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An Econometric Analysis of Disability and Labour Force Participation in Ireland
The Impact of Unobserved Heterogeneity and Measurement Error

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To

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Summary

This thesis provides benchmark estimates of the impact of disability on labour force participation in Ireland. Given the current focus on disability policy, this research is both necessary and timely for policymakers. In estimating the effect of disability on labour force participation, we are faced with many secondary questions and methodological problems, many of which this thesis aims to address. To this end, it contributes significantly to both national and international literature. The core questions addressed are;

- What is the impact of disability on participation?
- How significant are unobserved effects and state dependence?
- Is there differential measurement error in self-reported disability?
- What are the separate impacts of unobserved effects and measurement error in a labour force participation model?

Previous research (Bound, 1991 and Lindeboom and Kerkhofs, 2002) has set out the main methodological issues involved, namely classical and differential measurement error, endogeneity from participation to disability and endogeneity via unobserved heterogeneity. This thesis uses novel methods to address all of these issues and concludes with a new estimate of the impact of disability on participation. Key results include;

- the base effect of disability is to reduce labour force participation by approximately 30 percentage points, (participation rates for the non-disabled is 70 per cent);
- unobserved heterogeneity (comprising mainly of state dependence) accounts for 50 per cent of this base estimate;
- the disabled/ill labour force group are twice as likely to mis-report a severely limiting disability compared to what they would report if assessed as employed;
- the true impact of disability is to reduce participation by about 15 percentage points. Compared to the original estimate of 26 percentage points, about half of the bias is due to unobservables, and the remaining half is a combination of differential and classical measurement error.

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I am very grateful to a number of people, for their help and support during the research for this thesis, firstly to my supervisor Professor Donal O'Neill and to the research advisory committee of Dr. Olive Sweetman and Dr. Aedin Doris. Their dedication and interest throughout my research has much influenced the direction of this thesis, and I thank them for their careful reading of my work and their subsequent guidance. I would also like to thank my previous supervisor at the Economic and Social Research Institute, Professor Brian Nolan. His encouragement and supervision has greatly benefited my approach to research. The financial assistance from the Economic and Social Research Institute is also much appreciated. I gratefully acknowledge the support from Professor Eamon O'Shea, NUI Galway, during the completion of this thesis.

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Several colleagues have assisted me during my thesis - in particular I would like to thank Dr. Anne Nolan who carefully read some of my thesis. Many previous colleagues at the Economic and Social Research Institute and new colleagues at NUI Galway also provided friendly support.

I would like to thank my Mum, family, relatives and friends for their continued kind support during my research. Finally, I dedicate this thesis to the memory of my Dad, Brendan Gannon, who gave much support towards my research career and desire to complete my Ph.D. research.

Author's Declaration

Material from several chapters of this thesis has been published elsewhere and Authorship details, citations and summaries of my contributions are provided for each chapter below.

Material used in Chapter two forms the basis of two peer-reviewed published papers. The first is based on research conducted for the Equality Authority in 2004 (Gannon and Nolan, 2004a) and was subsequently published in The Economic and Social Review, (Gannon and Nolan, 2004b). I presented this work at the National Disability Authority Conference 2004. The research on disability and work transitions has been recently completed for the National Disability Authority and Equality Authority, (Gannon and Nolan, forthcoming 2006). The work has been reviewed periodically by both authorities and I presented the research at the National Disability Authority Annual Conference 2005. This research formed the basis for the second peer-reviewed publication, an invited contribution towards an international comparison of disability and employment. This will be published in a special version of '*Estudios de Economia Aplicada*' by end 2006.

Chapter three was sole-authored and has been published in *Health Economics*, 14:925-938, (Gannon, 2005). This paper was presented at the European Health Economics and Econometrics Workshop, Venafro, 2004, with Professor Jennifer Roberts as discussant. It was also presented at; the International Health Economics Association, World Congress, Barcelona 2005, chaired by Professor Michael Grossman; the Postgraduate Colloqium at NUI Maynooth, 2004, discussed by Professor Denis Conniffe.

Chapter four was sole-authored and forms the basis for two papers. The first was submitted (August 2006) for consideration of publication in *The Journal of Health Economics*. This has been previously reviewed at the ECuity III Workshop, Bonn, 2005 [discussed by Dr. Martin Schellhorn], seminars at NUI Maynooth, the ESRI, Department of Economics, UCC, and the European Conference on Health Economics, Budapest, 2006. Material on international comparisons and policy publications is taken from a second paper that has been accepted for presentation at the Budget Perspective Conference 2007 (held October 2006). This conference is organised by The Economic and Social Research Institute and the Foundation for Fiscal Studies, and has become an established part of public debate about budgetary issues. The paper is published in the conference proceedings.

Chapter five was sole authored and forms unpublished work. Preliminary results were presented at the Irish Economic Association Conference, 2006.

Chapter One
Introduction

1.1 Introduction

People with disabilities face many barriers to full participation in society, not least in the labour market. The extent and nature of participation in the labour market has a multitude of direct and indirect effects on the living standards and quality of life of people with disabilities, and is thus a critical area for investigation and policy concern. Furthermore, low employment rates of people with disabilities are increasingly becoming an issue of macroeconomic concern, as these people form an important set of currently under-utilised human resources (OECD, 2003). In terms of social expenditure, that on disability related programmes is over double that of unemployment compensation in many countries. Ireland is no exception - expenditure on illness and disability amounted to approximately 14% of total social welfare spending in 2004, over 1% of GDP. Although most OECD countries have undertaken substantial policy reform in terms of legislation, the extent of non-participation increased during the 1990s (OECD, 2003). For example, recent equality legislation in Ireland (namely the Employment Equality Act 1998 and Equal Status Act 2000) introduced disability as a ground on which discrimination in employment could not occur.

However, to date there has been no comprehensive account of the extent of participation for people with disabilities in Ireland, (see Bound (1991) for a review of international literature). The aim of this thesis therefore is to provide a detailed description of the labour market situation of people with disabilities in Ireland, and an analysis of factors associated with participation. Firstly, this thesis will provide, for the first time, benchmark levels of labour force participation by people with disabilities in Ireland. The benchmark levels are of crucial relevance to disability and employment policy in Ireland. With recent advances in disability law concerning the move towards a civil rights approach to disability, answers to this question are of significant importance to disability stakeholders, for example the National Disability Authority and Disability Federation Ireland. Secondly, this thesis contributes to international research by applying the latest econometric methodologies to analyse the relationship between disability and labour force participation. It seeks to answer how much of self-reported disability is measurement error arising from mis-reporting, and how much of the impact of disability on participation is due to unobserved individual characteristics. Furthermore, it estimates a dynamic model to determine the extent of the impact of previous non-participation, i.e. state dependence. The econometric models used to address these issues have been developed quite recently and these will be discussed in detail throughout the thesis. The application of these models to the problem of unobserved effects is novel in the disability and participation literature and provides a new way of approaching these questions. The model used to address the measurement error issue builds on previous econometric models, but the final version also applies a new variation of the model. The issues of measurement error and unobserved effects are also of interest to policy makers, as their results help to identify channels by which disability impacts on participation.

1.2 Review of disability schemes in Ireland

Disability schemes in Ireland are varied depending on whether or not the disability/illness is short-term or long-term, the extent of previous social insurance contributions and the cause of disability. Figure 1.1 illustrates a brief description. A report by the Department of Social and Family Affairs provides a more in-depth discussion of these payments and their historical context, (2003). To summarise, disability payments may be categorised into short and long-term payments, and entitlements also vary by previous social insurance contributions. The amounts received are comparable to unemployment assistance/benefit, so in that respect there is no incentive to prefer disability benefit. The incentive structure therefore lies in accessibility of these payments – if people think that disability payments are more readily available than unemployment payments, this may influence their disability reporting behaviour. Two main types of disability payments exist in Ireland -Disability Allowance is a weekly allowance paid to people with a disability who are aged 16 or over and under age 66. The disability must be expected to last for at least one year and the allowance is subject to both a medical suitability and a means test. The Deciding Officer may refer an individual for a medical assessment. Disability Benefit is a payment made to insured people who are unable to work due to illness. For this payment, individuals must attend their own GP to get a medical certificate. They may be required to attend a further medical assessment within the Department of Social Welfare, but this is at the discretion of the Deciding Officer.

Figure 1.1: Description of Disability Payments in Ireland

Short-Term		Long-Term
Injury Benefit ←	OCCUPATIONAL INJURY	→ Disablement Benefit
Disability Benefit ←	OTHER DISABILITY	→ Invalidity Pension
	PRSI CONTRIBUTIONS	

NO PRSI CONTRIBUTIONS

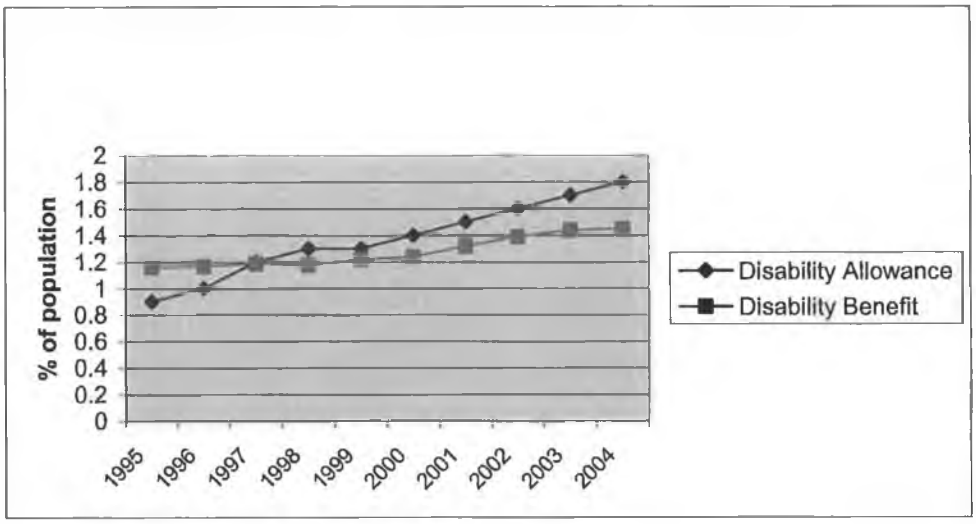
↓

Disability Allowance

(Disabled Persons Maintenance Allowance, pre 1996)

Figure 1.2 shows that the proportion of the population in receipt of the main disability payments increased between 1995 and 2004. This could be a reflection of improved access and information to social welfare payments for people with disabilities (this could include those who were previously employed but now are aware of their entitlements). On the other hand, it could be that there has been mis-reporting of disability status. The proportions receiving benefit fluctuate for all age groups indicating that it is not just because individuals are getting more disabilities as they get older, but that there are other reasons for the fluctuation in the proportions getting these payments.

Figure 1.2 Recipients of Disability Payments 1995-2004



Similar to the case of individuals who state their labour force status as unemployed, those who are near retirement age may also be prone to exaggerating their disability status, particularly if financial incentives exist. A pre-retirement allowance is available for individuals who have been unemployed for over a year and are aged 55 and over. The number of people in receipt of this payment dropped from about 15,000 in 1994 to approximately 11,000 in 2004. For those who wish to 'retire' at an earlier age or were recently employed, social assistance is less available. Individuals must prove they are unable to find work, so in this case they may be more inclined to report a disability and apply for disability benefits. The health and retirement literature has focused on this issue for the US, UK and the Netherlands, but until recently there has been no comparable analysis for Ireland, possibly because of data limitations.

1.3 Theoretical Background

Consider a model where individuals make decisions based on comparisons of utility from different states. Their choice between consumption and leisure is considered as a lifetime decision, and we assume that individuals maximise their expected utility over their lifetime. Following Bound *et al.* (1999), the labour force participation decision is based on the assumption that individuals maximise the expected value of future utility:

$$\max E_t \sum_{j=t}^{T} \beta^{j-t} U(C_j, L_j, Z_j) \qquad [1.1]$$

where C_j and L_j are consumption and leisure in period j respectively. Z_j is a vector of taste shifters and includes disability and β_j is the time-rate-of-preference discount factor.

The utility function is maximised subject to an intertemporal budget constraint:

$$A_{j+1} = (W_j H_j - C_j) + (1 + r_{j+1}) A_j \qquad [1.2]$$

where W_j is the wage, H_j is hours of work, A_j represents assets and r_j is the rate of interest. Solving this model provides an expression for optimal leisure as a function of W_j, H_j, A_j and Z_j. Theoretically, disability might influence each of these parameters. Depending on the nature of the disability, it might restrict the range of tasks the person can carry out, increase the costs of working, and affect the incentives faced – most obviously via receipt of disability-related state transfers. The effect is reinforced if disability increases access to unearned income. On the demand side, employers may be reluctant to employ individuals with a disability, either because of concerns about their productivity or because of additional costs associated with accommodating certain types of disability.

The lifecycle model is the basic model for research on disability and labour force participation, so the literature differs mainly in terms of the way that disability enters the utility function and/or econometric models. In particular, disability may be endogenous with respect to participation either by reverse causality or via the influence of unobserved individual characteristics. Much of the earlier literature did not account for this possibility. In later years, it was recognised that endogeneity may lead to an overestimation of the impact of disability and therefore received greater attention in the literature. This led to a range of different econometric methodologies to resolve this problem. It was also recognised that measurement error in self-reported disability would impact on the true effect of disability on labour force participation and this led to further advancements in the econometric techniques applied to this model.

1.4 Literature Review

Internationally, the first generation of econometric studies on the effect of disability on labour force participation emerged around the late 1970's. For example, Bartel and Taubmann (1979) estimated an OLS model of weekly hours worked to analyse the effect of health on earnings and labour supply. Chirokos and Nestel (1985) estimated a Tobit model relating annual hours worked to health history by looking at the degree of poor, good, improved or deteriorating health over the previous ten years.

Bound (1991) looked further at the methodology used by previous research and gave a comprehensive critique concerning the use of self-reported disability. In this light, more recent research has emphasised the importance of the way health and limitations are captured, with the type of health status variable used leading to different patterns in terms of labour force participation. Wolfe and Hill (1995), for example, measure health status using an index of limitation in daily activities. Madden and Walker (1999) measure health in terms of those who report a longstanding illness or disability, and find that poor health does significantly reduce the hours worked for both men and women in the UK. Kidd, Sloane and Ferko (2000) analyse the effect of health limitations on the kind of paid work possible. They confirm the presence of substantial wage and participation rate differences between disabled and non-disabled individuals in the UK.

Previous studies analysing unobserved individual effects in this context emerged in the mid 1980's. Sickles and Taubman (1986) were one of the first to use longitudinal data in estimating retirement decisions, and allow for unobserved heterogeneity in the retirement function. Estimating a binary random effects probit model, they allow for unobserved affects by simultaneously estimating the health and retirement equation, allowing the errors to be correlated. They allow for correlation of the unobserved effect with the disability variable, but they do not include the effect of labour market history. Their findings show that moving from poor health to good health decreases the probability of retirement, but they do not show how the health effect changes as a result of allowing for unobserved effects.

Bound (1991) looks at a retirement equation in the cross-sectional context, and shows that if the errors in the health and retirement equation are correlated, then there is an upward bias in the effect of health. He aims to identify the effects of financial incentives on reporting behaviour and retirement decisions, and investigates if objective measures may be used as a proxy for subjective measures of health. The author concludes that the self-reported measure is not reliable in estimating the effect of health on retirement. Kreider (1999) also analyses work participation with cross-section methodology and arrives at the same conclusion. He finds that when the true measure of disability is used, the effect on participation is lower, by 17.2 per cent for men and 24.9 per cent for women. Both Bound (1991) and Kreider (1999) use cross-section data to estimate the true effect of disability on participation, but identification of their models requires a variable that affects health but that is not correlated with participation.

In addition to unobserved heterogeneity, the more recent research focused on reporting errors in the disability variable. Kreider (1999), Bound *et al.* (1999) and Lindeboom and Kerkhofs (2002), have all established that reporting errors lead to a bias in the effect of disability in a labour force participation model. Kerkhofs and Lindeboom (1995) show that self-assessed health reporting varies by labour force status and financial incentives, with the disabled group more likely to mis-report.

Although there has been much research on the topic of disability and labour force participation, there are still some gaps in the literature, which this thesis aims to fill. In terms of literature to date, two significant gaps emerge. Firstly there is no research on this topic in Ireland. Secondly, the only paper to deal with concurrent problems of endogeneity and measurement error is Lindeboom and Kerkhofs (2002). The main drawback in their paper was the lack of a long panel of data. With two waves of data they required a simultaneous econometric specification. The availability of up to seven waves of panel data for the analysis in this thesis makes the process of estimation considerably more straight-forward. A common theme throughout this thesis and its contribution to this literature is in the way it deals with unobserved effects. To control for unobserved effects that may be correlated with disability a Mundlak (1978) estimator is applied to each model. In the dynamic model I follow the Wooldridge (2002) approach. This is a relatively new and underused approach to dealing with unobserved effects. The final part of this thesis applies a new approach to allow for both measurement error and endogeneity, combining the Mundlak approach of Chapter three with a cleansed measure of disability constructed from the generalised ordered probit model used in Chapter four. Compared to earlier research, this means we can distinguish between the two separate effects. The contribution of this thesis to the international use of applied econometric methodologies is summarised below and discussed in further detail within each chapter. Further technical details on these models are provided within each chapter.

