however, aim to provide relatively generous economic compensation at least for a limited time, whereas compensation systems designed to provide economic support for an extended time period are more limited. Studies of chronic and progressive diseases, such as MS, are informative in this regard due to a life-long need of both health care and income from different components of the welfare system. In the case of MS, early exits from the labour market through DP have been shown to be highly prevalent [48, 49, 110]. On a similar note, in Study II, where individuals on temporary SA were studied, it was shown that regardless of the diagnosis or the length of the initial spell of SA, the differences in disposable incomes between those with a previous SA spell and those without increases with time. Further studies are warranted to understand to which degree this could be due to alternations between different compensation systems.

## **5.5 METHODOLOGICAL CONSIDERATIONS**

The Swedish total population based registers, which were used in this thesis, enable longitudinal studies based on a large number of observations, which increases the precision of the estimates.

Increasing the number of observations in a study does not however affect error due to omitted variables, i.e., the systematic error. There are several sources of possible statistical bias. A low degree of bias within a study is often referred to as a given high “internal validity”; whereas how the results from a study can be applied in other settings is often referred to as “external validity” or generalisability. The following section will discuss different forms of potential statistical bias and how they were handled in the four studies in this thesis.

### **5.5.1 Information bias**

Information bias occurs when the exposure and/or outcome variable is misclassified (i.e., does not fully represent the information for which it was intended). Systematic misclassification can result in biased results.

Since the four studies in the present thesis were based on register data, information bias is, in general, less of a concern compared to when data are collected through e.g., questionnaires. Information from registers should not contain recall bias, untruthful answers, answers due to misunderstanding, etc. Neither are they prone to information loss due to loss of follow-up.

There are, however, also cases in register based research in which misclassification of the exposure and/or the outcome can occur. In Study II, a secondary aim was to analyse differences between SA diagnoses. However, there were no registered diagnoses for 16% of the SA spells. In the study, these missing diagnoses were included in a residual category which included all diagnoses which were not in one of the main categories (i.e., “other”, see heading “Exposures”). If these missing diagnoses systematically differed between the “true” diagnoses the results for both the “other” group and the group in question could be affected (higher/lower estimates). To date, there is, however, no support for such a non-random distribution of missing diagnoses from the many previous studies using this data.

### **5.5.2 Selection bias**

Selection bias is generally less of a concern in population wide register-based research since non-participation is not an option. In addition, Swedish sickness insurance is mandatory and covers all individuals working in Sweden. This means that there is no self-selected group as in the case of voluntary sickness insurance. For the same reason, neither is there a risk of “adverse selection”, i.e., a risk that those with the greatest need for sickness insurance have a higher coverage rate than others.

The Studies III and IV, may contain diagnosis-specific problems. Individuals with MS were identified as individuals with a MS diagnosis according to the earliest diagnosis in available registers (MiDAS and PAR). There is, obviously, a time lag from disease onset to diagnosis. Whether there is a systematic relationship between individual characteristics and time from disease onset to diagnoses is unclear, however. A factor which is often discussed in this context is individuals’ level of education (health seeking behaviour, opportunities for gathering relevant information etc.). If so, in Study IV, there may be a risk of selection bias associated with the initial identification of MS. This said, Study IV included indicator

variables for the year of diagnosis and adjustments for socio-demographic characteristics, which to some extent could potentially remedy this problem.

### **5.5.3 Confounding**

All four studies included in the thesis were observational studies in which confounding may be a prevalent problem. For this reason, adjustments for socio-demographic variables were performed in all four studies. There is, however, always a risk for residual confounding, i.e., that an important adjustment factor has been left out or not fully accounted for.

In the present studies, it is likely that more detailed information about individuals' health status could improve the knowledge gained from the sort of studies included in this thesis. It is likely that there is a high degree of within-group heterogeneity among those with a specific diagnosis, and their relation to SA. This could include both primary care, which unfortunately is not available in nationwide registers available for research, as well as disease specific measurements of disability or information on sub-classes of studied diseases (e.g., MS phenotypes). With additional information about the individuals' health status possible systematic bias could be detected, and potentially, be reduced further, and thereby strengthen the interpretation on how the exposure affects the outcomes, for example how temporary work absence affects subsequent self-sufficiency. This being said, the studies in the present thesis included both reliable health-related (in- and outpatient care) and socio-demographic factors (sex, age, education etc.) to limit the problem of confounding.

Regarding the two MS-specific studies in the present thesis, it should be noted that there is likely less within-group variation (both in terms of treatments and subsequent outcomes) compared to studies based on a broader population definition.

### **5.5.4 External validity**

External validity refers to the generalisability of results from a specific study when applied to another population – the general population, or a more specified target population.