1.5 Description of Living in Ireland Survey

The Living in Ireland Survey panel facilitates the use of the econometric models outlined above. The Survey was carried out each year from 1994 up to 2001, but information for the disability variable is only consistent from 1995 onwards, hence we concentrate the panel analysis on data from 1995-2001. The design is longitudinal, in that the same individuals are followed from one year to the next. Where possible each adult in the household was interviewed and the sample design aimed to produce a nationally representative sample. (Those living in institutions such as hospitals, nursing homes, convents, monasteries and prisons, were excluded from the target population). The survey thus provides not only a cross-sectional picture for each year, but also data that permits the analysis of changes over time. The size of the initial sample was substantially augmented in 2000 and all respondents were then followed up in 2001. We focus on individuals of working age, so we concentrate on the under 65 age group.

The Living in Ireland Survey obtained in-depth information about the current labour force status of each adult in sample households. We use all of this information to obtain an accurate indicator of labour force status – reflecting participation (working or seeking work) or non-participation.

The Living in Ireland Survey also included some questions directly focused on illness or disability. Respondents were asked:

“Do you have any chronic physical or mental health problem, illness or disability?”

It may well be that not only the presence of such an illness or disability but also the extent to which it limits or restricts a person may be important, so it is also important that the survey allows to distinguish:

a) those reporting a chronic illness or disability and saying that it limits them severely in their daily activities

b) those who report a chronic illness or disability and saying it limits them to some extent, and

c) those who report such a condition but say it does not limit them at all in their daily activities.

We should note that employers in Ireland, as in many other industrialised countries, are obliged by law to make 'reasonable accommodation' for those affected by disability. This may be achieved by changes in the work environment or in the way a job is performed, to enable a person with a disability to fully do a job and enjoy equal employment opportunities. For this reason, in the survey a person may respond as not limited in daily activities, but without adaptation it is possible that they should be classified as severely limited. The extent to which respondents say they are limited relates to their daily activities rather than work, but similar measures have been shown to have significant discriminatory power in terms of labour force participation in research elsewhere (e.g. Malo and Garcia-Serrano 2002).

This definition of disability is a standard measure used in many OECD countries –it conforms to the newer social model of disability whereby disability is seen as a consequence of social, attitudinal and environmental barriers that prevent people from participating in society. This model arises from a major shift in thinking about disability. Previously disability was viewed in terms of a medical model that focused on people's impairments and viewed these people as different to the norm. The measurement of disability in a survey context therefore poses considerable definitional and methodological difficulties. These issues are the subject of widespread debate, not least in respect of the implications for measurement of a shift from a medical to a social model of disability (Nolan *et al.* 2003). Nonetheless, research from other countries has faced similar difficulties but has contributed significantly to the debate on disability and labour force participation. Analysis of the Living in Ireland Survey can therefore add substantially to what we know about disability and participation in Ireland.

1.6 Summary of Chapters

Chapter two seeks to quantify the effects of disability on labour force participation in Ireland in a cross-sectional context. This provides baseline estimates of disability for the first time in Ireland. Using data from the Living in Ireland Survey it first looks at the relationship between current participation and current self-reported disability, with no controls for endogeneity or measurement error. The results show that those individuals reporting a severely limiting condition have a much lower probability of participation in the labour force than others, and this continues to be the case having controlled for other characteristics such as age, education and marital status. Chapter two also provides an analysis of the transitions into and out of disability and the related consequences for employment[1]. We compare the effect of onset, exit and persistent disability on the probability of employment. It looks at the characteristics associated with onset, exit and persistent disability and how this impacts on employment entry and exit. Pre-existing labour market disadvantage /selection effects are investigated. The results imply that employment policy should focus on the heterogeneity of disabled people, depending on their respective transitions into disability and the duration of their disability.

In Chapter three, the problem of unobserved heterogeneity is introduced. The dynamics of Chapter two are extended by exploring the channels through which previous disability affects levels of current participation. A range of panel models are considered, but our preferred model is a dynamic panel model. The estimation procedure has not previously been used in this context, so this chapter makes a significant contribution to the international literature. It shows how the estimates of current disability are changed once we control for the effect of past disability and previous participation. The results suggest that the base effect of disability is overestimated by between 40-60 per cent for men and by 5-10 per cent for women. An important finding from this paper is that the effect of past disability works via the channel of past non-participation.

Chapter four explores the possibility that reported limitations in daily activities are misreported, in particular for those who define their labour force status as disabled/ill,

[1] This material is taken from a paper that is an invited contribution towards a special edition on 'Disability and Employment' in an international journal 'Estudios de Economia Aplicada'. Hence, we concentrate on the decision to work only, compared to those not working. All other econometric models focus on participation probabilities i.e. working or unemployed but actively seeking work versus not participating in the labour force.

and assesses if financial incentives influence this group to mis-report. The main questions addressed are (1) was there state dependent reporting error and did economic incentives play a role, and (2) did this change over the years 1995 to 2001? Using a generalised ordered response model, cleansed measures of disability are calculated as predicted responses individuals would have made if employed. The results indicate that the disabled/ill group did over-report and the difference between actual and predicted probabilities only marginally changed between 1995 and 2001. When we control for unobserved heterogeneity the extent of measurement error is lower but still substantial, where almost 50 per cent of self-reports of severe limitations were mis-reports. Again, similar to the methodology for Chapter three, the final empirical model in this chapter has not been previously applied to measurement error of self-reported disability. In this context, this chapter gives added value to current international literature. International comparisons of mis-reporting behaviour are discussed and policy implications/lessons for Ireland are drawn from this analysis.

In Chapter five, the issues of unobserved heterogeneity and measurement error are brought together. The theoretical model is similar to that of Lindeboom and Kerkhofs (2002) but the estimation strategy is different – they use maximum likelihood simulation methods. However, because of the availability of a longer panel of data we use a less complicated methodology, namely the Mundlak (1978) estimator. Using the cleansed disability variable derived in the previous chapter, we differentiate between the impacts of classical and differential measurement error and unobserved heterogeneity.

Chapter six concludes the thesis and provides a brief summary of policy recommendations that were based on the findings of this research.

1.7 Conclusion

This introductory chapter set out the main issues addressed in this thesis. The overall aim is to estimate the impact of disability on labour force participation, while resolving the bias that results from unobserved heterogeneity and measurement error. The main findings are provided in detail within each chapter of this thesis, but in summary;

- disability does impact substantially on labour force participation;

- this effect is lower once we control for unobserved heterogeneity and state dependence forms most of this unobserved effect;
- there is an element of mis-reporting among some labour force groups – particularly the disabled/ill and retired; differential measurement error is significant;
- these findings of measurement error are similar to results from research in other countries;
- the true impact of disability is to reduce participation by about 15 percentage points. Compared to the original estimate of 26 percentage points, about half of the bias is due to unobservables, and the remaining half is a combination of differential and classical measurement error;
- disability policy priorities include targeting re-integration into the labour force, effective monitoring of disability payments, awareness of differences among people with disabilities in terms of condition and duration of disability.

Chapter Two
Disability and Labour Force Participation in Ireland

2.1 Introduction

While the likely linkages between disability, non-employment and poverty have been highlighted in an Irish policy context (see for example Combat Poverty Agency/Forum of People with Disabilities/National Rehabilitation Board 1994), this has been on the basis of very little direct representative evidence about disability and the labour market. Helping to fill this gap, this chapter analyses for the first time the factors associated with participation or non-participation in the labour market by people with disabilities in Ireland, firstly using cross-section data and then applying panel data to look at transitions in disability and work.

Our econometric analysis of the relationship between disability and labour force participation incorporates a range of socio-economic characteristics into the analysis, in order to isolate insofar as possible the impact of disability itself. The results suggest that individuals reporting a limiting disability have a substantially lower probability of participation in the labour force than others.

2.2 Theoretical and Empirical Background

The theoretical model has been outlined in Chapter one. Evidence for other countries does indeed suggest that employment rates for working-age individuals with a disability are lower than those for the rest of the working-age population. The motivation for trying to understand exactly why this comes about and how best to address it is not straightforward, given the range of direct and indirect implications it has for income and living standards and for social participation more broadly. Indeed, there has been a recent surge of interest in this topic in countries such as the UK, the USA and Germany, and in comparative analysis in an OECD and EU context.[2] This reflects *inter alia* a dawning realisation of the scale of spending on disability-related programmes – on average, OECD countries spend at least twice as much on such programmes as they do on unemployment programmes (OECD 2003). Disability benefit recipiency rates have been increasing in many countries, and such programmes typically account for at least

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[2] See especially European Commission (2001), OECD (2003).

10% of social spending. Furthermore, evidence from these countries suggests that disability-related benefit receipt is very likely to be long-lasting.

Understanding the relationship between disability and labour force participation is critically important, but it also gives rise to analytical challenges. The first complication, as in many other instances where one is trying to quantify the factors affecting labour market behaviour, is that individuals may differ in many respects other than presence or severity of disability, and it may be difficult to disentangle their effects. The second complication, specific to this application, is that the way in which disability itself is captured may be problematic, in that it may not be independent of labour market participation itself.

Our aim in this chapter is to produce estimates of the relationship between disability and labour force participation in Ireland for the first time. The results allow us to see first the extent to which those reporting chronic illness or disability limiting them in varying degrees are actually participating in the labour force. Secondly, we are able to control for a range of other socio-economic characteristics of the individual that might be expected to affect his or her labour force participation, thus isolating to some extent the impact of disability itself. The availability of a rich panel data-set allows us to also investigate transitions in disability and work.

There is however an important caveat to be noted. The possible endogeneity of self-reported health, which we have to rely on, has been noted in a number of studies (see for example Bound and Burkhauser 1999). Those not active in the labour market might be more likely than others (with the same actual disability status) to report themselves as disabled, for several reasons. One is that the presence of a limiting disability provides a justification for not being in work that is less open to stigmatisation. Another is that the individual may be in receipt of benefits that are linked to the presence of disability or incapacity to work, which could well affect their reporting behaviour. As we mentioned in Chapter one this could bias the results of an analysis which treats self-reported health as exogenous, as we do now in this chapter. We return to the implications in our concluding section.

2.3 Data

The Living in Ireland data used in this chapter has been described in Chapter one.[3] In this chapter we analyse the cross-sectional data from the 2000 survey, when the size of the sample was enhanced. We wish to focus on individuals of working age, so we exclude those aged 65 or over. The youngest individuals in this sample are aged 16 and the number of males and females are 3,315 and 3,362 respectively. The disability measure is constructed on the basis of individuals responding to the following question: "Do you have any chronic physical or mental health problem, illness or disability?"

The extent to which respondents say they are limited relates to their daily activities rather than work, but similar measures have been shown to have significant discriminatory power in terms of labour force participation in research elsewhere (e.g. Malo and Garcia-Serrano 2002). Furthermore, in Table 2.1 we see that there are different rates of employment and inactivity for each sub-group, suggesting it will be important to distinguish between the different levels of disability in our analysis of labour force participation. For instance, individuals with severe limitations are three times more likely to be inactive than those with no chronic illness or disability.

Table 2.1 Labour Force Status by level of restriction, 2000

	Severely Limited	*Limited to some extent*	*Not Limited*	*No chronic illness or disability*
Employed	18.9	35.9	57.1	68.1
Unemployed but seeking work	4.0	8.4	9.6	7.1
Inactive	77.1	55.7	33.3	24.8
N	153	548	294	5622

The effects of disability on labour force participation may differ among individuals depending on other characteristics for example age or education. We therefore include measures of age, education, region, unearned income, age of youngest child and marital status in our analysis. These variables are defined in detail and summary statistics are provided in Table A2.1.

[3] A study carried out for the Equality Authority, entitled *Disability and Labour Market Participation in Ireland* (Gannon and Nolan 2004a), also used data from the Quarterly National Household Survey (QNHS) Disability Module 2002 to provide a descriptive account of the employment status of people reporting long-standing chronic illness or disability. Patterns of disability and employment are the same from both sources. We also applied the baseline model of current disability and participation to the QNHS data, and we found similar results to those found in this chapter, (see Gannon and Nolan 2004b).

Before looking at the relationship between disability and labour force participation in more detail, the remainder of this section looks at dynamics of disability. In particular we distinguish between onset, exit and persistent disability. We begin by looking at those actually observed in the panel survey to experience onset, exit and persistent disability and show some summary statistics. Following Jenkins and Rigg (2003) we label movements into chronic illness and disability as 'onset' – because we can then see what happens to the outcomes we are interested in, i.e. employment as disability occurs. In doing so it is helpful to first identify all those individuals who are "at risk of onset" at a particular point, and see how many actually experience onset. We can then compare the outcomes of interest for those experiencing onset with those who were "at risk" but did not experience it. Those who are already reporting disability are not by definition "at risk" – we cannot observe them experiencing onset. Similarly we define 'at risk of exit' for individuals who experienced disability for two years and 'exit' for those who then left the state of disability after two years of 'at risk'. Persistent disability is defined as having a disability throughout the panel. With the exception of persistent disability, all trajectories are measured in two year events, to try and minimise the incidence of short term disabilities/chronic illnesses.

A total of 2,309 adults aged 15-65 were followed throughout the period from 1995 to 2001, so we have (2,309 x 7) = 16,163 observations in all. Out of these observations or "person-waves", the respondent reported having a chronic illness or disability in 2,489 cases or 16% of the total – so that is the average cross-sectional disability rate over the period. However, not all the observations will be included as "at risk of onset" – because some people reported disability throughout and thus were never "at risk" in that sense, for example. We provide numbers of observations and adults in onset and exit disability states in Table A2.2. This shows that 1,972 persons were "at risk of onset" over a total of 6,997 observations or person-waves when we use a two-year definition of "at risk". A total of 166 individuals are then observed to experience onset, in other words start reporting the presence of a chronic illness or disability and do so for at least two years in a row. The number of persons "at risk of exit" is much smaller than the numbers at risk of onset. However, a higher proportion then exit: 138 exits are observed, out of a total of 755 "opportunities to exit" – occasions when someone in the sample had reported disability in the previous two years and was then observed for two more years. In terms of persistent disability, there are 124 individuals in the sample reported disability in each year from 1995 to 2001, representing almost 6 per cent of all respondents.

In Table 2.2 we present some summary statistics for individuals in each of the three disability states. Onset of chronic illness/disability is more likely to be reported by older people and by those with lower levels of education qualifications. The probability of onset rises sharply for those over 55 years of age and is much higher for those with no educational qualifications beyond primary level than for those with higher attainment levels – which is in itself associated with age, since older people have lower levels of education on average than younger ones. The opposite pattern to that seen for those experiencing onset is evident for people with an exit from disability. The percentage exiting (as a proportion of all those at risk) seems to fall with age and with level of educational attainment. It also suggests women were more likely to exit than men. Looking in a descriptive fashion at the characteristics of those experiencing disability throughout the panel, we see from Table 2.2 that persistent disability is most frequent in the older age groups and the lowest educational attainment categories.

Table 2.2 Chronic Illness/Disability by Selected Characteristics

	% at risk and experiencing onset of chronic illness/disability	*% at risk and experiencing exit from chronic illness/disability*	*% experiencing persistent chronic illness/disability*
Gender			
Men	1.9	9.4	6.2
Women	2.1	16.6	4.0
Age			
15-24	0.6	20.0	1.5
25-34	1.7	20.0	3.2
35-44	1.3	12.7	4.0
45-54	1.7	13.7	6.8
55-64	3.9	8.5	7.5
Education			
Primary/none	3.5	9.5	10.0
Secondary	1.5	15.3	3.3
Third level	1.2	21.8	2.0

We can look further into the incidence of onset, exit or persistent disability for each type of characteristic while controlling for the influence of other individual and household characteristics by estimating a logistic model. We estimate a latent variable model and probabilities are calculated as:

$$D_{it}^{*} = X_{it}\beta + u_{it} \tag{2.1}$$

where D_{it}^{*} is the underlying latent variable that indexes the measure of disability, u_{it} is the random error term with a logistic distribution, X_{it} is a column vector of explanatory variables, and β is a column vector of parameters to be estimated. The dependent variable is $d_{it} = 1$ if $D_{it}^{*} > 0$ or $d_{it} = 0$ if $D_{it}^{*} \leq 0$. This model is estimated as a maximum likelihood logit model and

$$P(d_{it} \mid X_{it}) = \frac{e^{X_{it}\beta}}{1 + e^{X_{it}\beta}} \tag{2.2}$$

Because we are using panel data, we estimate a pooled logistic model and adjust the standard errors for clustering at the individual level.

In Table 2.3 column 1[4], we predict the likelihood that someone who was at risk of onset will then report a chronic illness or disability, depending on a set of characteristics that we believe might affect that probability. The explanatory variables we use include age, gender, education, labour force status and household composition. Since some of these (for example labour force status) may well be influenced by chronic illness or disability, for those with a disability onset we use values for the explanatory variables measured two years before onset, while for those with no onset we use the values in the first year they are observed in the panel, i.e. 1995. The results show that age is statistically significant in predicting onset, with the likelihood of onset increasing sharply as one moves from below 45 to 45-54, and then 55-64. Having no educational qualifications increases the odds of becoming disabled, most likely this effect is channelled via the subsequent occupational choice and/or social disadvantage. Individuals in households

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[4] For comparison with similar research in the UK (Jenkins and Rigg, 2003) we present the results as log odds, expressed as a linear function of the explanatory variables, $\ln\left(\frac{p(d_{it} \mid X_{it})}{1 - p(d_{it} \mid X_{it})}\right) = X_{it}\beta$. The effect of a unit change in X on the log odds of the event occurring is thus given by the β coefficient.

with one child less likely to have an onset of disability. This is an unexpected result and may be correlated with gender and/or the number of adults in a household. The other socio-demographic characteristics are not statistically significant in distinguishing those who experience onset – the small number of cases observed to do so, reduces the likelihood of detecting such effects. With the exception of the results for the variables of one child and working, these results are similar to those found by Jenkins and Rigg (2003) using the BHPS data.