The comprehensiveness of a country's welfare system is of importance for the external validity of the results. Welfare systems, which are designed to provide a safety-net for its inhabitants, are present in most countries. However, the extent of coverage and types of support systems vary. Sweden has an extensive welfare system, and of particular relevance in the present context - a national sickness insurance that covers all workers from income loss due to absence from work as a result of morbidity. For this reason, generalisations of the results in this thesis may be limited to a context with similar welfare systems.

Demographic composition is also very relevant for evaluating external validity. All four studies in the present thesis were based on individuals in specific working age. Therefore, extrapolating the results should be done with these restrictions in mind. Similarly, the composition of the work force is of importance in generalising the results to other countries.

Notably, the labour force participation of women in Sweden is higher, and in some cases considerable higher, than in many other countries.

Another possible consideration is that the welfare-state legislation, in the present case that concerns compensation for temporary SA from work, unemployment and disability insurance can change over time, which could influence the generalisability of the study results in the future. However, if the main purpose of the compensation system is the same over time, it can be argued that comparisons are meaningful. For example, although the legislation for SA has undergone many reforms in the last 60 years, its main function has not changed – to provide temporary financial compensation in the event of morbidity [111].

Regarding diseases such as MS, but also others, treatments and diagnostic procedures can change over time. They can also differ between countries and in different health-care systems, even within a country. For example, in Sweden, the time from the estimated onset of MS to diagnosis has decreased over the last two decades [112]. Further, in comparison to the studies based on traditional labour market exposure (Study I and Study II), which to some extent depend on social policy, MS is a diagnosable disease. If the level of hospital care and treatment options is roughly equal, then the effect of MS on individuals work capacity could, arguably, be generalised to other settings. It should, however, be noted that such comparisons would still be indirectly affected by social policy in terms of the compared countries availability of welfare systems.

In Study I, the study population was defined as having low/no income from work (consisting mainly of the long-term unemployed) in 1995. However, Sweden experienced a major economic recession in the time period 1991-1994. This resulted in low demand for workers and relatively high overall unemployment both in this period and for several years to follow. The *prevalence* of long-term unemployed in 1995 was thus likely affected by the economic recession. Also, the socio-demographic *composition* of the long-term unemployed and in particular youth unemployment was affected. So, it is possible that the results are not fully generalizable to a period with another macro-economic setting. Due to the long follow-up period (15 years), which was an advantage in measuring the long-term outcomes of the initial employment situation, the dependence of the final outcome on the initial macro characteristics of the labour market during the early 1990's could not be evaluated within the context of the study.

In Studies III and IV, incomes among individuals with MS were compared to individuals in the general population without MS. No comparisons were, however, made to individuals with another type of chronic disease or chronic symptoms. To what extent the MS-specific studies can be informative for other diagnoses will depend highly on the diagnosis group to which extrapolation of results are under consideration. On the other hand, the results may provide inspiration in designing studies for other diagnosis groups.

It is usually not the case that a study either has external validity or does not have it. The answer is more often somewhere between these two extremes. Nor can external validity be

evaluated by statistical methods. It is always a matter of discretion, were the specific target population's characteristics and the objectives in generalising results from one study to another are crucial. Comparisons between the Nordic countries, which overall have a similar demographic composition, similar health care- and welfare systems are often considered appropriate regarding studies on SA and DP. Further, it would be interesting to perform similar studies in country contexts with different welfare regimes.

## **5.6 CONCLUSION**

In all four studies, negative associations between morbidity and labour market outcomes were observed. Among the long-term unemployed, those who had a previous period of inpatient care had an increased likelihood of a transition into sickness insurance, whereas the opposite was observed from transitions into work. This suggests a health selection process among the long-term unemployed.

Having a history of SA was associated with decreased economic welfare – with the strongest effect being associated with SA due to a mental diagnosis. The results show that the entire negative effect on earnings was not entirely covered by the different components in the welfare system.

Among individuals with MS, the composition of income after the onset of MS, changed increasingly from earnings to sickness insurance for temporary SA and then to an increasingly higher proportion of a full DP, with the increase in time since the initial MS diagnosis. Further, continued participation in the labour market among individuals with MS showed a high degree of occupational heterogeneity. Most significantly, MS patients with manual jobs or with lower levels of education exited the labour force sooner than others.

These results can be of importance in further discussions of the sick-listing procedures and the role of social insurance in the trade-off between directed insurance in supporting remaining in or returning to work in conjunction with temporary and chronic morbidity, while providing income security when paid work is not possible. Further, the studies in this thesis also highlight the importance of considering the, often complex, intertwined compensation systems when studying associations between the roles of welfare system for individuals with reduced work capacity due to morbidity.