The relationship between poverty and disability onset is of particular interest. Onset might well lead to an increased risk of entering poverty, but the relationship may also work the other way: people already in poverty may be more susceptible to chronic illness/disability onset, as the extensive research literature on health inequalities suggests (Burchardt, 2003). To explore this we tested income poverty status before onset as an explanatory variable. This was measured by whether the individual was in a household falling below 60% of median income in the sample, which is a widely used measure of poverty. This turned out to be significant, with individuals living in such households 1.7 times more likely to experience onset of chronic illness or disability than others.

The causal relationship between poverty, education, labour force status and the onset of chronic illness/disability is of course a very complex one, with all these outcomes being inter-linked and each both affecting and potentially affected by disability. The relatively small numbers in the surveys observed with disability onset limit the depth in which this can be explored, but these results provide useful background to the analysis of what happens to employment as onset occurs. As well as analysing what happens when someone starts a period of disability, we look at what happens to employment when a disability spell ends, and so we now turn to how that is captured in the survey and how many people are observed as "exiting" disability.

In the same table, column 2, we present estimates for the probability of exit from a disability. However, we do not find significant age (except for those aged 35-44) or education effects; it does suggest that women, those who are in work (prior to exit) and those with two or more children are more likely to exit disability.[5] The significant effect of age 35-44 could be related to labour market status, and the importance of returning to work following a short-term disability.

The regression analysis presented in column 3, suggests that those with low education and those aged 35 or over are indeed more likely than better educated and/or younger respondents to have experienced persistent disability. On the other hand, women, those who were in work when first observed in 1995, and those with two or more children have a reduced probability of experiencing persistent disability.[6]

Table 2.3 Logistic Regression Model of Chronic Illness/disability

	Odds Ratio		
	Probability of Onset of disability	Probability of exit from disability	Probability of persistent disability
Female	1.2350	2.2120*	0.3456**
No education qualifications	1.5093**	0.7104	2.0133**
Working	1.1724	1.9657**	0.1743**
Two adults	0.9636	1.2772	0.8422
Three + adults	0.9683	0.7861	0.8464
One child	0.5941**	1.3389	0.7011
Two+ children	1.0191	1.8612*	0.5147**
Age 25-34	1.8902	0.3878	2.6970*
35-44	1.7494	0.3162**	4.3517**
45-54	2.7234***	0.4785	3.6792**
55-64	6.7983**	0.4225	2.1617
Year	1.0434	0.8302*	0.9981
N	6997	755	15332
Pseudo R-squared	0.0492	0.0657	0.1277

Note: $**p \leq 0.05, *p \leq 0.10$

2.4 Methodology

Having looked in detail at the pattern of disability in the sample, we now look at the impact of disability on labour force participation. We begin by looking at the impact of current disability on current labour force participation. We assume that an individual's

[5] Poverty status was also tested in the statistical model, but unlike the results for disability onset did not prove significant in predicting exit.
[6] Once again we also tested poverty status in the statistical model but it was not significant in this case.

labour force participation decision is determined by a comparison of the offer wage and their reservation wage, where they will participate if the offer wage is higher. We do not directly observe the reservation wage, but we do know the outcome of their participation decision, so our dependent variable LFP (Labour Force Participation) is a dichotomous variable distinguishing participants (those in work or unemployed but actively seeking work) from non-participants. Unemployed individuals who are not seeking work are counted as non-participants. The structure of the error term in the labour force participation model determines the appropriate model of estimation. We assume that the error is normally distributed, and use a maximum likelihood probit model to predict the probability of participating in the labour force.

The dependent variable is y_i=1 if $y_i^* > 0$ or y_i=0 if $y_i^* \leq 0$, and the latent variable equation is

$$y_i^* = x_i'\beta + u_i . \qquad [2.3]$$

y_i^* is the underlying latent variable that indexes the measure of labour force participation, u_i is the normally distributed stochastic error term, X_i' is a column vector of explanatory variables, and β is a column vector of parameters to be estimated.

The estimated co-efficients from the probit model provide an indication of the direction of effect of an explanatory variable on this probability. In order to determine the change in predicted probabilities in percentage points, that are associated with changes in the explanatory variables, we present also the partial effects. Marginal probability effects are the partial effects of each explanatory variable on the probability that the observed dependent variable equals 1. Firstly, we determine the probability of labour force participation as:

$$P(LFP_i = 1 \mid X_i) = F(X_i'\beta) = \Phi(X_i'\beta) . \qquad [2.4]$$

If the explanatory variable is continuous, then we calculate the marginal probability effect with respect to X_{ik} as:

$$\frac{\partial P(LFP_i = 1)}{\partial X_{ik}} = \frac{\partial \Phi(X_i'\beta)}{\partial X_{ik}} = \phi(X_i'\beta)\frac{\partial X_i'\beta}{\partial X_{ik}} = \phi(X_i'\beta)\beta_k, \qquad [2.5]$$

where k is the k-th element in X_i, and ϕ is the standard normal density function. In practice, the X_i' is calculated at the means of the independent variables.

Most of our explanatory variables are dichotomous dummy variables so the marginal probability effects may be interpreted as the change in probability of labour force participation resulting from a change in one category of a variable to another, and we calculate these effects for a discrete variable X as $P(LFP_i = 1 \mid x_{ik} = 1) - (P(LFP_i = 1 \mid x_{ik} = 0) = \Phi(X_{1i}'\beta) - \Phi(X_{0i}'\beta)$, where X_{1i}' is a vector of explanatory variables with $X_{ik} = 1$, and X_{0i}' is a vector of explanatory variables with $X_{ik} = 0$. X_{1i}' and X_{0i}' are calculated at the means of the other independent variables[7].

So far we are assuming that each of the explanatory variables has constant differential effects, e.g. we are assuming that if there is a lower probability of labour force participation for the severely disabled, then this is so whether they are young or old. However, it may be the case that for example individuals aged 45-54 who are severely disabled may show a lower probability of labour force participation. In other words, there may be interactions between the two variables severely disabled and age 45-54. In this case, their effect on our outcome variable, LFP, may not be simply additive, but multiplicative. For this reason, we test several specifications of our models with interactions effects. For example, if we model labour force participation as:

$$y_i^* = Z_1'\beta_1 + Z_2'\beta_2 + Z_3'\beta_3 + u_i, \text{ where } y_i=1 \text{ if } y_i^* > 0 \qquad [2.6]$$

0 otherwise,

and $Z_1 = X_1$, $Z_2 = X_2$ $Z_3' = X_1'X_2'$.

[7] Alternatively, we could estimate the marginal effects at every observation and then use the sample average of the individual marginal effects, but in large samples both approaches give the same answer, (Greene, 2000).

In this model, X_2 affects the impact of X_1 and the partial effect is calculated as:

$$\frac{\partial P(LFP_i = 1)}{\partial X_{i1}} = \frac{\partial \Phi(Z_i^{'}\beta)}{\partial X_{i1}} = \phi(Z_i^{'}\beta)\frac{\partial Z_i^{'}\beta}{\partial X_{i1}} = \phi(Z_i^{'}\beta)(\beta_1 + \beta_3 X_2) \qquad [2.7]$$

Because the patterns of labour force participation for men and women may be rather different, we estimate separate equations for each. Firstly we estimate the effect of disability on labour force participation focusing purely on the categories, (1) Ill/Disabled with severe limitation (2) Ill/Disabled with some limitation and (3) Ill/Disabled with no limitation. These effects may be influenced by the age, marital status and educational qualifications of an individual, and these variables are added as a second set of explanatory of variables in the second regression we will report. The age of children may have an important influence on the labour force participation decision for women. These variables are included as part of a final set of explanatory variables in the second regression we report. For ease of comparison of the estimates between men and women, the child variables are included for men also. We then include interaction terms based on education and age.

As noted in Section 2.2, the nature of the variable being used to capture disability is critical. Disability is entirely self-reported rather than externally observed, and the nature of that reporting process may have implications for the weight to be placed on the results. We return below to this issue and its implications for interpreting our results, having presented the results of estimating the model described.

2.5 Results for Model of Labour Force Participation

We now present the results of estimating the probit model of labour force participation described in Section 2.4 with Living in Ireland survey data for 2000. We look first at results for men, then for women, and then explore possible interaction effects.

2.5.1 Results for Men

The estimation results for men are presented in Table 2.4. It is interesting to look first at the overall goodness of fit of the model and how it changes as we add explanatory variables, as reflected in the McFadden R^2. Initially this has a value of 0.1073, meaning that the model using only disability status to explain labour force participation performs 10.7% better than one that specifies the probability of labour force participation as a constant. When we add age, marital status, education and number of children this increases considerably to 0.2465.

Table 2.4 shows that when only the three variables capturing chronic illness or disability are included as explanatory factors, men with a chronic illness or disability which limits them severely in their daily activities have on average a reduction of 58 percentage points in the probability of being in the labour force, relative to men without a chronic illness or disability. Men with a chronic illness which limits them in their daily activities "to some extent" also have a substantially reduced probability of being in the labour force, though the reduction of about 36 percentage points is a good deal less than for those who are severely limited. Finally, men with a chronic illness that does not limit them in their daily activities have a probability of being in the labour force that is not significantly different to those without such a condition.

These figures take no account of the fact that those reporting a chronic condition may also differ in other ways that could influence their labour force participation. They could for example be older or less well educated on average, and that could help to explain their lower levels of labour force participation. So the second column of Table 2.4 shows the estimation results when the full set of explanatory variables is included in the estimated model, controlling for differences in age, education, marital status and number of children. The effect of a severely limiting disability on labour force participation actually rises slightly, although the difference is not statistically significant. That effect falls for those who are ill/disabled with some limitation, from 36 to 30 percentage points, while the effect for reporting illness/disability with no limitation remains insignificant.

In terms of the other explanatory variables, labour force participation increases with age up to 54 compared to those aged 55-64, men with secondary or third level education have a greater probability of participating in the labour market than those with no qualifications, and the probability of participation is slightly higher for men who have children aged between 12 and 18.

Table 2.4 Marginal Effects, Men, 2000

	Marginal Effect with No Controls	*Marginal Effect with Controls*
Disabled with severe limitation in daily activities	-0.5796**	-0.6101**
	(0.0464)	(0.0502)
Disabled with some limitation in daily activities	-0.3599**	-0.2948**
	(0.0313)	(0.0326)
Disabled with no limitation in daily activities	-0.0132	-0.0117
	(0.0339)	(0.0297)
Age 15-24		-0.0147
		(0.0245)
25-34		0.1142**
		(0.0117)
35-44		0.1054**
		(0.0125)
45-54		0.0864**
		(0.0119)
Married		0.0736**
		(0.0205)
Unearned Income/100		-0.0002
		(0.0019)
Secondary education		0.0819**
		(0.0156)
Third level education		0.0916**
		(0.0108)
Border, Midlands, West Regions		0.0031
		(0.0113)
Age youngest child <4		0.0402
		(0.0256)
>=4 and <12		0.0156
		(0.0221)
>=12 and <18		0.0411**
		(0.0169)
McFadden R^2	0.1073	0.2484
N observations	3315	3315

Note: $**p \leq 0.05, *p \leq 0.10$

2.5.2 Results for Women

The estimation results for women are shown in Table 2.5, and show a similar pattern to those for men. Before controlling for other characteristics, on average women with a chronic illness or disability which limits them severely in their daily activities have a probability of being active in the labour force that is 51 percentage points lower than women with no chronic illness or disability. Women with a condition that is limiting "to some extent" have a reduction of 26 percentage points in their probability of participation. These are slightly smaller negative effects than for men in the same illness/disability situation. Unlike men, though, women with a chronic illness or disability that does not limit them in their daily activities are also less likely to be in the labour force.

When we control for age, education, and other factors, as for men the impact of a severely limiting disability is effectively unchanged, at about a 52 percentage points reduction. For women with a condition that is limiting "to some extent" that reduction is now 22 percentage points. Women with a non-limiting chronic illness or disability are 7 percentage points more likely to participate compared to non-disabled women, but this is only significant at the 10% level.

As far as other variables are concerned, the effects of age, education, marital status and the presence of young children all have the impact on the probability of participation that would be expected from previous studies, with participation for example lower for married women and those with young children and higher for those with third-level education.

Table 2.5 Marginal Effects, Women, 2000

	Marginal Effect with No Controls	*Marginal Effect with Controls*
Disabled with severe limitation in daily activities	-0.5140** (0.0339)	-0.5245** (0.0379)
Disabled with some limitation in daily activities	-0.2599** (0.0296)	-0.2164** (0.0332)
Disabled with no limitation in daily activities	-0.1259** (0.0405)	-0.0708* (0.0434)
Age 15-24		0.1327** (0.0364)
25-34		0.3645** (0.0239)
35-44		0.3277** (0.0259)
45-54		0.2631** (0.0255)
Married		-0.0818** (0.0281)
Unearned Income/100		-0.0060 (0.0029)
Secondary education		0.2233** (0.0244)
Third level education		0.3904** (0.0195)
Border, Midlands, West Regions		-0.0463** (0.0204)
Age youngest child <4		-0.2093** (0.0346)
>=4 and <12		-0.1141** (0.0333)
>=12 and <18		-0.0388 (0.0320)
McFadden R^2	0.0311	0.1481
N observations	3362	3362

Note: $**p \leq 0.05, *p \leq 0.10$

2.5.3 Testing for Interactions

The models presented so far have implicitly assumed that the effect of disability on labour force participation is constant across for example different age groups or education levels. However, the impact of disability may in fact be more or less pronounced depending on the age or education level of the individual affected, and this could be important in understanding these effects and framing policies to reduce them. Including interactions between the explanatory variables in our estimated models can capture such inter-relationships, so we test a variety of such interactions.

Table A2.3 shows the estimated interaction terms for education and illness/disability, for both men and women. There are very few individuals in the survey with third level education and a severe limitation (5 men and 5 women) and few women with secondary education and a severe limitation (27 women), so we combine the categories severely and some extent limited for both men and women and focus on the interaction terms between limited in daily activities and types of education. None of these interaction terms are significant for women, indicating that the effects of disability are similar across all education groups. For men, we find significant effects of secondary education for those with severely or to some extent limiting disabilities. Men with a disability that does not limit them in daily activities who have third level education are not statistically different to men with no disability.

One might expect that the effects of disability on labour force participation would vary with age so another interesting interaction is disabled/limitation with age group (all interaction results are available from the author on request). For women, we find that two interactions are significant – limited to some extent and age either 25-34 or 35-44 and the marginal effects are -0.23 and -0.17 respectively. This means that women aged 25-34 would see a further reduction in their labour force probability due to a somewhat limiting disability, of 23 percentage points. For women aged 35-44, this further reduction is 17 percentage points compared to women in other age categories. We also find that women aged 45-54 who are disabled but not limited in daily activities are more likely to participate, the marginal effect of the interaction is 21 percentage points. For men, there are two significant interaction effects. Men who are aged 35-44 and are severely limited have a further reduction in labour force probability of 25 percentage points, compared to other individuals in other age groups and also with a severely limiting disability. For those who are limited to some extent, they are 9 percentage points more likely to participate if aged 15-24.

2.6 Results for Disability transitions and work

We now make use of the panel data 1995-2001 and the dynamic information in relation to disability onset, exit and persistence to deepen our understanding of the impact of disability on paid work. The previous section showed that those reporting a chronic illness or disability are much less likely to be in employment than those who say they have no such illness or disability.

However, some key points must be kept in mind in interpreting this cross-sectional pattern for people with disabilities. Not all of that difference in employment rates may be attributable to the presence or absence of disability per se, because those who report disability may also have other characteristics that disadvantage them in the labour market – for example in terms of age, gender, education and skills, or geographic location. Interpretation is further complicated by the fact that some of those other disadvantages may themselves sometimes have been affected by the presence of a long-standing disability – for example, the level of education and skills acquired. Finally, it is not so much the presence of disability itself as the extent to which it restricts the individual and the way that it is perceived in the labour market, as well as the extent of broader societal barriers to participation, that matter in terms of employment outcomes.

We now build on the results of section 2.5 to deepen the dynamic analysis of disability and labour force participation. We start by comparing the employment probability of persons reporting an onset of disability with those who were at risk but did not experience onset. We then look at employment rates for those who "exit" from a spell of chronic illness or disability. Finally, we focus on the employment situation of those who reported persistent disability over the course of the panel survey.

Table 2.6 shows the work status of such individuals one year before the onset of illness/disability, in the year of onset, and in the year following onset of the illness/disability.

Table 2.6 Employment Status for Those With Onset of Disability

	1 year before onset	Year of onset of chronic illness/disability	Year after Onset
	%	%	%
Employed	61.4	46.4	42.8
Non-employed	38.5	53.6	57.2
N=166			

We see that around 60% of those who become ill or disabled were in employment in the years before onset. Their employment rate falls to about 46% in the year of onset of the illness or disability. One year after onset the employment rate remains well below what it was before the onset of chronic illness or disability, and the inactivity rate is over half compared with one-third before onset.

These figures, although still based on only a relatively small number of cases in the data, certainly suggest that onset of disability is indeed associated with a substantial decline in the employment rate. Two further points are worth noting about the level of their employment rate before and after onset. The first is that even before onset their employment rate was below the overall average, at about 60% rather than 70%. Secondly, though, their employment rate in the year after onset, at just over 40%, is as low as the overall average for all those reporting chronic illness or disability, which will include some people who have been in that situation for much longer (as well as some only reporting it for the first time). So in terms of the 40%-70% contrast in employment rates between those with versus without a disability (see Gannon and Nolan 2004a), for these individuals about two-thirds of that gap seems to be reasonably attributable to the onset of disability and the fact that it has lasted at least over two waves of the panel; the remaining one-third of the gap is then attributable to "selection effects" – the pre-existing labour market disadvantages that these individuals had, in terms of education etc., before onset.

It is particularly interesting to know what distinguishes the people who leave employment following onset of a chronic illness or disability from those who do not, so we look at their profiles in terms of some key characteristics. Table 2.7 compares the profile of those who leave employment in the year of onset, those who remain employed in the year of onset but have left by the following year, and those who remained in employment throughout. We see that women and persons with no educational qualifications constitute a much higher proportion of those who leave employment than of those who do not. On the other hand the groups are not markedly different in terms of age or family composition. Unfortunately the sample sizes in these different groups are not large enough to support a formal statistical analysis to see whether these suggestive differences are in fact significant in statistical terms.

Table 2.7 Characteristics of Onset by Employment Status

	Employed in year before onset, not employed in year of onset	*Employed in year before and year of onset, not employed in year after onset*	*Employed in year before, of and after onset*
		%	
Female	59	64	40
No qualifications	45	54	29
Mean age	45	52	46
Mean number of children	1.0	0.6	0.8
Mean number of adults	2.4	2.7	2.5
N	102	77	71

We now estimate a probit model to see how much disability onset seems to affect the probability of leaving work having been employed in the previous year. This allows us to look at the contribution which disability onset on its own makes, having controlled for other factors. It calculates probabilities relative to the omitted reference category, and the results are in Table 2.8 in terms of the implied marginal effects of each variable compared with someone who did not experience onset, is a man, is in the omitted age category of under 25 etc.

The first column of the table shows that if the only explanatory variable included in the model is disability onset, then individuals with an onset are 23 percentage points more likely to stop working than the omitted category, who were at risk but did not experience onset. About 5% of that reference category stopped working from one year to the next, so this is the baseline figure against which the effects of an onset of chronic illness or disability are assessed. This means that about 28 per cent of people with an onset will stop work compared to only 5 per cent of those without an onset.

Table 2.8 Probability of Stopping Work

	Onset of Chronic Illness/Disability Only	*+Personal Characteristics*	*+Household circumstances*	*+Education*
Onset of chronic illness/disability	0.2314**	0.2082**	0.2043**	0.1939**
Female		0.0650**	0.0649**	0.0673**
Age 25-34		-0.0233**	-0.0224**	-0.0247**
35-44		-0.0292**	-0.0351**	-0.0391**
45-54		-0.0291**	-0.0309**	-0.0369**
55-64		0.0010	0.0081	-0.0057
2 adults in household			-0.0040	-0.0012
3 or more adults in household			0.0060	0.0059
1 child in household			0.0088	0.0078
2 or more children in household			0.0309**	0.0296**
No education qualifications				0.0357**
Year	-0.0032	-0.0034	-0.0029	-0.0024
R squared	0.0261	0.0769	0.0843	0.0919
N	4802	4802	4802	4802

Note: $**p \leq 0.05, *p \leq 0.10$

When we control for age and gender in the second column, we see that women and older workers are more likely to stop working, and when this is taken into account the estimated effect of disability onset falls slightly to 20 percentage points. In the third column we incorporate some household characteristics as explanatory variables, and see that individuals in households with two or more children are more likely to stop working, but the estimated effect of disability is not affected. In the final column we introduce having no educational qualifications and this does increase the individual's probability of stopping work, but once again this makes no difference to the impact of disability onset. So the results of formal statistical analysis confirm the broad picture conveyed by the comparison of employment rates before and after disability onset, that a reduction of about 20 percentage points is associated with onset.

As noted earlier, it is not only the presence but also the severity of a chronic illness or disability that may be critical in determining its impact. We can examine this by replacing the variable capturing disability onset with three variables, for onset of a chronic illness or disability that hampers the person in their daily activities severely, to some extent, or not at all. The results show that those reporting onset but not hampered in daily activities have a lower probability of working by 10 percentage points, compared to those without an onset of chronic illness or disability. For those who are hampered severely or to some extent by the chronic illness or disability, the percentage predicted to be working is much lower; the predicted impact of onset of a hampering disability is now a reduction of the order of 30 percentage points, controlling for other factors. There are however very few cases where we observe onset of a severely hampering disability, so the effect of onset of a disability that hampers severely versus to some extent cannot be reliably distinguished.

As well as the individual's own characteristics and their household composition, it might well be that the economic circumstances in which they find themselves affect whether they stay in employment having experienced onset of disability. In particular, being in a disadvantaged household before onset may affect the relationship between disability onset and employment. We tested for such an effect by including as an additional explanatory variable whether in the year before onset the person was in a household falling below 60% of median income. The results show that coming from such a household does increase the likelihood that the person will stop working, by about 7 percentage points. This may be related to a range of factors such as disability or education levels. Those who experience disability onset may do so because their level of income was so low that leaving their jobs and becoming dependent on social transfers is a profitable option. Their reservation wages may be pushed up, therefore hindering their labour participation. In our model, the effects of onset remain the same when we include previous poverty status – however, due to the potential endogeneity of poverty status, it is difficult to conclude whether or not those in lower income are more likely to leave work after disability onset[8].

If the likelihood of being in work declines substantially when disability onset occurs, it is also clearly of interest to look at what happens when someone who has been reporting a chronic illness or disability stops doing so – does their employment rate go back up? We now turn to exit from disability and the probability of being in work. In terms of exit from disability, we found there were 72 cases in the sample aged under 65 who

[8] Earlier on in this chapter, we saw that poverty does impact on disability onset, so there is a plausible hypothesis that people from lower incomes will be more likely to leave employment once they acquire a disability. The relationship between poverty, disability and education is complex, and is an interesting avenue for future research.

reported a chronic illness or disability for two years and then reported no such illness or disability for the next two years, and Table 2.9 shows the employment rate for these people in the year before disability "exit", the year of exit, and the following year. We see that 50 per cent were employed when they reported the chronic illness or disability. This rose to 58 per cent in the year they stopped reporting such an illness or disability, and was slightly lower in the next year. This is quite a substantial increase in the employment rate when we consider that we have concentrated on those who had the chronic illness or disability for at least two years, and also does not suggest any significant lag between exit from that status and the increase in proportion employed, though it is of course confined to those who then remain free of disability over the two-year period.

Table 2.9 Employment Status for those Exiting Chronic Illness/Disability

	Year Before Exit	Year of Exit from Chronic Illness/Disability	Year after Exit
	%	%	%
Employed	50.0	58.3	56.2
Non-employed	50.0	41.7	43.8
N=72			

We then estimate a probit model of the probability of being in work for the entire sample of individuals who had a chronic illness or disability for the previous two years. The results in Table 2.10 show that those who exit disability are 10 percentage points more likely to be in work than those at risk who do not exit. However, when we enter additional explanatory variables to control for other factors such as age, gender, and having no educational qualifications, the effect of exiting disability was no longer significant. Individuals who exited from disability had the same probability of getting work as other individuals who were at risk of exit but did not recover from their disability. This implies the longer-term effects of disability are also significant in terms of future employment.

This increase in the probability of being in employment is smaller than the reduction associated with disability onset that we estimated in the previous section. There is no reason to expect that one would simply offset the other; apart from anything else, the same people do not simply "flow" into and out of disability, since some of those experiencing onset do not exit. In addition, even if the same people were involved it could well be that different processes operate in the labour market in terms of employment retention on disability onset versus returning to employment on disability exit.

Table 2.10 Exit and Probability of Being in Work

	Exit from Chronic Illness/Disability only	*+ personal characteristics*	*+ household characteristics*	*+education*
Exit from chronic illness/disability	0.1039**	0.0723**	0.0693*	0.0574
Female		-0.0372	-0.0263	-0.0371
Age 25-34		-0.0819**	-0.0778**	-0.0688**
35-44		-0.1093**	-0.1045**	-0.0932**
45-54		-0.1871**	-0.1991**	-0.1611**
55-64		-0.3434**	-0.3654**	-0.3162**
Two adults			-0.0218	-0.0295
Three + adults			0.0282	0.0154
One child			-0.0485*	-0.0471*
Two+ children			0.0217	0.0214
No education qualifications				-0.0676**
Year	-0.0247**	-0.0097	-0.0087	-0.0092
Pseudo R^2	0.0273	0.1950	0.2276	0.2510
N	488	488	488	488

Note: $^{**}p \leq 0.05, ^{*}p \leq 0.10$

Over the life of the panel survey, 124 individuals of working age reported a chronic illness or disability throughout. As we saw earlier, these individuals are more likely than those with shorter or no experience of disability to be male, older, and have low education levels. Over half of those reporting chronic illness or disability throughout were not working in any of the survey waves. This compares with 25% for those who reported disability onset during the period, and 18% for those not reporting any chronic illness or disability throughout the panel. Differences in the number of years spent employed or non-employed could be partly due to other characteristics such as gender, age or education, so we now estimate formal statistical models to try to disentangle these effects. We take all working-age adults in the sample, and look at the probability that they were in employment in a given wave of the panel – so the number of observations is again the total number of adults by the number of waves we observe them. In Table 2.11 we estimate the model to look at the effect of persistent disability on the probability of being at work. The first point of comparison is with those reporting no disability throughout the panel, and these are used as the reference category. Secondly, it is also of interest to compare those experiencing persistent disability with those who reported disability onset, disability exit, and other durations or trajectories of disability over the life of the panel, so these are also included among the variables in the estimated model.[9] Each adult is included in the regression each time they are observed in the panel – so someone reporting onset will be counted first as a person without disability and then as a person who has reported onset; their labour force status at each of those points in time is what the model seeks to understand. We look first at the results when only the variables relating to disability are included, and then at what happens to these estimates when other individual and household characteristics are added to the model as explanatory factors.

[9] This could be, for example, someone reporting disability but for only one year – since we only count it as an "onset" if it lasts at least two years – or someone reporting disability in six out of the seven years – since we only count an "exit" lasting two years or more will be counted in this "other" category in the years they are reporting disability, and in the reference category in the other years. Similarly, someone reporting chronic illness or disability every second year will fall into this other category when they are reporting disability.

Table 2.11 Persistent Chronic Illness/Disability and Probability of Work

	Pr(Working) Base	*Personal Characteristics*	*Household Circumstances*	*Education*
Chronic illness/disability for entire panel	-0.4190**	-0.4695**	-0.4387**	-0.4138**
Disability onset	-0.2621**	-0.2204**	-0.2032**	-0.1865**
Disability exit	-0.1421**	-0.1044**	-0.0688	-0.0554
Other disability trajectory	-0.1428**	-0.1041**	-0.0840**	-0.0678**
Female		-0.3547**	-0.3715**	-0.3808**
Age 25-34		0.0984**	0.0987**	0.1181**
35-44		0.0586**	0.0789**	0.1052**
44-54		-0.0165	-0.0121	0.0348
55-65		-0.2433**	-0.2712**	-0.2008**
Adult2			-0.0183	-0.0301
Adult3			-0.0546	-0.0558
Child1			-0.0013	0.0025
Child2			-0.0573**	-0.0523**
Poor in previous year			-0.3858**	-0.3561**
No education qualifications				-0.1403**
Year	0.0213**	0.0279**	0.0281**	0.0260**
N	15332	15332	15321	15321
R squared	0.0422	0.1780	0.2366	0.2460

Note: $**p \leq 0.05, *p \leq 0.10$

We see in the first column that persistent disability has a marked impact on the probability of being in work, reducing it by 42 percentage points compared with the reference category. That category comprises those reporting no disability throughout the panel, and for those individuals 70% were in employment in a given wave. This means that for those who always reported a disability, the predicted employment rate is only 28% (that is, 70%-42%). Controlling for age and gender (in column 2) actually increases the estimated effect of persistent disability, but when household characteristics and the individual's education levels are included (in columns 3 and 4) that effect falls back again to about the level seen without any controls. So the impact of persistent disability throughout the panel survey on the likelihood of being in work is very substantial indeed.[10] (As explained earlier, capturing the severity of persistent disability for individuals over the period proved difficult since it proved quite variable from one year to the next, so we have not sought to incorporate that into our analysis of persistence.)

[10] Note that in looking at the impact of different disability experiences Gannon and Nolan (2004a) looked at the employment rate in 2000 of those who had experienced persistent disability (and other durations), whereas here we have incorporated employment over the entire period from 1995 to 2001.

The results also show that those who reported disability onset, disability exit or other disability trajectories are less likely to be in employment in a given wave than those who reported no disability, but that gap is considerably less than for those persistently reporting disability. (The point of reference being used here for these people is not the same as in the earlier analysis focused on onset and exit, where the comparison was with those "at risk"; we include them here where the reference group is those experiencing no disability in order to allow a direct comparison with the impact of persistent disability.)

2.7 Conclusions and implications

People with disabilities face many barriers to full participation in the labour market, with serious implications for living standards and quality of life. This chapter has analysed the factors associated with participation or non-participation in the labour market by people reporting chronic illness or disability in Ireland. The results of the cross-section analysis show a substantial impact on labour force participation of having a long-standing illness that limits the individual severely in their work or daily life. Working-age men reporting such a condition had a labour force participation probability of 60 percentage points lower than those without a condition, having controlled for other characteristics such as age and education, while for women the corresponding reduction was over 40%. Since the labour force participation rate for women is much lower than men, this means that the predicted participation rate for men and women severely limited by a longstanding illness or disability is only 25% and 10% respectively on average. For those reporting a longstanding illness which limited them to some extent though not severely, there was also a significant though much smaller impact on the likelihood of participating in the labour force. For those reporting a longstanding illness or disability that did not limit them in their work or daily activities there was no statistically significant effect on labour force participation. These results are broadly similar to the findings similar studies using the same methods, for example in the UK (Madden and Walker, 1999) and in the US (Chirokos and Nestel, 1985 and Stern, 1989).

Research on the topic elsewhere also highlights a number of ways in which investigation of this issue could usefully be developed. In particular, methods recently applied elsewhere using panel data go beyond what can be achieved with cross-sectional analysis. For example, Bardasi, Jenkins and Rigg (2003) using data from the British Household Panel Survey find that becoming disabled is indeed associated with a very sharp decline in employment there. Panel data from the Living in Ireland Survey allowed this dynamic perspective to be adopted in this chapter and we differentiated the transitions into and out of a disability state. Analysis of the characteristics associated with an increased risk of onset showed that older people are more likely to become ill or disabled. Having been in a low-income household in the previous year was also associated with an increased probability of disability onset. Among all those "at risk", persons initially in work seemed more likely than others to report exiting disability. Those experiencing persistent disability were seen to be disproportionately older and poorly educated.

We then examined what happens to employment after an "onset" of disability. Having taken a range of personal and household characteristics into account, the onset of disability was associated with a decline of about 20 percentage points in the probability of being active in the labour force. We then focused on those observed in the panel "exiting" chronic illness or disability. Further analysis of these individuals confirmed that exiting disability was associated with an increase of about 7 percentage points in the probability of being in employment, having controlled for personal and household characteristics. Finally, we showed that persistent disability - reporting chronic illness or disability throughout the seven years of the panel survey - was associated with a greatly reduced likelihood of being in employment. Only 13% of these individuals were in employment throughout the period. When a range of personal and household characteristics was taken into account, such persistent disability was shown by statistical analysis to be associated with a 42 percentage point reduction in the likelihood of being in employment.

These findings show that not only persistent disability but also disability onset are associated with a very substantial reduction in the likelihood that someone will be in employment. This poses a major challenge for policy in relation to tackling the many-faceted barriers to obtaining and maintaining employment that face people with disabilities. While this chapter aimed to explore various strands of disability duration and impacts on labour force participation, we acknowledge the caveat that self-reported disability may be endogenous with respect to employment status. Furthermore, if reporting of disability in the survey is prone to measurement error, the true effect of disability may be inaccurately estimated. In this chapter, disability is treated as exogenous and our results therefore provide a foundation on which to build more complex dynamic models. We therefore explore each of these issues in this thesis, firstly by looking at endogeneity in chapter three.

Appendix 2

Table A2.1 Variable definitions for Dependent and Independent Variables

Variable	Definition	*Men*	*Women*
LFP	=1 if participating in the labour market, =0 otherwise	84.0	57.8
Disabled with severe limitation	=1 if disabled and severely limited in daily activities, =0 otherwise	2.8	1.7
Disabled with some limitation	=1 if disabled and limited to some extent in daily activities, =0 otherwise	8.1	8.3
Disabled with no limitation	=1 if disabled and not limited in daily activities, =0 otherwise	4.1	4.7
	(Base category=No disability)	84.0	85.1
Age 15-24	=1 if aged 15-24 years, =0 otherwise	24.0	22.4
Age 25-34	=1 if aged 25-34 years, =0 otherwise	18.6	17.7
Age 35-44	=1 if aged 35-44 years, =0 otherwise	20.1	21.2
Age 45-54	=1 if aged 45-54 years, =0 otherwise	20.4	21.2
	(Base category=aged 55-64 years)	16.6	16.9
BMW	=1 if living in Border, Midlands, West region, =0 otherwise	30.8	28.5
	(Base category=Rest of Country)		
Secondary Education	=1 if highest level of education completed is secondary, =0 otherwise	58.5	61.3
Third Level Education	=1 if highest level of education completed is third level, =0 otherwise	18.4	18.9
	(Base category=No qualifications or highest level of education completed is primary)		
Married	=1 if married or living with a partner, =0 otherwise	55.6	59.8
Age Youngest Child<4	=1 if age of youngest child is less than 4, =0 otherwise	10.1	12.2
Age Youngest Child>=4 and <12	=1 if age of youngest child is greater than or equal to 4 and less than 12, =0 otherwise	14.6	16.9
Age Youngest Child>=12and <18	=1 if age of youngest child is greater than or equal to 12 and less than 18, =0 otherwise	12.1	13.3
Unearned Income	=Net Household Income – Net Individual Disposable Income (Net Individual Disposable Income includes net incomes from work, social welfare payments and child benefit. Net Household Income aggregates individual data to household level)	356.49 (309.11)	478.60 (346.91)

Note: The regional classifications are based on the NUTS (Nomenclature of Territorial Units) classification used by Eurostat.