## **5.7 FURTHER RESEARCH**

There are still many “blind spots” in the research field of determinants of income and health, especially regarding the adverse effects of temporary absence from work due to morbidity on subsequent labour market outcomes. The following section provides suggestions of further research - and can hopefully contribute by inspiring new studies in this area.

There is an increasing amount of research showing negative associations between receiving compensated SA and subsequent labour market outcomes. A major difficulty when studying the associations between SA and subsequent opportunities on the labour market is, however,

to distinguish between the effects of morbidity from the effects of SA. This constitutes a major challenge in the field. One approach would be to use specific empirical settings as a natural experiment (e.g., before/after legislation reforms). Suitable empirical conditions can, however, be hard to find. Further, the findings from Sweden, from the period 1998-2008 have shown that aggregated SA can both increase and decrease dramatically, despite the absence of changes in legislation [7]. Even when there is a change in legislation, practical implementation takes time, and, in addition, expectations in conjunction with changes in legislation (or administrative procedures) can affect both administrative and individual behaviour prior to implementation.

A promising avenue for the future is to construct reliable indicators of health status, which could then be used to adjust for individual-level heterogeneity in health status. Detailed diagnosis specific information from clinical registers, in combination with information on economic and demographic factors from the nationwide registers could be useful for such endeavour and warrants further attention. In this way one could, potentially, identify groups that are more adversely affected by SA for a given type of morbidity than others. Following the strategy of limiting individual heterogeneity in morbidity further - the next step in such an endeavour would, therefore, be to include clinical information from the Swedish MS register. Or more generally, to apply this analytic strategy to various types of patient groups –both with chronic and non-chronic diseases.

On a similar note, there are several theories on the underlying mechanisms behind the adverse effects of long-term SA on labour market outcomes (see heading “Possible negative effects of being on sickness absence” in the Introduction). These theories are not mutually exclusive, and more than one may be at work for a given individual. It would be a step forward to quantify the characteristics of these effects, and attempt to estimate their magnitudes. This would contribute to informed decisions in directed interventions on a policy level. Also, some risk factors are more likely to be successfully addressed using policy tools than others. But, some are also much more important for the well-being of individuals. For this reason, it is important to be aware and understand the mechanisms underlying the potential impact on work careers of the different risk factors per se. A concrete example is the negative outcome of long-term SA from the workforce associated with mental diagnoses, where the current knowledge suggests that long periods of SA are both fostering and reinforcing a feeling of social isolation, and may itself have an overall undesirable negative effect on continued workforce participation. The same mechanism may be at work for other diagnosis sub-groups, even if to a lesser degree.

Furthermore, chronic diseases are common and, as seen in the case of MS (Studies III and IV), despite the difficulties involved a considerable proportion of this group remains in work. It is, however, possible that individuals with a chronic disease, due to risk aversion – or employer discrimination – are less mobile than they could be on the labour market even when there are possible options available. This would suggest that the problem is that individuals with chronic diseases experience insecurity on the labour market – a form of indirect adverse

effect in its own right. Also, by not changing jobs individuals with a history of illness, even though their current work situation is stable, risk forgoing the wage increases that often accompany job-to-job mobility. Increasing the knowledge about job-to-job-mobility among the chronically ill who, despite their disease have considerable or full work capacity, could be directed to enhance this knowledge and the consequences for wages as well as the possible remedies. This could contribute to more general information on the possible negative lock-in side-effects that potentially could accompany all forms of morbidity.

Finally, the Swedish sickness insurance system allows for part-time absence, thus enabling part-time work for the remainder of the normal working hours. This opportunity is not available in all sickness insurance regimes. Knowledge on whether the possibility of compensated part-time absence from the workplace extends the duration of staying in the labour market among the chronically ill or those with other disease or injuries, and under what conditions (e.g., types of occupations), is still limited. The empirical findings from Sweden suggest that this may be an important instrument in facilitating gradual return to work in conjunction with more complicated diseases and injuries, but the validity of this theory remains to be tested. Results from such research could help discover possible additional needs for support helping individuals with for example a chronic disease succeed in remaining longer in the work force.