Table A2.2 Onset and Exit in Chronic Illness/Disability, 1995-2001

	Total at risk	Onset of chronic illness/disability	At risk but no onset
Number of Persons	1,972	166	1,806
Number of person-waves	6,997	166	6,831
% of total person-waves	100	2.4	97.6
	Total at risk	Exit from Chronic Illness/Disability	At risk but no exit
Number of Persons	333	96	237
Number of person-waves	755	96	659
% of person-waves	100	13.0	87.0

Table A2.3 Interaction effects for education and disability

	Men	Women
Not disabled (reference)		
Disabled with severe/some limitation	-0.4654**	-0.3231**
	(0.0451)	(0.0526)
Disabled with no limitation	-0.0985**	-0.1359
	(0.0620)	(0.0914)
Age 55-64 (reference)		
15-24	-0.0142	0.1344**
	(0.0091)	(0.0360)
25-34	0.1129**	0.3633**
	(0.0120)	(0.0238)
35-44	0.1022**	0.3266**
	(0.0129)	(0.0257)
45-54	0.0876**	0.2621**
	(0.0121)	(0.0254)
Single (reference)		
Married	0.0737**	-0.0814**
	(0.0208)	(0.0279)
Unearned Income/100	0.0002	-0.0066**
	(0.0019)	(0.0029)
No Qualifications (reference)		
Secondary education	0.0469**	0.2057**
	(0.0175)	(0.0269)
Third level education	0.0820**	0.3836**
	(0.0131)	(0.0211)
(Remainder of Country-reference)		
Border, Midlands, West Regions	0.0051	-0.0442**
	(0.0114)	(0.0204)
No children (reference)		
Age youngest child <4	0.0375*	-0.2049**
	(0.0259)	(0.0346)
>=4 and <12	0.0103	-0.1116**
	(0.0228)	(0.0322)
>=12 and <18	0.0359*	-0.0379
	(0.0177)	(0.0319)
Disabled limitation/secondary education	0.0655**	0.0856
	(0.0156)	(0.0665)
Disabled no limitation/secondary education	0.1023**	0.0979
	(0.0082)	(0.0945)
Disabled limitation/third level education	0.0572	0.0453
	(0.0310)	(0.1016)
Disabled no limitation/third level education	-0.0334	-0.0682
	(0.0839)	(0.1707)
McFadden R^2	0.2479	0.1440
N observations	3315	3362

Note: $**p \leq 0.05, *p \leq 0.10$

Chapter Three

A Dynamic Analysis of Disability and Labour Force Participation in Ireland 1995-2000

3.1 Introduction

In chapter two we presented the base impact of current, previous and persistent disability on labour force participation, without controlling for biasing factors such as endogeneity or measurement error. Nonetheless, in studying the effect of disability on labour force participation, we are faced with a variety of analytical challenges, such as the effect of unobserved characteristics of disabled individuals and the effect of their past participation in the labour market. This chapter uses panel data methods to control for these factors and we estimate the impact of disability on participation, controlling for unobserved heterogeneity and past participation.

The focus of previous policy for disabled people has been on the provision of services, whereas more recently, there is a campaign for civil rights and the provision of legislation for equality and full participation[11]. Employers and policy makers are therefore interested in whether or not disability has an effect on participation. In estimating the effect of disability on labour force participation, there are two main sources of bias that may arise, from measurement error and endogeneity. Previous research by Bound, (1991) and Lindeboom and Kerfhofs, (2002) has already set out the main issues involved and we now review these to emphasise the motivation for this paper. Firstly, there may be problems with the measurement of the disability variable and lack of comparability across individuals may lead to underestimates of the effect of disability (via classical measurement error). On the other hand, economic or psychological incentives may affect an individual's response to questions on disability, leading to differential measurement error within the self-reported measure of disability in the participation model. Secondly, participation and disability may be endogenously related because of direct effects of participation on disability. In addition, there may be unobservables that influence both disability and participation

[11] The employment policies (Employment Equality Act 1998 and Equality Act 2004) in Ireland define disability as 'including total or partial absence of bodily or mental facilities, chronic disease, whether manifest or not, learning and personality disorders'. These policies are directed at all individuals with a disability, even if not registered as disabled.

outcomes, for example through an individual's time preference or previous investments in human or health capital. In this paper, we focus on controlling for the latter, referred to by Lindeboom and Kerkhofs, (2002) as 'classical endogeneity'[12].

Our data offer the possibility of analysing the relationship between disability and labour force participation over a significant period rather than just at a point in time, and allow us to use panel data techniques in our estimation. Using panel data, we capture the effects of variables that are particular to an individual and are constant over time. Labour force participation may also be influenced by past participation, where non-participants in the previous year may be less likely to participate in the current year. Although this may be true for all individuals, it may also be a specific characteristic of disabled people and lead to an incorrect interpretation of the disability effect. It may be that disability reduces the probability of previous participation, and therefore indirectly influences current participation. Using panel data, we can incorporate this state dependence effect and re-estimate the effect of disability on participation.

More recently, Lindeboom and Kerkhofs (2002) also include the effect of past labour market outcomes on current health in their retirement model. They find that for elderly people, working in the previous period only slightly decreases the value of health. They estimate a multinomial logit model, to facilitate the three different labour market states compared to working, available to individuals nearing retirement age in the Netherlands. Although they only have two waves of panel data, by using information on previous labour market history, they specify an equation for initial participation and estimate the probability of working initially. This is included into the overall likelihood function from which unobserved effects are integrated out. They find that the effects of health are exaggerated for elderly people in a simple multinomial model, compared to their preferred model.

[12] The issue of reporting behaviour has been dealt with in the context of the retirement literature. Bound (1991) gives an excellent exposition of the issues involved with reporting behaviour and the resulting bias, and concludes that without external information about reporting behaviour it is not possible to identify the extent of the reporting bias. Later studies follow this approach, (e.g. Lindeboom and Kerkhofs, (2002) and Kreider, (1999)) and make assumptions regarding systematic reporting behaviour to identify the extent of reporting bias. This paper does not focus on reporting issues.

The contribution of this paper to the literature on disability and participation is in the way the dynamics are estimated and in particular the approach used to deal with initial conditions. Bound *et al.* (1999) analysed the dynamic relationship between health and labour force transitions, and examined how the timing of health shocks affects labour force behaviour but noted that to credibly control for initial conditions is a difficult task. We follow the Wooldridge (2002) approach to control for unobserved effects that may be correlated with disability and we discuss this further in section 3.3. This is different to the approach to Lindeboom and Kerfhofs (2002) mainly because we use six waves of panel data and can therefore identify the effect of past participation within a less complicated model. The main focus in this paper is to model two labour market outcomes – participation and non-participation – and hence we concentrate on a binary response variable. In contrast to Lindeboom and Kerkhofs (2002) and Bound *et al.* (1999) we follow an approach by Wooldridge (2002) that allows us to avoid specifying a distribution for the initial participation. The likelihood function from our approach is easier to estimate and serves the same purpose in terms of looking at the effect of unobserved heterogeneity. Our findings using Irish data are similar to previous international research; reported disability status overestimates the effect of disability on participation. In addition, we show exactly how much unobserved heterogeneity contributes to variation in participation and how this changes the effect of disability. Finally, we show the effect of past disability (via it's effect on previous participation), on current labour force participation.

3.2 Data

The data on disability and labour force participation in Ireland are from the Living in Ireland Survey 1995-2000. Within the sample there is considerable attrition over the period with 7,254 individuals responding in 1995 and only 3,670 of these still present by 2000. We present the composition of the sample at each wave in Table 3.1 and return to the potential effects of this attrition in section 3.4. We wish to focus on individuals of working age, hence we exclude those aged 65 and over.

Table 3.1 Sample Size and Composition at each Wave

	1995	1996	1997	1998	1999	2000
Men	50.4	50.5	50.4	49.8	49.9	49.1
Women	49.6	49.5	49.6	50.2	50.1	50.9
Age 15-24	24.9	24.7	24.2	23.7	22.8	23.1
24-34	20.5	20.2	20.3	20.5	20.0	18.7
35-44	20.6	20.7	21.1	20.9	21.4	21.3
45-54	19.1	19.4	19.3	19.7	19.8	19.5
55-65	14.8	14.9	15.0	15.2	15.9	17.4
Education						
Primary	26.9	26.3	26.2	24.6	23.8	21.8
Secondary	59.8	60.7	60.7	58.7	58.3	60.7
Third Level	13.2	13.1	13.1	16.6	17.9	17.6
Married	59.1	58.7	59.2	58.5	58.6	56.9
N	7254	6337	5782	5273	4482	3670

In the Living in Ireland Survey, detailed information on current labour force status was obtained. For current purposes this allows us to distinguish between those who were at work, or unemployed but seeking work – who we will count as active in the labour force – and all others, whom we will count as inactive. The percentage of those unemployed but seeking work is quite low ranging from 7.5% in 1995 to 2.8% in 2000, giving a panel average of 5.1%. For this reason, we do not include them as a separate category in our dependent variable. Only 2.2% of the panel is retired before the age of 65, with more men than women taking early retirement. For those who had a disability in the previous year, 1% changes from employment to retirement in the current year, and only 0.5% go from non-participation into retirement. Of all those currently with a disability, 2% of men leave employment for retirement and 4% become retired following a spell of non-participation. While it would be interesting to analyse the effect of disability on early retirement, again the sample size does not allow such investigation. A more detailed survey of disability and retirement of older workers in Ireland would provide better data for this purpose.

As in chapter two, the measure of disability is based on individual responses to the following question:

"Do you have any chronic, physical or mental health problem, illness or disability?"

We should note that employers in Ireland as in many other industrialised countries are obliged by law to make 'reasonable accommodation' for those affected by disability. This may be achieved by changes in the work environment or in the way a job is performed to enable a person with a disability to fully do a job and enjoy equal employment opportunities. For this reason, in the survey a person may respond as not limited in daily activities, but without adaptation it is possible that they should be classified as severely limited. The extent to which respondents say they are limited relates to their daily activities rather than work, but similar measures have been shown to have significant discriminatory power in terms of labour force participation in research elsewhere (e.g. Malo and Garcia-Serrano, 2003). Furthermore, as Table 3.2 shows there are different rates of participation for each sub-group, so it is important that we distinguish between the different levels of disability, in our analysis of labour force participation.

Table 3.2 Labour Force Status by level of limitation

	Severe limitation	*Some limitation*	*No limitation*	*No chronic illness or disability*
Men				
Participation	34.92	58.02	81.45	91.59
Non-participation	65.08	41.98	18.55	8.41
N	189	655	318	6026
Women				
Participation	13.82	31.82	44.65	55.15
Non-participation	86.18	68.18	55.35	44.85
N	123	707	318	6522

The effects of disability on labour force participation may differ among individuals, depending on other characteristics, for example age or education. Since disability may be correlated with other variables, we include measures of age, education, region, unearned income, age of youngest child and marital status. These variables are defined in detail in chapter two and summary statistics are provided in Table A2.1. The youngest individuals in this sample are aged 16 and the number of observations of males and females are 7,188 and 7,670 respectively.

3.3 Model

A general model of labour force participation and disability may be constructed as follows:

$$y_{it}^{*} = b_0 + b_1 y_{it-1} + b_2 D_{it} + b_3 D_{it-1} + b_4 z_{it} + \alpha_i + \varepsilon_{it} \qquad [3.1]$$

where y_{it} is the observed indicator of labour force participation, y_{it}^{*} is the underlying construct generating y_{it} and z_{it} represents a range of other variables. We also include lagged values of disability into our model, (D_{it-1}) and this allows us to distinguish the effects on participation of those who have a longer-term disability from those who have just acquired their disability. The individual time invariant unobserved effect is captured by α_i. In order to distinguish between the two effects – unobserved individual effects and past participation - we include a lagged dependent variable into the model.

The empirical model is motivated by a lifecycle model where the choice between consumption and leisure is considered as a lifetime decision, and we assume that individuals maximise their expected utility over their lifetime (following Bound *et al.* (1999)). Our main aim to concentrate on how the disability effect changes once we allow for unobserved individual effects and state dependence in labour force participation. For individuals who have different expectations about future disability depending on the duration of their disability, those with previous disability that is expected to persist are less likely to participate in the future. Since disability may be expected to reduce wages and increase disutility of work we would expect current disability to be negatively related to current participation. The effect is reinforced if disability increases access to unearned income[13]. We are also interested in the effects of lagged disability conditional on current disability. People who are persistently with a disability may be less likely to recover; therefore, we might expect differences in the behaviour of two individuals both of whom are disabled today if their previous

[13] Our specification includes a measure of unearned income but does not include a control for wages. Correctly accounting for the relationship between disability and wages is a topic for future research.

disability status was different. Lagged effects may also be significant if transition takes time or if there is state dependence in unemployment. In this case we might expect to see different behaviour across two individuals neither of whom are disabled today if past disability had caused one of them to leave the labour force in the past. We test this in our paper by explicitly modelling state-dependence in labour force participation and observing the resulting effect on lagged disability.

To provide some baseline estimates of disability we firstly estimate a static pooled model assuming that the errors are independent over time and uncorrelated with the explanatory variables. This model assumes that disability is exogenous (we relax this assumption later on) and provides us with base estimates, with which we can compare results from models that incorporate unobserved heterogeneity and state dependence. For notational purposes, we let x_{it} include disability, lagged disability and other variables, for the remainder of the chapter. The log likelihood function for the pooled panel data is similar to that of the cross sectional probit:

$$\log L(\beta) = \sum_{i=1}^{N} \sum_{t=1}^{T} y_{it} \log F(x_{it}'\beta) + \sum_{i=1}^{N} \sum_{t=1}^{T} (1 - y_{it}) \log(1 - F(x_{it}'\beta)) \quad [3.2]$$

and maximising this across all i with respect to β, we obtain the pooled probit estimator. The standard errors have been adjusted to account for clustering at the level of the individual.

While this model provides us with base estimates of disability, it does not allow us to answer two important questions. The first interesting question is whether or not the control variables appropriately account for any unobserved characteristics of disabled people that also influence their labour force participation decision? If this were not true, we would expect that the actual effect of current disability should be lower.

The second question is whether or not past disability affects current participation directly, or does it work through a separate channel by negatively affecting past participation? If so, we would expect to see that past participation influences current participation, and the effect of past disability should disappear. This would suggest that past disability still does have an effect on current participation, but does so by a) directly influencing past participation and therefore, b) indirectly affecting current participation.

To allow for these effects we estimate a dynamic model of participation that incorporates both past participation and unobserved effects. In general terms the following likelihood is derived and maximised;

$$f(y_{i0},...,y_{iT} \mid x_{i0},...,x_{iT},\beta) = \int_{-\infty}^{\infty} f(y_{i0},...,y_{iT} \mid x_{i1},...x_{iT},\alpha_i,\beta) f(\alpha_i \mid x_i) d\alpha_i$$

[3.3]

$$= \int_{-\infty}^{\infty} [\prod_{t=1}^{T} f(y_{it} \mid y_{i,t-1},x_{it},\alpha_i,\beta)] f(y_{i0} \mid x_{i0},\alpha_i,\beta) f(\alpha_i \mid x_i) d\alpha_i$$

In a dynamic model, we observe individuals at some time after the start of the process, and most likely the initial state is not randomly assigned to the individual. If the initial state and unobserved effect are correlated we need to specify $f(y_{i0} \mid x_i,\alpha_i)$ - known as the initial conditions problem. Heckman (1981) suggests approximating $f(y_{i0} \mid x_i,\alpha_i)$ and then specifying $f(\alpha_i \mid x_i)$. Then $f(y_{i0},...,y_{iT} \mid x_i)$ is obtained by integrating out the unobserved effect. The main difficulty in this approach is in specifying the distribution of initial participation. We therefore follow an alternative approach suggested by Wooldridge (2002) where we consider:

$$f(y_{i1},...,y_{iT} \mid y_{i0},x_i) = \int_{-\infty}^{\infty} f(y_{i1},...,y_{iT} \mid y_{i0},x_i,\alpha_i) f(\alpha_i \mid y_{i0},x_i) d\alpha_i \qquad [3.4]$$

To control for correlated unobserved heterogeneity we follow Mundlak (1978) and Wooldridge (2002) and specify the distribution of the unobserved effect conditional on the initial value y_{i0} and the time-averages of any potentially endogenous variables:

$$\alpha_i = \alpha_0 + \alpha_1' y_{i0} + \alpha_2' \bar{x}_i + a_i . \qquad [3.5]$$

The estimate of α_1 is of interest as it shows the direction of the relationship between the unobserved effect and the initial value of labour force participation. The relative importance of the unobserved effect in the error variance of the labour force participation equation is measured as $\rho = \sigma_a^2 / (1 + \sigma_a^2)$. This is also the correlation between the composite latent error ($\alpha_i + \varepsilon_{it}$) across any two time periods.