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## 7 REFERENCES

1. OECD: **Sickness, Disability and Work: Breaking the Barriers: A Synthesis of Findings across OECD Countries**: OECD Publishing; 2010.
2. Currie J, Madrian BC: **Health, health insurance and the labor market**. *Handbook of labor economics* 1999, **3**:3309-3416.
3. SIA: **Social Insurance in Figures 2016**. *Swedish Social Insurance Agency, Stockholm, Sweden* 2016.
4. Allebeck P, Mastekaasa A: **Risk factors for sick leave-general studies**. *Scandinavian Journal of Public Health* 2004, **32**(63 suppl):49-108.
5. Henrekson M, Persson M: **The effects on sick leave of changes in the sickness insurance system**. *Journal of Labor economics* 2004, **22**(1):87-113.
6. Lidwall U, Marklund S: **Trends in long-term sickness absence in Sweden 1992–2008: the role of economic conditions, legislation, demography, work environment and alcohol consumption**. *International Journal of Social Welfare* 2011, **20**(2):167-179.
7. SIA: **Analysing the variation in the level of sickness absence. Essential explanations to the ups and downs of sick leave**. *Swedish Social Insurance Agency, Stockholm, Sweden*, 2014.
8. Johansson P, Palme M: **Do economic incentives affect work absence? Empirical evidence using Swedish micro data**. *Journal of Public Economics* 1996, **59**(2):195-218.
9. Lidwall U, Marklund S, Skogman-Thoursie P: **Sickness absence in Sweden**. *Worklife and health in Sweden* 2004:183-204.
10. Lidwall U: **Sick leave diagnoses and return to work: a Swedish register study**. *Disability and rehabilitation* 2015, **37**(5):396-410.
11. Tullman MJ: **A review of current and emerging therapeutic strategies in multiple sclerosis**. *Am J Manag Care* 2013, **19**(2 Suppl):S21-27.
12. Smith JP: **Healthy bodies and thick wallets: the dual relation between health and economic status**. *The Journal of Economic Perspectives* 1999, **13**(2):145-166.
13. Larsson L: **Sick of being unemployed? Interactions between unemployment and sickness insurance**. *The Scandinavian Journal of Economics* 2006, **108**(1):97-113.
14. Aittomäki A, Martikainen P, Rahkonen O, Lahelma E: **Household income and health problems during a period of labour-market change and widening income inequalities—A study among the Finnish population between 1987 and 2007**. *Social science & medicine* 2014, **100**:84-92.
15. Benzeval M, Judge K: **Income and health: the time dimension**. *Social science & medicine* 2001, **52**(9):1371-1390.
16. Gunasekara FI, Carter K, Blakely T: **Change in income and change in self-rated health: Systematic review of studies using repeated measures to control for confounding bias**. *Social science & medicine* 2011, **72**(2):193-201.
17. Ecob R, Davey Smith G: **Income and health: what is the nature of the relationship?** *Social science & medicine* 1999, **48**(5):693-705.

18. Wikman A, Wiberg M, Marklund S, Alexanderson K: **Activities and sources of income after a period of long-term sick leave-a population-based prospective cohort study.** *BMC Public Health* 2012, **12**(1):745.
19. Bäckman O, Franzén E: **Employment and the labour market (Chapter 2).** *International Journal of Social Welfare* 2007, **16**(s1):S35-S66.
20. Pedersen J, Bjorner JB, Burr H, Christensen KB: **Transitions between sickness absence, work, unemployment, and disability in Denmark 2004-2008.** *Scandinavian journal of work, environment & health* 2012, **38**(6):516-526.
21. Pedersen J, Gerds TA, Bjorner JB, Christensen KB: **Prediction of future labour market outcome in a cohort of long-term sick-listed Danes.** *BMC Public Health* 2014, **14**(1):494.
22. Øyeflaten I, Lie SA, Ihlebæk CM, Eriksen HR: **Multiple transitions in sick leave, disability benefits, and return to work.-A 4-year follow-up of patients participating in a work-related rehabilitation program.** *BMC Public Health* 2012, **12**(1):748.
23. Øyeflaten I, Lie SA, Ihlebæk CM, Eriksen HR: **Prognostic Factors for Return to Work, Sickness Benefits, and Transitions Between These States: A 4-year Follow-up After Work-Related Rehabilitation.** *Journal of occupational rehabilitation* 2014, **24**(2):199-212.
24. Geyer S: **Income, income, or income? The effects of different income measures on health in a national survey.** *Journal of epidemiology and community health* 2011, **65**(6):491-496.
25. SIA: **Försäkrad inkomst i socialförsäkringen 1991-2010. Inkomster över taken samt individer som saknar sjukpenninggrundande inkomst i olika grupper av befolkningen [Insured income in the social insurance 1991-2010].** *Swedish Social Insurance Agency, Stockholm, Sweden, 2012.*
26. Palmer E, Svensson I, Tirmén P, Österlund N: **Sjukförmåner på deltid [Part-time sickness benefits].** *Välfärd på deltid Sockholm: SNS Studieförbundet Näringsliv och Samhälle pp* 2008:99-155.
27. Andrén D: **"Half empty or half full": The importance of the definition of part-time sick leave when estimating its effects.** *Working paper, School of Business, Örebro University, 2011(4/2011).*
28. Andrén D: **Is part-time sick leave helping the unemployed?** *Working paper, School of Business, Örebro University, 2011.*
29. SIA: **Sjukfrånvarons utveckling 2016 [The development of sickness absence 2016].** *Swedish Social Insurance Agency, Stockholm, Sweden, 2016.*
30. SIA: **Sjukfrånvaro i psykiska diagnoser. En Studie av Sveriges befolkning 16-64 år. [Sickness absence due to mental diagnoses].** *Swedish Social Insurance Agency, Stockholm, Sweden, 2014.*
31. Staland Nyman C, Andersson L, Spak F, Hensing G: **Exploring consequences of sickness absence—a longitudinal study on changes in self-rated physical health.** *Work* 2009, **34**(3):315-324.