The likelihood function is now:

$$\int_{-\infty}^{\infty} [\prod_{t=1}^{5} f(y_{it} \mid y_{i,t-1}, x_{it}, \alpha_i, \beta)] f(\alpha_i \mid y_{i0}, x_{it}, \beta) d\alpha_i \qquad [3.6]$$

where $f(\alpha \mid y_{i0}, x_{it}, \beta) = \Phi(\alpha_1 y_{i0} + \alpha_2 \bar{x}_i, \sigma_a^2)$ if y_{it}=1.

In this model of labour force participation, the individual effects are assumed to be random draws from a population, but correlated with the explanatory variables. We estimate a dynamic random effects probit model and maximise this likelihood function with respect to β and σ_α^2. This model assumes that the errors can now be correlated over time through the unobserved effect. The explanatory variables are assumed to be strictly exogenous and are uncorrelated with the error term, ε_{it}, for each individual. The advantage of using this model over the pooled static model is that we can now estimate parameters with greater efficiency. While the pooled model would allow us to obtain consistent estimates of these parameters, it is inefficient relative to our full conditional maximum likelihood model. Furthermore, the pooled model does not allow for correlation between the unobserved effect and explanatory variables.

The means of variables are added as a set of controls for unobserved heterogeneity and we are now estimating the effects of changing explanatory variables but holding the average fixed. However, we should note that in this model, it is only possible to identify the effect of time-constant explanatory variables if we assume that the unobserved effect is partially uncorrelated with the time constant variable, where the coefficient for the correlated random effect part of that variable is zero.

In the pooled probit model we obtained estimates of β / σ_u and because the total error variance was normalised to 1, the estimated βs were population-averaged parameters by default. However, the random effects model parameter estimates will only be the same as those from the pooled model when $\sigma_\alpha^2 = 0$. Therefore we need to rescale the βs that are estimated from the model. This is achieved by dividing the parameter estimates from the random effects model by $\sqrt{(1+\sigma_a^2)}$.

The dynamic random effects probit model relies on the assumption of strict exogeneity of the explanatory variables (x_i) conditional on α_i:

$$P(y_{it}=1 \mid x_i, y_{it-1},\ldots,y_{i0},\alpha_i)=P(y_{it}=1 \mid x_{it}, y_{it-1},\alpha_i) \quad . \qquad [3.7]$$

This means, that conditional on participation in the previous year and conditional on the unobserved individual effect, participation in the current year should not be related to any explanatory variable in past or future years. However, in our dynamic model, misspecification may arise from feedback effects from current labour force participation to future disability. We tested for exogeneity of the three limitation variables, by including future values of disability into the pooled probit model, (following Wooldridge (2002)). If the current disability variables are strictly exogenous, we should find the future values to be insignificant. We found that severe and some limitations are significant, meaning that these two variables are subject to feedback effects in the model for men. In that case, we should not rely on the results of the dynamic random effects model, as the assumption of strict exogeneity has been violated. Using a pooled dynamic probit model we can obtain consistent (yet inefficient) estimates and in that sense is more reliable than the random effects model, (Biewen, 2004). The pooled probit model with time averages only requires contemporaneous exogeneity, i.e. it only restricts the relationship between the disturbance and explanatory variables in the same time period. The pooled probit model does not rely on the strict exogeneity assumption, and so allows us to estimate a dynamic model of participation controlling for correlated heterogeneity, providing consistent but inefficient estimates (Biewen, 2004).

3.4 Results

Descriptive statistics

Chapter two contained a detailed description of disability dynamics. Table 3.3 provides a brief summary of year to year transitions. Firstly, we note that of those who have a disability at any year, 73% remain so in the following year. This means that approximately one quarter of all individuals recover from their disability, and so it is of interest to see if there is a lagged effect of disability on their current labour force participation. Similarly, the participation of those who do not recover is of interest. Furthermore, 6% of all men and women have a new disability each year, and again we would like to observe if this affects their current participation status. Within the group that do not recover there are also changes in the severity of their disability, so in our model we focus on the three categories of severe, some and no restrictions in daily activities.

Table 3.3 Transitions in Disability Status

	No Disability t	Disability t
	%	%
No Disability t-1	94.0	6.0
Disability t-1	27.2	72.8

Static Pooled Probit Model:

Using the Living in Ireland Survey 1995-2000, we estimate a range of panel models to capture the effect of disability on participation. The main variables of interest are, disability and the associated limitations in daily activities, but we also control for other factors that may be correlated with disability, as mentioned earlier. In addition, it is likely that past disability has a direct effect on current participation, so we include lagged variables for the three types of disability. Pooling all available data for the years 1995 to 2000, and estimating a standard probit model, we obtain estimates from the pooled balanced sample[14]. We present results from this pooled static model in Table 3.4, Columns 1 and 4, for men and women respectively. These results are

[14] We tested for non-random attrition using the procedure suggested by Wooldridge, (2002). The results find no evidence to suggest that our reported results are affected by non-random attrition.

presented as parameter coefficients, but we will later discuss some of the main results in terms of percentage effects.

The effects of current disability are quite high for both men and women, reducing the probability of current labour force participation significantly. At a first glance, disability has a greater negative effect on the labour force participation probability of men, compared to women. Although the effect of a severely limiting disability is less for women than men, it is still substantial. In the case of men, even those with no limitations have a slight reduction in the probability of participation. For women, we see that the probability of participation for those with no limitations, is not significantly different from women with no disability. The gap between the effects of severe and some limitations is quite large for men and even more pronounced for women, suggesting that severe disability has a more negative effect on women's participation. Past disability, in the previous year, also has a substantial effect on current participation, and is not much lower than the effect of current disability. The equality of current and past disability is also implicit in the results presented by Au *et al.* (2004) in Table 10. This applies in the case of severe and some limitations, for both men and women. Similar to current disability and severe limitations, we see that individuals who previously had a severely limiting disability have a much lower probability of current participation, compared to those with no previous disability.

Table 3.4 Panel Model Results

	Men (coefficients)			Women (coefficients)		
	[1]	[2]	[3]	[4]	[5]	[6]
	Pooled Static	Random effects dynamic (re-scaled)	Pooled Dynamic	Pooled Static	Random effects dynamic (re-scaled)	Pooled Dynamic
Lag LFP		0.7511**	1.687**		0.7494**	1.7974**
		(0.1194)	(0.0918)		(0.0835)	(0.0623)
Disabled with severe limitation	-1.2368**	-0.6639**	-0.5653**	-0.9173**	-0.8256**	-1.1359**
	(0.1314)	(0.2653)	(0.2218)	(0.1736)	(0.2827)	(0.2393)
Disabled with some limitation	-0.7886**	-0.5159**	-0.4757**	-0.3296**	-0.3137**	-0.4210**
	(0.0814)	(0.1594)	(0.1285)	(0.0755)	(0.1283)	(0.1106)
Disabled with no limitation	-0.2066**	-0.3464**	-0.3397**	-0.0175	-0.1811**	-0.2732**
	(0.1042)	(0.2161)	(0.1380)	(0.0928)	(0.1497)	(0.1326)
Lagged Disability						
Disabled with severe limitation	-1.0555**	-0.2534	-0.0765	-0.6203**	-0.1470	0.0102
	(0.1275)	(0.2593)	(0.2465)	(0.1626)	(0.2863)	(0.2643)
Disabled with some limitation	-0.5802**	0.0259	0.1796	-0.2742**	-0.0056	0.0514
	(0.0783)	(0.1592)	(0.1302)	(0.0714)	(0.1303)	(0.1177)
Disabled with no limitation	-0.0925	0.0887	0.1298	-0.0290	-0.0495	-0.0464
	(0.1175)	(0.2254)	(0.1461)	(0.0962)	(0.1566)	(0.1363)
Initial condition						
LFP in 1995		1.2059**	0.6399**		0.8984**	0.6315**
		(0.2096)	(0.0944)		(0.1353)	(0.0626)
Random effect (time averages)						
Disabled with severe limitation		-0.8815**	-0.9013**		-0.3077	-0.2653
		(0.5948)	(0.4588)		(0.7211)	(0.5607)
Disabled with some limitation		-0.7265**	-0.7146**		-0.1387	-0.1209
		(0.3237)	(0.2371)		(0.2744)	(0.2041)
Disabled with no limitation		0.3616	0.2146		0.4464*	0.5171*
		(0.5068)	(0.3297)		(0.3844)	(0.3087)
Constant	0.4642**	-0.8210**	-1.0449**	-0.5446**	-0.1118**	-1.5214**
	(0.1332)	(0.2167)	(0.1332)	(0.1074)	(0.1595)	(0.0945)
N	5930	5930	5930	6330	6330	6330
Pseudo R^2	0.2772		0.5371	0.1700		0.5303
Rho		0.4684**			0.3984**	

Note: $**p \leq 0.05, *p \leq 0.10$. *(Significance in random effects models are based on t-stats on base coefficients, not on the rescaled coefficients reported in this table). Estimation was carried out using the xtprobit command in Stata Version 7.0*

In terms of the other explanatory variables (see Table A3.1), we see that labour force participation increases with age up to 34 (compared to those aged 55-64), but the effect falls slightly after the age of 44. Those with secondary or third level education have a greater probability of participating in the labour market. As expected, we see that women with children are less likely to participate, and this effect gets smaller as the youngest child is older. The opposite effect is found for men, where children increase the probability of participation, in particular when the youngest child is either aged less than 4, or in the older age group of 12-18.

Dynamic Model

The results from the dynamic random effects probit model with correlated heterogeneity are presented in Table 3.4, columns 2 and 5 for men and women respectively. We discuss these results in three steps, (1) state dependence, (2) the effect of current and lagged disability and (3) unobserved heterogeneity.

The coefficient on lagged participation is viewed as an indicator of state dependence, and suggests that previous participation has a significant positive effect on current participation, for both men and women. This suggests, that even after controlling for observed and unobserved differences among individuals, participation in the previous year is associated with a higher probability of participation in the current year. This effect is similar for men and women.

Current disability with severe and some limitations now has a lower effect on current participation, and this difference is more pronounced for men. Previous disability is now insignificant for men and women. By including past participation into the model, the effect of previous disability appears to have no effect on current participation. This suggests that previous disability may have influenced previous participation, and now influences current participation via the channel of past participation. This does not imply, that past disability has no effect on current participation - it simply suggests that its effect is now operating through the channel of past participation. In this respect our findings are similar to those reported in Bound *et al.* (1999). In their paper lagged health was not an important determinant of labour force exits. However it is important to realise that the sample used in Bound *et al.* (1999) was restricted to those individuals who were working at time t-1, which is equivalent to conditioning on past participation. Our results make this conditioning explicit.

Disney *et al.* (2004) tested whether participation responses to health shocks were symmetric and found that health improvements have a weaker effect on transitions from inactivity than the reverse. One could test for these asymmetries in our model by including an interaction term between current and lagged disability. However, given the 3-fold specification of disability adopted in this paper, a full set of interactions would be intractable. This is an issue that we hope to return to in future work.

The results from this dynamic model, suggest that unobserved characteristics may have been part of the effect of current disability in the pooled model for men. Indeed, if we look at the correlated part of the random effect (time averages), this would suggest that having severe or some limitations is associated with unobserved characteristics that reduce the probability of participation for men, i.e. part of the original current disability effect is due to unobserved characteristics. For women, the disability results of the random effects model are generally the same as in the static pooled model. The extent of unobserved effects is higher in the model for men, with 47 per cent of the total variance due to unobserved heterogeneity. The corresponding result for women is 40 per cent.

Two different patterns emerge for men and women when we use the pooled estimator of the dynamic model. The results of the dynamic pooled probit model are presented in columns 3 and 6 of Table 3.4. Firstly, for men the effects of all variables are generally the same, compared to the random effects model, with the exception of lagged and initial participation. Previous participation has a higher effect, and initial participation has a lower effect. This could indicate that the random effects estimate of state dependence may be biased due to a violation of the no-feedback assumption. For women, the effects of current disability are now higher compared to those in the random effects model. The effect of young children has increased slightly. The estimate on lagged disability has increased, and the effect of initial participation is now lower.

We note that although the random effects model for women may be preferable, we would still expect reasonably similar results from the pooled dynamic model. This is not the case, as the pooled model provides more negative estimates of disability. To explore this further, we again followed Wooldridge (2002) and tested for the exogeneity of two variables – age of youngest child and education. Third level education failed the strict exogeneity test, and it is possible that there is some interaction between disability and education for women. Since the disabled may have a lower incentive to invest in education, the effects of disability on participation are small once the endogeneity of education is taken into account, (Walker and Thompson, 1996).

Average partial effects:

So far, we have presented the results as parameter estimates, but it is also interesting to present some of the results as percentage effects. So we now estimate some average partial effects, using the population-averaged parameters $\beta_a = \hat{\beta} / \sqrt{(1+\sigma_a^2)}$. This allows us to get partial effects, that are averaged over the population distribution of the unobserved effect and we can then compare these to the partial effects of the pooled model. The probability of participation is $N^{-1}\sum_{i=1}^{N} \Phi(\hat{\psi}_a + x_{it}\hat{\beta}_a + \bar{x}_i\hat{\xi}_a) = N^{-1}\sum_{i=1}^{N} \Phi[(\psi + x_{it}\beta + \bar{x}_i\xi).(1+\sigma_a^2)^{-1/2}]$ and for a discrete variable we evaluate this expression at different values for x_{it}, i.e. 0 and 1, and form the difference to obtain the average partial effect. The average partial effect for a continuous variable x_j is obtained by using the average across i of $\hat{\beta}_{aj}\phi(\hat{\psi}_a + x^0\hat{\beta}_a + \bar{x}_i\hat{\xi}_a)$.

Our main variables of interest are current and lagged disability, but the parameter estimates for lagged disability in the dynamic models are insignificant. For this reason, we only discuss the average partial effects calculated for current disability and lagged participation. In Table 3.5, columns 1 and 4, we see that the average partial effect of current disability is similar for men and women in the pooled static model. Once we introduce unobserved heterogeneity and state dependence into the model, this effect is much lower for men. In the pooled dynamic model, disabled men who are severely limited in daily activities are approximately 8 percentage points less likely to participate compared to those with no disability. Although this effect is quite small, we also see that men who did not participate in the previous year have a lower probability of current participation by 40 percentage points. The parameter estimates of lagged disability were insignificant in this model, suggesting that part of the non-participation in the previous period is due to the effect of previous disability[15].

The results for women are quite different, in that when we control for unobserved heterogeneity and state dependence, the effect of current disability is now slightly higher in the pooled dynamic model, compared to the pooled static model. However, the preferred dynamic model for women may be the random effects model, given that we did not reject strict exogeneity of the disability variables. Therefore, the results suggest that women who are currently severely limited have a lower probability of current participation by 25 percentage points. The effects of some and no limitations are much lower. Similar to the case of men, when we compared the static and dynamic models, we saw earlier that the effect of lagged disability is no longer significant. In Table 3.5, we show that the average partial effect of lagged participation is 13 percentage points - this is the magnitude of state dependence.

Table 3.5 Average Partial Effects

	Men			Women		
	[1]	[2]	[3]	[4]	[5]	[6]
	Pooled Static	Random effects dynamic (rescaled)	Pooled Dynamic	Pooled Static	Random effects dynamic (rescaled)	Pooled Dynamic
Disabled with severe limitation	-0.3346** (0.0504)	-0.1111**	-0.0865** (0.0471)	-0.3377** (0.0502)	-0.2557**	-0.3979** (0.0598)
Disabled with some limitation	-0.1680** (0.0238)	-0.0746**	-0.0654** (0.0230)	-0.1308** (0.0295)	-0.0787**	-0.1666** (0.0428)
Disabled with no limitation	-0.0330** (0.0187)	-0.0461**	-0.0438** (0.0221)	-0.0069 (0.0369)	-0.0435**	-0.1086** (0.0524)
Lag LFP		0.1292**	0.3927**		0.1296**	0.6286**

Note: $**p \leq 0.05, *p \leq 0.10$ *(Significance in random effects models are based on t-stats on base coefficients, not on the rescaled coefficients reported in this table).*

[15] It is important to realise that the insignificance of the lagged disability effect arises from the modelling of participation dynamics and not unobserved heterogeneity. Lagged disability remains significant in random effects models that do not model labour force dynamics.

Within the context of similar research using data from other countries, the contribution of unobserved effects to the base disability effect is quite similar in this paper. Using data for the UK, Kidd *et al.* (2000) show that 50 per cent of the difference in participation rates between disabled and non-disabled men is due to unexplained effects. Likewise, Kreider (1999) uses US data and finds that the estimate of disability for men is overestimated by 17.2%. Lindeboom and Kerkofs (2002) use data from the Netherlands and show that the effect of bad health on the probability of receiving disability benefit is overestimated, but the effect on the probability of receiving unemployment benefit is underestimated. The coefficients for the base models are –4.179 and -0.826, and for the corrected models are –2.261 and –2.131 respectively. Compared to all of these findings, our parameter estimates for currently disabled men with severe or some limitations, suggest that approximately 40-50% of the base effect is due to unobserved individual effects/state dependence. For women, we find that the original estimates of severe and some limitations are overestimated by about 5-10%.

In terms of policy, the results from this paper show that unobserved effects are an important factor in the participation decision for disabled people. In this paper, we cannot determine the nature of these unobserved characteristics, but further knowledge on these effects are necessary for integration of disabled people into the labour force. We find that past participation is also an important factor in the participation decision for disabled people, and the effect of past disability on past participation is relevant in this context[16]. The results highlight the difference in effects between longer term and short-term disability. The effect of past disability may have a continued effect through state dependence in labour force participation, even after recovery from the disability. Therefore, the focus of disability policy should be on early targeting of disabled individuals into employment. Additional information on how participation affects future disability will also prove useful, in that we may be

[16] The overall result in this paper is the same as in Bound *et al.* (1999) – people with lagged disabilities have the same participation rate as those without previous disabilities. In the retirement literature, Au *et al.* (2004) find that past disability decreases the probability of participation, but they do not control for state dependence. An additional finding in our paper is that the effect on participation is influenced by previous disability via previous participation.

able to establish how past occupational injuries from past participation affect current disability and participation, and people with these disabilities may re-join the labour force. The incentive effects of disability benefits may also play a role here and these factors will be investigated in future research.