32. Bratberg E, Dahl SÅ, Risa AE: **‘The double burden’: do combinations of career and family obligations increase sickness absence among women?** *European Sociological Review* 2002, **18**(2):233-249.
33. Lahelma E, Laaksonen M, Lallukka T, Martikainen P, Pietiläinen O, Saastamoinen P, Gould R, Rahkonen O: **Working conditions as risk factors for disability retirement: a longitudinal register linkage study.** *BMC Public Health* 2012, **12**(1):309.
34. Bruusgaard D, Smeby L, Claussen B: **Education and disability pension: a stronger association than previously found.** *Scandinavian Journal of Social Medicine* 2010, **38**(7):686-690.
35. Gjesdal S, Bratberg E: **The role of gender in long-term sickness absence and transition to permanent disability benefits.** *The European Journal of Public Health* 2002, **12**(3):180-186.
36. Karlsson N, Borg K, Carstensen J, Hensing G, Alexanderson K: **Risk of disability pension in relation to gender and age in a Swedish county; a 12-year population based, prospective cohort study.** *Work* 2006, **27**(2):173-179.
37. Mittendorfer-Rutz E, Härkänen T, Tiihonen J, Haukka J: **Association of socio-demographic factors, sick-leave and health care patterns with the risk of being granted a disability pension among psychiatric outpatients with depression.** *PloS one* 2014, **9**(6):e99869.
38. van Agt HM, Stronks K, Mackenbach JP: **Chronic illness and poverty in the Netherlands.** *The European Journal of Public Health* 2000, **10**(3):197-200.
39. Lindholm C, Burström B, Diderichsen F: **Does chronic illness cause adverse social and economic consequences among Swedes?** *Scandinavian Journal of Public Health* 2001, **29**(1):63-70.
40. Lindholm C, Burström B, Diderichsen F: **Class differences in the social consequences of illness?** *Journal of epidemiology and community health* 2002, **56**(3):188-192.
41. Holland P, Burström B, Whitehead M, Diderichsen F, Dahl E, Barr B, Nylén L, Chen W-H, Thielen K, van der Wel KA: **How do macro-level contexts and policies affect the employment chances of chronically ill and disabled people? Part I: The impact of recession and deindustrialization.** *International Journal of Health Services* 2011, **41**(3):395-413.
42. Ahlgren C, Odén A, Lycke J: **High nationwide prevalence of multiple sclerosis in Sweden.** *Multiple Sclerosis Journal* 2011, **17**(8):901-908.
43. Kavaliunas A, Manouchehrinia A, Karrenbauer VD, Gyllensten H, Glaser A, Alexanderson K, Hillert J: **Income in Multiple Sclerosis Patients with Different Disease Phenotypes.** *PloS one* 2017, **12**(1):e0169460.
44. Boiko A, Vorobeychik G, Paty D, Devonshire V, Sadovnick D: **Early onset multiple sclerosis A longitudinal study.** *Neurology* 2002, **59**(7):1006-1010.
45. Ghezzi A, Pozzilli C, Liguori M, Marrosu M, Milani N, Milanese C, Simone I, Zaffaroni M: **Prospective study of multiple sclerosis with early onset.** *Multiple Sclerosis Journal* 2002, **8**(2):115-118.

46. Simone I, Carrara D, Tortorella C, Liguori M, Lepore V, Pellegrini F, Bellacosa A, Ceccarelli A, Pavone I, Livrea P: **Course and prognosis in early-onset MS Comparison with adult-onset forms.** *Neurology* 2002, **59**(12):1922-1928.
47. Hammond SR, McLeod JG, Macaskill P, English DR: **Multiple sclerosis in Australia: prognostic factors.** *Journal of clinical neuroscience* 2000, **7**(1):16-19.
48. Gyllensten H, Wiberg M, Alexanderson K, Hillert J, Tinghög P: **How does work disability of patients with MS develop before and after diagnosis? A nationwide cohort study with a reference group.** *BMJ open* 2016, **6**(11):e012731.
49. Björkenstam C, Alexanderson K, Wiberg M, Hillert J, Tinghög P: **Heterogeneity of sickness absence and disability pension trajectories among individuals with MS.** *Multiple Sclerosis Journal—Experimental, Translational and Clinical* 2015, **1**:2055217315595638.
50. Jennum P, Wanscher B, Frederiksen J, Kjellberg J: **The socioeconomic consequences of multiple sclerosis: a controlled national study.** *European Neuropsychopharmacology* 2012, **22**(1):36-43.
51. Pflieger CCH, Flachs EM, Koch-Henriksen N: **Social consequences of multiple sclerosis (1): early pension and temporary unemployment—a historical prospective cohort study.** *Multiple sclerosis* 2010, **16**(1):121-126.
52. Glad SB, Nyland H, Aarseth JH, Riise T, Myhr KM: **How long can you keep working with benign multiple sclerosis?** *J Neurol Neurosurg Psychiatry* 2011, **82**(1):78-82.
53. Lunde HMB, Telstad W, Grytten N, Kyte L, Aarseth J, Myhr K-M, Bø L: **Employment among Patients with Multiple Sclerosis-A Population Study.** *PloS one* 2014, **9**(7):e103317.
54. Roessler RT, Rumrill PD, Fitzgerald SM: **Predictors of employment status for people with multiple sclerosis.** *Rehabilitation Counseling Bulletin* 2004, **47**(2):96-103.
55. Markussen S: **The individual cost of sick leave.** *Journal of Population Economics* 2012, **25**(4):1287-1306.
56. Hansen J: **The effect of work absence on wages and wage gaps in Sweden.** *Journal of Population Economics* 2000, **13**(13):11.
57. Andersen SH: **The cost of sickness: On the effect of the duration of sick leave on post-sick leave earnings.** *Social science & medicine* 2010, **70**(10):1581-1589.
58. Andrén D, Palmer E: **The Effect of Sickness History on Earnings in Sweden.** *Economic Issues* 2008, **13**(1).
59. Nordström K, Ekberg K, Hemmingsson T, Johansson G: **Sick leave and the impact of job-to-job mobility on the future vocational situation.** *PloS one* 2012.
60. Ekberg K, Wåhlin C, Persson J, Bernfort L, Öberg B: **Is mobility in the labor market a solution to sustainable return to work for some sick listed persons?** *Journal of occupational rehabilitation* 2011, **21**(3):355.
61. Hultin H, Lindholm C, Malfert M, Möller J: **Short-term sick leave and future risk of sickness absence and unemployment-the impact of health status.** *BMC Public Health* 2012, **12**(1):861.

62. Hultin H, Lindholm C, Moller J: **Is there an association between long-term sick leave and disability pension and unemployment beyond the effect of health status?—a cohort study.** *PloS one* 2012, **7**(4):e35614.
63. Hesselius P: **Does sickness absence increase the risk of unemployment?** *The Journal of Socio-Economics* 2007, **36**(36):23.
64. Bryngelson A: **Long-term sickness absence and social exclusion.** *Scandinavian Journal of Public Health* 2009, **37**(8):839-845.
65. Backhans M, Fredlund P, Lindholm C: **Sociala och ekonomiska konsekvenser av sjukskrivning [Social and economic consequences of sick leave].** i *Theorell T (red): Den höga sjukfrånvaron, Arbetslivsinstitutet, Stockholm* 2005.
66. Floderus B, Goransson S, Alexanderson K, Aronsson G: **Self-estimated life situation in patients on long-term sick leave.** *Journal of rehabilitation medicine* 2005, **37**(5):291-299.
67. Eriksson S, Johansson P, Langenskiöld S: **What is the right profile for getting a job? A stated choice experiment of the recruitment process.** *Empirical Economics* 2016:1-24.
68. Janlert U, Hammarström A: **Which theory is best? Explanatory models of the relationship between unemployment and health.** *BMC Public Health* 2009, **9**(1):235.
69. Virtanen M, Kivimäki M, Vahtera J, Elovainio M, Sund R, Virtanen P, Ferrie JE: **Sickness absence as a risk factor for job termination, unemployment, and disability pension among temporary and permanent employees.** *Occupational and Environmental Medicine* 2006, **63**(3):212-217.
70. Andrén D: **First exits from the Swedish labor market due to disability.** *Population research and policy review* 2008, **27**(2):227-238.
71. Lidwall U: **Termination of sickness benefits or transition to disability pension after changes in sickness insurance: a Swedish register study.** *Disability and rehabilitation* 2013, **35**(2):118-124.
72. Aittomäki A, Martikainen P, Laaksonen M, Lahelma E, Rahkonen O: **Household economic resources, labour-market advantage and health problems—A study on causal relationships using prospective register data.** *Social science & medicine* 2012, **75**(7):1303-1310.
73. Andrén D: **Long-term absenteeism due to sickness in Sweden. How long does it take and what happens after?** *The European Journal of Health Economics* 2007, **8**(1):41-50.
74. Carlsen K, Harling H, Pedersen J, Christensen KB, Osler M: **The transition between work, sickness absence and pension in a cohort of Danish colorectal cancer survivors.** *BMJ open* 2013, **3**(2).
75. Helgesson M, Johansson B, Nordqvist T, Lundberg I, Vingård E: **Sickness absence at a young age and later sickness absence, disability pension, death, unemployment and income in native Swedes and immigrants.** *The European Journal of Public Health* 2015, **25**(4):688-692.