3.5 Conclusions

People with disabilities face many barriers to full participation in the labour market, with serious implications for living standards and quality of life. This paper has analysed the factors associated with participation or non-participation in the labour market, using data on people reporting chronic illness or disability in a large-scale Irish representative survey. The results of the panel analysis presented in this paper, bring out the scale of the impact on labour force participation, of having an illness or disability that limits the individual severely in their daily life.

We controlled for state dependence and unobserved heterogeneity by estimating a dynamic model with correlated random effects. The results show that unobserved heterogeneity contributes substantially to the base effect of disability for men, and to some extent for women. In our preferred model, (pooled dynamic) disabled men with a current severe limitation are now only 9 percentage points less likely to participate compared to non-disabled men. However, the effect of past participation is quite high, at 40 percentage points. For women, our preferred model is the dynamic model with correlated random effects. Those with a severely limiting disability have a lower probability of participation by 26 percentage points, compared to women with no disability. The effects of some and no limitations are less substantial. The effect of past participation is lower in the model for women, reducing current participation by 13 percentage points. The interaction of disability, education and participation of women, should be explored further.

In this chapter, we aimed to provide more accurate estimates of the effect of disability on participation. However, we acknowledge some limitations. In particular, if the reporting of disability in the survey is prone to measurement error, we cannot estimate the true effect of disability on participation. This may help to explain the substantial contribution of unobserved individual effects, but without extending the model to allow for measurement error in reporting behaviour, our results on the effect of disability on participation are not conclusive. We consider the issue of measurement error in chapter four.

Appendix 3

Table A3.1 Panel model results - other explanatory variables

	Men (coefficients)			Women (coefficients)		
	[1]	[2]	[3]	[4]	[5]	[6]
	Pooled Static	Random effects dynamic (re-scaled)	Pooled Dynamic	Pooled	Random effects dynamic (re-scaled)	Pooled Dynamic
Age 15-24	0.0881**	-0.8044*	-0.5994	0.9325**	-0.1242	0.0592
	(0.1631)	(0.6526)	(0.4252)	(0.1408)	(0.3934)	(0.3009)
25-34	0.9489**	-0.2594	-0.2330	1.2672**	-0.0685	-0.0317
	(0.1594)	(0.5269)	(0.3671)	(0.1118)	(0.3048)	(0.2232)
35-44	0.9263**	-0.2174	-0.2452	1.2020**	-0.0020	0.0226
	(0.1431)	(0.3834)	(0.2523)	(0.1078)	(0.2496)	(0.1789)
45-54	0.5843**	0.0922	0.0223	0.7312**	0.0905	0.0609
	(0.1066)	(0.2447)	(0.1685)	(0.0935)	(0.1784)	(0.1269)
Secondary	0.3396**	-0.0350	-0.0513	0.4454**	-0.0354	-0.0590
Education	(0.0941)	(0.1923)	(0.1365)	(0.0687)	(0.1422)	(0.0902)
Third level	0.4645**	0.6479**	0.5838**	1.2310**	0.2164*	0.2114
Education	(0.1275)	(0.2693)	(0.2174)	(0.1041)	(0.2059)	(0.1574)
Married	0.2918**	0.6706	0.5780	-0.3147**	-0.3427**	-0.3765**
	(0.1309)	(0.6458)	(0.4449)	(0.0894)	(0.2915)	(0.1842)
Age youngest	0.3949**	0.2806	0.2240	-0.6454**	-0.6096**	-0.7032**
child <4	(0.1913)	(0.4664)	(0.2715)	(0.1051)	(0.2177)	(0.1754)
>=4 and <12	0.1202	0.2101	0.0871	-0.3852**	-0.3356**	-0.3934**
	(0.1435)	(0.3776)	(0.2241)	(0.0917)	(0.1987)	(0.1563)
>=12 and <18	0.3626**	0.2887	0.1881	-0.1006	-0.2261**	-0.2767**
	(0.1177)	(0.2512)	(0.1491)	(0.0885)	(0.1566)	(0.1227)
Unearned	-0.0021	0.0077	-0.0043	-0.0228**	0.0026	-0.0031
Income/100	(0.0142)	(0.0274)	(0.0244)	(0.0092)	(0.0145)	(0.0106)
BMW	0.1935**	0.1534	0.1836*	-0.0942	-0.0253	-0.0200
	(0.0846)	(0.1787)	(0.1026)	(0.0664)	(0.1222)	(0.1067)
Random effect (time averages)						
Age 15-24		1.1475**	0.8998*		0.9388**	0.8116**
		(0.7107)	(0.4639)		(0.4491)	(0.3238)
25-34		0.8831**	0.8192**		0.7351**	0.7433**
		(0.5869)	(0.4005)		(0.3594)	(0.2513)
35-44		0.9544**	0.9506**		0.8458**	0.8774**
		(0.4605)	(0.2951)		(0.3078)	(0.2084)
45-54		0.3444	0.3871*		0.4373**	0.5064**
		(0.3034)	(0.2013)		(0.2386)	(0.1579)
Married		-0.6698	-0.5980		0.1869	0.1999
		(0.6708)	(0.4587)		(0.3168)	(0.2058)
Secondary		0.4802**	0.4405**		0.2498**	0.2794**
Education		(0.2467)	(0.1637)		(0.1731)	(0.1113)
Third level		-0.3652	-0.3497		0.3795**	0.4228**
Education		(0.3198)	(0.2347)		(0.2567)	(0.1877)
Age youngest		0.2600	0.2245		0.1913	0.2489
child <4		(0.5784)	(0.3555)		(0.2803)	(0.2116)
>=4 and		-0.1027	-0.0108		0.2234	0.2855
<12		(0.4472)	(0.2590)		(0.2405)	(0.1802)
>=12 and		0.1202	0.1151		0.2012	0.2574*
<18		(0.3339)	(0.2052)		(0.2158)	(0.1555)
Unearned		-0.0137	-0.0018		-0.0310**	-0.0248*
Income/100		(0.0393)	(0.0311)		(0.0225)	(0.0146)
BMW		0.1183	0.0743		-0.0233	-0.0291
		(0.2250)	(0.1343)		(0.1552)	(0.1166)

Note: $**p \leq 0.05, *p \leq 0.10$ *(Significance in random effects models are based on t-stats on base coefficients, not on the rescaled coefficients reported in this table). Estimation was carried out using the xtprobit command in Stata Version 7.0.*

Chapter Four
The Influence of Economic Incentives on Reported Disability Status

4.1 Introduction

Self-reported disability status is often relied upon in labour force participation models, but this may be reported with error for economic or psychological reasons and can lead to a bias in the effect of disability on participation. The fact that some individuals may be prone to mis-reporting their disability or health status is well documented and the main types of measurement error involved in estimating the effect of disability on labour force participation are sufficiently described in previous literature (Bound, 1991, Lindeboom and Kerkhofs, 2000). In summary, firstly there may be problems with the measurement of the disability variable and lack of comparability across individuals may lead to underestimates of the effect of disability (via classical measurement error). Secondly, economic or psychological incentives may affect an individual's response to questions on disability, leading to systematic reporting errors by different groups of individuals within the self-reported measure of disability, i.e. differential measurement error. In addition to measurement error, there may be unobservables that influence both disability and participation outcomes. In this chapter, we focus on estimating the extent of differential measurement error (by labour force state) in reported limitations in daily activities[17].

Kerkhofs and Lindeboom (1995) proposed a model of health reporting, applied to assessing the extent of state dependent reporting error in subjective health in the Netherlands. The purpose of their model was to compare subjective and objective measures of disability across labour force states. The model conditioned on an objective measure of disability and other explanatory variables for example age or education, so that labour force status did not have any additional effect on the latent true disability variable. In this chapter, we follow this model by comparing subjective and objective measures of disability and then determine if any differences remain across labour market states, using the employed group as the reference category. If

[17] Chapter three deals with estimating the effect of disability on participation in the presence of classical endogeneity. This acknowledged that if the reporting of disability in the survey is prone to measurement error, then we cannot estimate the true impact of disability on participation. Therefore the objective of this chapter is to estimate the extent of measurement error and to assess the influence of economic incentives on state dependent reporting behaviour.

there are any remaining differences in reported disability between labour force groups, this is evidence of state dependent reporting errors relative to the employed. Kerkhofs and Lindeboom (1995) concluded that state dependent reporting behaviour is an indicator of financial incentives to mis-report. In their later paper however (Lindeboom and Kerkhofs, 2002), they noted that the extent of this mis-reporting may have been over-estimated due to the presence of unobserved differences between workers and non-workers. Results from that paper indicate that unobservables should be incorporated into the reporting model. In this chapter, we therefore estimate reporting behaviour with and without controlling for unobserved effects – this provides us with a more accurate magnitude of mis-reporting.

There are two main motivations for this chapter. Firstly, we wish to establish if economic incentives to mis-report exist in Ireland and how these compare to previous international research. Similar to other European countries there has been an increase in the number of disability benefit recipients in Ireland since the mid 1990s. Therefore, we would like to know if this represents an increase in the prevalence of true disability or is there an element of mis-reporting of disability status to justify being out of work and in receipt of disability payments. The main questions we address are (1) was there state dependent reporting error and did financial incentives play a role, and (2) did this change over the years 1995 to 2001? Our discussion puts forward some reasons for any potential change. The second motivation lies in the econometric methodology. The main contribution of this chapter to the international literature is in the manner we model the self-reported disability variable – while previous research has used the generalised ordered probit model, we initially apply the corresponding logit model. This performs similarly to the probit model, but additionally allows us to simultaneously carry out model specification tests. In particular, we test the fundamental assumption that the objective measure satisfies the parallel regression theory. Previous research (Kerkhofs and Lindeboom, 1995) used likelihood ratio tests for a similar analysis in the probit model. The result of the specification test in our paper is similar to Kerkhofs and Lindeboom (1995), i.e. the objective variable does not affect reporting behaviour. In addition, we control for unobservables using a random effects generalised ordered probit model – again, while the outcome of this would be similar to that if we used models outlined in previous research (e.g. Lindeboom and Kerkhofs, 2002), we now have the advantage of a much longer panel of data; seven waves compared to two waves previously in Lindeboom and Kerkhofs, (2002). The latter paper demonstrated that with panel data we can then use a less complicated model to get an estimate of state dependent reporting behaviour. Their proposal was to use the time-averages of the potentially endogenous objective and labour force state variables as a control for correlation between the unobserved effect and these endogenous variables [i.e. Mundlak estimator]. The problem with short panels is that the time averages may be strongly correlated with the endogenous variables; therefore Lindeboom and Kerkhofs, (2002) stated their preferred method was to simultaneously estimate subjective and objective health. In our paper, because we have a much longer panel of data, we follow the Mundlak approach; the estimation procedure is less complicated but will achieve a similar outcome.

Our findings using Irish data are similar to previous international research; mis-reporting of disability is influenced by economic incentives in particular for the labour force groups of disabled/ill and retired. We add to international results by showing exactly how much mis-reporting is over-estimated once we control for unobserved effects. In terms of applied econometric models, the variant of the generalised ordered probit model applied in this chapter has not been used in previous research.

4.2 Irish System

Labour force participation changed dramatically in Ireland during the 1990s. The numbers in employment increased dramatically, and by 2001 there was almost full employment, leaving an unemployment rate of 3.6%. For those who were still out of work, the eligibility rules for receiving unemployment assistance became more stringent, whereby unemployed persons must have proved they were actively seeking work to ensure continued receipt of unemployment assistance. The replacement rate—the ratio of unemployment benefits to after-tax wage income—was reduced from a high of 77 percent to 64 percent in 1994, a level below the OECD average. The Irish welfare system traditionally provided "more or less permanent support for the unemployed" with no maximum duration for unemployment assistance. In recent years, however, recipients in some age groups have been required to register in a public employment or training program if they wish to continue to receive benefits after their first six months on the rolls (Tille and Yi, 2001).

During a cycle of full employment, individuals that do not wish to work may be required to seek an alternative explanation for their non-participation. Psychological and financial incentives may influence them to state that they are unable to work. Perhaps some individuals who do not want to work would have claimed they had a disability in order to (1) get disability social welfare assistance, or to (2) justify themselves for not working. Two main types of disability payments exist in Ireland - Disability Allowance is a weekly allowance paid to people with a disability who are aged 16 or over and under age 66. The disability must be expected to last for at least one year and the allowance is subject to both a medical suitability and a means test; Disability Benefit is a payment made to insured people who are unable to work due to illness. The proportion of the population in receipt of these payments increased between 1995 and 2000. This could be a reflection of improved access and information to social welfare payments for people with disabilities. On the other hand, it will be interesting to see if in fact there has been mis-reporting of disability status. The proportions receiving benefit fluctuate for all age groups indicating that it is not just because individuals are getting more disabilities as they get older, but that there are other reasons for the fluctuation in the proportions getting these payments.

Similar to the case of individuals who state their labour force status as disabled/ill or unemployed, those who are near retirement age may also be prone to exaggerating their disability status. A pre-retirement allowance is available for individuals who have been unemployed for over a year and are aged 55 and over. However, for those who wish to 'retire' at an earlier age, social assistance is less available. Individuals must prove they are unable to find work, so in this case they may be more inclined to report a disability and apply for disability benefits. The health and retirement literature has focused on this issue for the US, UK and the Netherlands, but to date there is no comparable analysis for Ireland, possibly because of data limitations.

By definition of the different labour force groups, we would expect varying levels of reported disability, and Table 4.1 confirms this expectation. For those who are employed there is a high proportion reporting no restriction or disability. Although

5% are restricted in some way, we would expect that employed workers would not mis-report as there seems little incentive for them do so (Kreider, 1999). Unemployed individuals on the other hand are more likely to report a disability and we will need to disentangle whether this is true disability or mis-reporting with a view to obtaining disability allowance in the future. This may be difficult to do - it could be that due to lack of information they are claiming unemployment assistance rather than disability allowance, or it may be that they prefer to state their labour force status as unemployed rather than disabled, to avoid any potential discrimination. The disabled/ill group have a large proportion that say they are restricted in daily activities, as expected. About 14 per cent say that they are not restricted or have no disability. Our hypothesis is that the disabled/ill group may over-report for financial and psychological reasons, but this could also be true for the retired group. We show in Table 4.1 that almost one third report a limitation, so we hypothesise that this group may also over-report their disability status. The next group are the self-employed and we would expect that they have no incentive to mis-report – about 8% of them are restricted in some way. Finally, the other group include all others not represented in previous categories, including those in home duties. While these groups are not the focus of the chapter, it will be interesting to comment on their disability reporting behaviour.

Table 4.1 Labour Force Status by Restrictions, 1995-2001

	Severe	Some	None	No Disability	N
Employed	0.61	4.6	3.3	91.5	19889
Unemployed	1.59	9.18	2.75	86.5	2069
Disabled/ill	*33.1*	*52.6*	*4.94*	*9.35*	*1134*
Retired	*9.47*	*23.08*	*8.28*	*59.17*	*845*
Self employed	1.04	6.93	3.76	88.27	2497
Other	2.02	9.52	4.22	84.25	14132
All	2.33	8.61	3.84	85.22	40566

Source: Calculations using Living In Ireland data 1995-2001

Another objective of this chapter is to determine if the proportion mis-reporting a disability changed in any year. If so, this provides motivation for looking at changes in reporting behaviour and why this may have occurred. In Table 4.2 we show some administrative figures to support our proposal that individuals may have changed their reporting behaviour over the period[18]. First, we see that the number of applicants deemed as unqualified or who did not attend medical examination increased over the years. This could be the result of increased surveillance on this social welfare payment. It could also suggest that individuals were claiming they had a disability in an attempt to receive disability allowance. The increasing number of cases referred for examination but then not qualifying could support this view. Secondly, for Disability Benefit the number of applicants also increased dramatically up to 1998. Higher proportions were found capable of work after 1998. This suggests that individuals may have been over-reporting their disability status.

Table 4.2 % of unqualified/non-attendance to medical examinations

	1995	1996	1997	1998	1999	2000	2001
Disability Allowance							
Cases referred for examination	N/A	N/A	6423	7229	8862	10285	9663
% Unqualified	N/A	N/A	28	32	30	28	31
% Non-attendance	N/A	N/A	25	26	27	33	32
Disability Benefit							
Cases referred for examination	54226	52059	55089	63927	59224	45037	41710
% Capable of Work	14.8	12.8	13	11.8	12.5	15.6	15
% Non-attendance	29	31.4	30.3	32.0	30.7	27.6	29.8

Source: Statistical Information on Social Welfare Services, Department of Social, Community and Family Affairs

4.3 Model and Estimation

There are two types of possible endogeneity of disability within a labour force participation model – (1) true disability status and work could be related through unobservables or a direct effect of labour market state on true disability (2) subjective reported disability and labour market state could be correlated – i.e. there could be state dependent reporting error. Kerkhofs and Lindeboom (1995) suggest an approach that assumes away the first type of endogeneity, but this applies to a disability-reporting model only. In their later paper (2002), they demonstrate how this

[18] In 1996 the administration of Disability Allowance was transferred to another government department, so we do not have data on the numbers in receipt of this in 1995 and 1996.

endogeneity must also be controlled for in a participation model. In this chapter, we concentrate on the reporting model and return to the participation model in the next chapter.