76. Pedersen P, Lund T, Lindholdt L, Nohr EA, Jensen C, Søggaard HJ, Labriola M: **Labour market trajectories following sickness absence due to self-reported all cause morbidity—a longitudinal study.** *BMC Public Health* 2016, **16**(1):337.
77. WHO: **International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10).** *World Health Organization*, 1992.
78. SCB: **Background Facts, Labour and Education Statistics 2011:4, Integrated database for labour market research.** *Statistics Sweden, Örebro, Sweden*, 2011.
79. SIA: **MiDAS: Sjukpenning och Rehabiliteringspenning, Version 1.02 [MiDAS: Sickness benefits and rehabilitation sickness benefits, Version 1.02].** *Swedish Social Insurance Agency, Stockholm, Sweden*, 2011.
80. Ludvigsson JF, Almqvist C, Bonamy A-KE, Ljung R, Michaëlsson K, Neovius M, Stephansson O, Ye W: **Registers of the Swedish total population and their use in medical research.** *European journal of epidemiology* 2016, **31**(2):125-136.
81. SCB: **Rikets indelningar: årsbok över regionala indelningar med koder, postadresser, telefonnummer m m [Country classifications: yearbook of regional classifications with codes, postal addresses, phone numbers etc.].** *Statistics Sweden, Stockholm, Sweden*, 2003.
82. Parsons LS: **Performing a 1: N case-control match on propensity score.** In: *Proceedings of the 29th SAS Users Group International (SUGI) conference: 2004;* 2004: 165-129.
83. Austin PC, Grootendorst P, Anderson GM: **A comparison of the ability of different propensity score models to balance measured variables between treated and untreated subjects: a Monte Carlo study.** *Statistics in medicine* 2007, **26**(4):734-753.
84. de Vries SO, Fidler V, Kuipers WD, Hunink MG: **Fitting Multistate Transition Models with Autoregressive Logistic Regression Supervised Exercise in Intermittent Claudication.** *Medical decision making* 1998, **18**(1):52-60.
85. Humphreys BR: **Dealing with zeros in economic data.** *Department of Economics, University of Alberta, Alberta* 2013.
86. Tooze JA, Grunwald GK, Jones RH: **Analysis of repeated measures data with clumping at zero.** *Statistical methods in medical research* 2002, **11**(4):341-355.
87. Tobin J: **Estimation of relationships for limited dependent variables.** *Econometrica: journal of the Econometric Society* 1958:24-36.
88. Allebeck P, Mastekaasa A: **Swedish Council on Technology Assessment in Health Care (SBU). Chapter 3. Causes of sickness absence: research approaches and explanatory models.** *Scandinavian journal of public health Supplement* 2003, **63**:36-43.
89. Leigh JP: **The effects of unemployment and the business cycle on absenteeism.** *Journal of Economics and Business* 1985, **37**(2):159-170.
90. Virtanen P, Liukkonen V, Vahtera J, Kivimäki M, Koskenvuo M: **Health inequalities in the workforce: the labour market core–periphery structure.** *International Journal of Epidemiology* 2003, **32**(6):1015-1021.
91. Vingård E, Alexanderson K, Norlund A: **Consequences of being on sick leave.** *Scandinavian Journal of Public Health* 2004, **32**(63 suppl):207-215.

92. Stenbeck M, Hjern A: **Social consequences of illness (Chapter 5)**. *International Journal of Social Welfare* 2007, **16**(16):22.
93. Knapstad M, Øverland S, Henderson M, Holmgren K, Hensing G: **Shame among long-term sickness absentees: Correlates and impact on subsequent sickness absence**. *Scandinavian Journal of Social Medicine* 2014, **42**(1):96-103.
94. García Gómez P, López Nicolás A: **Health shocks, employment and income in the Spanish labour market**. *Health Economics* 2006, **15**(9):997-1009.
95. Lechner M, Vazquez-Alvarez R: **The effect of disability on labour market outcomes in Germany**. *Applied Economics* 2011, **43**(4):389-412.
96. Lidwall U, Johansson M, Johansson F: **Inkomstutvecklingen för individer med sjukersättning och aktivitetsersättning—Ekonomisk standard för åren 1991–2006 [Economic development for individuals on disability pension 1991–2006]**. Swedish Social Insurance Agency, Stockholm, Sweden, 2009.
97. Riphahn RT: **Income and employment effects of health shocks A test case for the German welfare state**. *Journal of Population Economics* 1999, **12**(3):363-389.
98. Ernstsson O, Gyllensten H, Alexanderson K, Tinghög P, Friberg E, Norlund A: **Cost of illness of multiple sclerosis-A systematic review**. *PloS one* 2016, **11**(7):e0159129.
99. Naci H, Fleurence R, Birt J, Duhig A: **Economic burden of multiple sclerosis**. *Pharmacoeconomics* 2010, **28**(5):363-379.
100. Pugliatti M, Rosati G, Carton H, Riise T, Drulovic J, Vécsei L, Milanov I: **The epidemiology of multiple sclerosis in Europe**. *European Journal of Neurology* 2006, **13**(7):700-722.
101. Chruzander C, Tinghög P, Ytterberg C, Holmqvist LW, Alexanderson K, Hillert J, Johansson S: **Longitudinal changes in sickness absence and disability pension, and associations between disability pension and disease-specific and contextual factors and functioning, in people with multiple sclerosis**. *Journal of the Neurological Sciences* 2016.
102. Busche K, Fisk J, Murray T, Metz L: **Short term predictors of unemployment in multiple sclerosis patients**. *The Canadian Journal of Neurological Sciences* 2003, **30**(2):137-142.
103. Glad S, Aarseth J, Nyland H, Riise T, Myhr KM: **Benign multiple sclerosis: a need for a consensus**. *Acta Neurologica Scandinavica* 2010, **122**(s190):44-50.
104. Julian LJ, Vella L, Vollmer T, Hadjimichael O, Mohr DC: **Employment in multiple sclerosis**. *Journal of neurology* 2008, **255**(9):1354-1360.
105. Patti F, Pozzilli C, Montanari E, Pappalardo A, Piazza L, Levi A, Onesti E, Pesci I: **Effects of education level and employment status on HRQoL in early relapsing-remitting multiple sclerosis**. *Multiple sclerosis* 2007, **13**(6):783-791.
106. Simmons RD, Tribe KL, McDonald EA: **Living with multiple sclerosis: longitudinal changes in employment and the importance of symptom management**. *Journal of neurology* 2010, **257**(6):926-936.
107. Landfeldt E, Castelo-Branco A, Svedbom A, Löfroth E, Kavaliunas A, Hillert J: **Sick leave and disability pension before and after diagnosis of multiple sclerosis**. *Multiple Sclerosis Journal* 2016, **22**(14):1859-1866.

108. Smith MM, Arnett PA: **Factors related to employment status changes in individuals with multiple sclerosis.** *Multiple sclerosis* 2005, **11**(5):602-609.
109. Pearson J, Alla S, Clarke G, Mason D, Anderson T, Richardson A, Miller D, Sabel C, Abernethy D, Willoughby E: **Multiple Sclerosis impact on employment and income in New Zealand.** *Acta Neurologica Scandinavica* 2016.
110. Tinghög P, Hillert J, Kjeldgård L, Wiberg M, Glaser A, Alexanderson K: **High prevalence of sickness absence and disability pension among multiple sclerosis patients: a nationwide population-based study.** *Multiple Sclerosis Journal* 2013, **19**(14):1923-1930.
111. SIA: **Förändringar inom socialförsäkringsområdena 1968-01-01 - 2010-07-01 [Changes in social insurance 1968-01-01 - 2010-07-01].** *Swedish Social Insurance Agency, Stockholm, Sweden*, 2010.
112. Hillert J, Stawiarz L: **The Swedish MS registry—clinical support tool and scientific resource.** *Acta Neurologica Scandinavica* 2015, **132**(S199):11-19.