We define reported disability as D^s (subjective reported disability), latent true disability as D^* and objective disability as D^0. The problem of differential measurement error occurs if reported disability does not accurately measure true disability due to its dependence on labour force status (L), so $D^s = f(D^*, L)$. As the value of true disability is unknown, (the latent D^*), we use an objective measure of disability as a proxy. True disability may also be influenced by labour force status and some other explanatory variables (x_1), e.g. education, so $D^* = f(D^0, x_1, L)$ [19]. Within our model of reporting behaviour, this suggests endogeneity between true disability status and labour force status may be problematic, and therefore we need to find a model that will allow us to condition this out.

Following Kerkhofs and Lindeboom (1995) an appropriate model is based on the assumption that conditional on the objective measure and other explanatory variables, labour force status provides no further information about true disability:

$$pdf(D^* \mid D^0, x_1, L) \equiv pdf(D^* \mid D^0, x_1). \qquad [4.1]$$

This means that even though there could be endogeneity via the effect of labour market status on true disability, this is controlled for once we condition on objective disability and other exogenous variables. Any effect of L on D^* is captured by the objective measure of disability and the exogenous variables x_1, so any remaining effect of L on disability is taken as evidence of state dependent reporting bias. This is the key identifying assumption of the model. The aim of the model is to compare subjective and objective measures of limitations and if there are any remaining differences for any particular groups we can assume this is evidence of state dependent reporting bias. The question is how closely related is the objective measure

[19] Reported disability may also be influenced by other explanatory variables, therefore $D^s = f(D^*, L, x_2)$.

to the subjective measure. If it is not a close substitute, then we must also control for observed individual characteristics (x_1).

In summary the model is:

$$D^* = f(D^0, x_1) \qquad\qquad D^s = f(D^*, L, x_2) \qquad [4.2]$$

This may be estimated using generalised ordered response models where we assume there is an unobservable latent disability measure D^* that is represented by objective disability, some other exogenous variables (x_1) and a time invariant unobserved individual effect (δ_i):

$$D_{it}^* = f(D_{it}^0) + x_{1it}\beta + \delta_i + e_{it} \qquad [4.3]$$

In a standard ordered response model the unknown cut-points (or threshold parameters) are $\alpha_1 < \alpha_2 < \ldots < \alpha_j$, but now

$$\alpha_j = \tilde{\alpha}_j + x_{it}\gamma_j + \delta_{ij}, \qquad [4.4]$$

where in our case x consists of both L and other explanatory variables x_2. It is also possible that the thresholds vary by time invariant unobserved individual effects, so we include δ_{ij}.

We define

$$D_{it}^s = 1 \text{ if } D^* \le \alpha_1$$
$$D_{it}^s = 2 \text{ if } \alpha_1 < D^* \le \alpha_2$$
$$D_{it}^s = j \text{ if } D^* > \alpha_j \qquad [4.5]$$

where D_{it}^s=1 if individuals are severely restricted in daily activities, D_{it}^s=2 if they are restricted to some extent, D_{it}^s=3 if they have no restrictions and D_{it}^s=4 if there is no disability. The cumulative probabilities of the discrete outcomes in the generalised ordered response model are;

$$\Pr[D_{it}^{s} \leq j \mid x_{it}, \delta_{ij}] = F(\tilde{\alpha}_j + x_{it}\gamma_j + \delta_{ij} - x_{it}\beta - \delta_i) = F(\tilde{\alpha}_j - x_{it}\beta_j - \delta_{ij}) \text{ j=1..J} \quad [4.6]$$

The distribution F is either Φ or Λ depending on whether the distribution of the error term is normal or logistic respectively. This type of model has previously been estimated by a generalised ordered probit model (see Lindeboom and Kerkhofs, 2002 and Hernandez-Quevedo *et al.,* 2004). Instead we focus intially on the generalised ordered logit model – it serves the same purpose and allows us to simultaneously test if D^0 and x_1 do in fact influence D^* rather than D^s. To facilitate the inclusion of unobserved effects we later estimate the generalised ordered probit model. While we noted in Table 4.1 that there are differences in reported disability status between labour force groups, we also estimate an ordered logit model to look at the statistical significance of these differences and to provide baseline estimates of the cut-points. The standard ordered logit model is based on the parallel regression assumption whereby the cut-points do not vary by any of the explanatory variables. It is plausible however that the cut-points vary by labour force state, among other variables, so we test this assumption by applying the Brant (1990) test to determine if any variables do influence the cut-points differently.

In equation [4.6] we note that γ_j and β cannot be separately identified with the same x entering the index function and the generalised thresholds, so we define $\beta_j = \beta - \gamma_j$. Similarly, the components δ_{ij} and δ_i cannot be separately identified. The correct specification of the generalised model depends on using appropriate variables in the index and the threshold part of the model. Kerkhofs and Lindeboom (1995) paid considerable attention to this issue, stating that inclusion of some exogenous variables in x_2 rather than x_1 may be undesirable, but nonetheless does not affect the performance of the model. However, if the objective disability measure is found to influence the thresholds, then specification of the model is not satisfactory. In their paper, they rely on likelihood ratio tests to assess the accuracy of their specifications. But by using the generalised ordered logit model we can simultaneously test whether or not the explanatory variables and objective disability variables affect the thresholds. This is achieved by testing the hypothesis $\gamma_j = 0$. For example, if $\gamma_j \neq 0$ then the variable in question should be included in the threshold part of the model. Effectively, this is the same as the Brant parallel regression assumption in the standard ordered logit model.

We estimate the generalised ordered response model first without unobserved individual effects and secondly including these effects. This means we can then identify the contribution of unobserved heterogeneity to reporting errors, and furthermore this allows us to compare our results to both Lindeboom and Kerkhofs (2002) and Kerkhofs and Lindeboom (1995). In this chapter, the model without unobserved effects is simply equation [4.3] and [4.4] where $\delta_i = 0$. This is similar to the model of Kerkofs and Lindeboom, (1995). In their later paper (2002) however, they emphasised the importance of correcting for endogeneity of the objective health measure, and showed how the importance of reporting bias had been overstated in the earlier paper. They found that due to unobserved differences that exist between workers and disability recipients, the extent of over-reporting was less than previous. They account for this endogeneity by including an equation for the objective health measure as a function of work history, other observed characteristics and unobservables.

The estimation approach we use however is different – we estimate a random effects generalised ordered probit model with correlated heterogeneity, i.e. we include unobserved effects into the index and threshold part of the generalised ordered probit model. This avoids the need to simultaneously model two separate equations for reported and objective disability but yet allows us to include unobserved effects into the reporting model. Boes and Winklemann (2006) use a similar model to estimate a model of subjective well-being, allowing the thresholds to vary by several characteristics including unobserved effects. Contoyannis *et al.* (2004) estimate a dynamic random effects ordered probit model and include unobserved effects into the model, but do not however let the thresholds vary by any of the explanatory variables or unobserved effects. Our model is a combination of these two models and includes unobserved effects in both the thresholds and index i.e., $\delta_i \neq 0$ and $\delta_{ij} \neq 0$.

This unobserved effect could be correlated with other explanatory variables, for example x_1, x_2 or L. To control for this, we follow the approach of Mundlak (1978) whereby the distribution of the unobserved effect is conditional on the time-averages of any potentially endogenous variables. To allow for possible correlation between δ_{ij} and x_{it}, we condition on the unobserved effects using the Mundlak model:

$$\delta_{ij} = \phi_j \bar{x}_i + a_i \qquad [4.7]$$

where $a_i \mid x_i \sim Normal(0, \sigma_a^2)$. If we expected that the individual unobserved effect is only correlated with variables in the index part of the ordered response model, then $\delta_i = \phi\bar{x}_{1i} + a_i$ and the complete model could be estimated using a standard random effects ordered probit model. It is also possible that there are some unobserved effects that influence both labour force status and the thresholds of this model - the unobserved effect could be correlated with labour force status. In that case we should include individual effects that affect each threshold differently. By conditioning on the unobservables we can control for unobserved individual effects that affect reported disability status as well as labour force status. In this case, $\phi_j = \phi - \phi_j$, so if the same unobserved effect enters the index function and thresholds, then the two components cannot be separately identified[20]. In other words, ϕ_j would be a combination of the two unobserved effects. The final model is based on equations [4.3] and [4.7], and is estimated using the random effects ordered probit model incorporating means of the explanatory variables into both the index and threshold parts of the models. The coefficients are re-scaled so that we can compare the results to those from the pooled models – this is achieved by dividing the parameter estimates from the random effects model by $\sqrt{(1+\sigma_a^2}$[21].

[20] Unobserved effects in the cut-points are $\phi_j \bar{x}_i + a_{1i}$ and in the index are $\phi\bar{x}_i + a_{2i}$. The complete unobserved effect is therefore $\phi_j = \phi - \phi_j$.

[21] We change to a probit model at this stage to facilitate estimation. Because we are not directly comparing the coefficients (we only measure the magnitude of predictions relative to the employed), this does not affect our final conclusions. We also estimated probit models similar to the standard logit, and generalised ordered logit, and results confirm that are conclusions are the same.

Finally, using the models with and without unobserved heterogeneity, we predict responses of individuals to the disability questions, as if they were employed. This is our relative measure of mis-reporting disability status and is interpreted as the economic incentives effect. Our results are compared to those of both Lindeboom and Kerkhofs, (2002) and Kerkhofs and Lindeboom (1995), but in addition to previous research we can identify the contribution of unobserved effects to mis-reporting.

4.4 Data

The data on disability and labour force participation in Ireland are from the Living in Ireland Survey 1995-2001. We wish to focus on individuals of working age, hence we exclude those aged 65 and over. A full listing of the variables used are given in Table 4.3.

Table 4.3 Variable definitions for Dependent and Independent Variables

Variable	Definition
Reported Disability	=1 if severely restricted in daily activities =2 if restricted to some extent in daily activities =3 if not restricted in daily activities =4 if no disability reported
Unemployed	=1 if labour force status is unemployed, =0 otherwise
Disabled/ill	=1 if labour force status is disabled/ill, =0 otherwise
Retired	=1 if labour force status is retired, =0 otherwise
Self employed	=1 if labour force status is self employed, =0 otherwise
Other	=1 if labour force status is training, home duties, education, =0 otherwise (Base category=Employed)
Female	=1 if female, =0 otherwise
Secondary Education	=1 if highest level of education completed is secondary, =0 otherwise
Third Level Education	=1 if highest level of education completed is third level, =0 otherwise (Base category=No qualifications or highest level of education completed is primary)
Married	=1 if married or living with a partner, =0 otherwise
Age	= age in years
Visits	=1 if Number of GP visits during last 12 months>5 and Number of Hospital visits during last 12 months>0 =0 otherwise
Stress	=1 if cut down on normal activities due to illness or injury, or emotional or mental health problems and GHQ12>2 and Not Satisfied with Work or Daily Activity =0 otherwise

An ordered measure of reported disability is constructed from the Living in Ireland survey on the basis of individual responses to the following question:

"Do you have any chronic, physical or mental health problem, illness or disability?"

We use responses to a follow-up question concerning the impact of the disability to distinguish between severe, to some extent and no limitations in daily activities.

Our model implies that the objective should be reliable. The variable (along with x_I variables if necessary) should be a sufficient statistic for the effect of labour force status on true disability. The most appropriate measure would be physicians' reports but this is usually not available in individual surveys. Previous research has used other less objective but relevant health measures, for this purpose. For example, in their assessment of self-assessed health, Lindeboom and van Doorslaer (2004) use the McMaster Health Utility Index, a generic health status index developed at McMaster University that measures both quantitative and qualitative aspects of health. This measure also relies on self-reporting but the advantage is that respondents are only required to answer to 8 health attributes, and then using weights, (derived from a different valuation survey and different sample) an overall health utility score on a scale of zero to one is derived. Hernandez-Quevedo *et al.* (2004) use the SF36 questionnaire and compare it to self-assessed health. This includes 36 items that measure health across 8 dimensions of health. Kerkhofs and Lindeboom (1995) note that to find an objective measure that is correlated with work related health is a difficult task and for that reason focus on self-assessed health. However, they go on in a later paper (2002) and compare the same objective measure to self-reported work related health. The aim of this paper is to focus on limitations in daily activities, so we will need to find suitable objective measures for comparison purposes in our model that will act as a sufficient statistic for the effect of labour market status on true disability. In the Living in Ireland data there is no complete objective disability measure suitable for the purposes of this model. We therefore use proxies of disability status. Kerkhofs and Lindeboom (1995) suggest using GP visiting rates - there is an expectation that individuals with a higher number of GP visits per year will most likely be less healthy than individuals who do not visit their GP to the same extent. Furthermore, almost 18% of acquired disabilities in Ireland were work related in 2002 (QNHS), so to capture the effect of major work accidents we create a variable called Visits if an individual made 5 or more GP visits and at least one Hospital visit within the previous year. The second work related disability we control for relates to stress

Table 4.4 Ordered Logit of reported Disability Status

	Coefficient
Unemployed	-0.5388**
Disabled/ill	-3.7131**
Retired	-1.3432**
Self Employed	-0.0956
Other	-0.4305**
(reference=employed)	
Age	-0.0257**
Female	-0.1904**
Secondary Education	0.3939**
Third level Education	0.5620**
(reference group=primary or no qualifications)	
Married	0.0207
Year	-0.0233**
α^1	-5.7732
α^2	-3.6177
α^3	-3.1873
Pseudo R^2	0.1161
N	33126

$**p \leq 0.05, *p \leq 0.10$

These coefficients clearly indicate that the disabled/ill and retired have a higher propensity to report restrictions in daily activities, compared to the employed. The negative coefficients on age, female and year indicate that for older people, women and in later years in the sample, the probability of severe limitations is higher compared to younger people, men, and in earlier years respectively. The positive coefficient on education shows that with increased education, the probability of no disability will increase and that of severe limitations will decrease. All of these results are as expected.

The main focus of our results is on the effect of labour force status on reported disability. Before determining if there is state dependent reporting behaviour of disability, we firstly establish that there are actual differences in reported disability across labour market states. Results in Table 4.4 indicated that the disabled/ill and retired were more likely to report a limiting disability, so we next present the results from a simple generalised ordered logit model of limitations where the thresholds are allowed to vary by independent characteristics, again with employed individuals as the reference group. Initially we let the thresholds vary by labour force status only, but we should bear in mind that other observed factors including a measure of objective health have yet to be included into the model.

Table 4.5 presents results from the basic generalised ordered logit model including the cut-off points for each of the labour force groups. For severe limitations, and in each of the labour force groups, the cut-off points (α_1) lie to the right of that for the employed group. This implies that all other labour force groups report the probability of severe limitations in a different manner to those in work. The groups that are further to the right are the disabled/ill and retired, showing that the extent of their reporting of some limitations is much greater. The next set of cut-off points (α_2) represents the probability of reporting severe or some limitations, compared to no limitations or no disability. Again, the results show that the cut-off points for the disabled/ill and retired are to the right of that of the employed, indicating different reporting behaviour. Finally, α_3 represents all types of limitations v no limitations.

We also estimate this model and let the thresholds vary by year - the cut-off points are generally the same and the year variable is significant for α_3 only. Individuals are less likely to report 'no disability' later on in the 1995 to 2001 period – we return to potential explanations for this result once we establish if disability reporting fluctuated over the period after we compare the subjective and objective measures of disability.

Table 4.5 Generalised Ordered Logit of Limitations Cut-Off Points

	α_1	α_2	α_3
Cut points	Severe	Some	None
Employed (ref. Group)	-5.091	-2.9024	-2.37
Unemployed	-4.3401	-2.0691	-1.8433
Disabled/ill	-0.9803	1.6656	2.1284
Retired	-2.3235	-0.8089	-0.4278
Self employed	-4.7505	-2.5248	-2.1225
Other	-4.023	-2.0402	-1.6661
Log likelihood	-16153.15		
Pseudo R^2	0.099		
N	33126		

Are the differences in the probability of reported disability status actually reporting behaviour or simply a reflection of true disability? As demonstrated in section 4.3, to establish this we would need to introduce an objective measure and then look at the cut-points.

Following the approach of Kerkhofs and Lindeboom (1995) the subjective and objective disability are compared to identify state dependent reporting errors, and this is achieved by estimating a generalised ordered logit model. We suspect that the objective measures used here are not highly correlated with the subjective measure of disability and may not capture the full extent of labour market effects on true disability, so other explanatory variables such as education, gender and marital status are included into the model. The decision on what variables to include in the reporting part of the model is a matter of judgement, so to facilitate this we estimate the model while at the same time testing the parallel assumption for each variable. If a variable fails the parallel assumption test, then it perhaps should be included in the reporting part of the model, where the thresholds vary by that variable. As noted by Kerkhofs and Lindeboom (1995) if the objective disability variable affects the thresholds differently, then specification of the estimated model is not satisfactory. Therefore, one of the most important results from our model is that the objective measure of disability does satisfy the parallel regression assumption. As we have hypothesised, the results from this model indicate that the thresholds should vary by all labour force status groups, with the exception of the self-employed – they are found to have similar thresholds in reporting disability, as the employed. The thresholds are also found to vary by age, but not by educational attainment. Kerkhofs and Lindeboom (1995) show a similar result in terms of education, but they also show that the thresholds do not vary by age. Finally, our results suggest that the thresholds should vary by year. This is an important result, suggesting that reporting behaviour may vary over time. A significant coefficient was found for the third threshold, although the magnitude is quite small. Nonetheless, it does indicate that we should explore the changes in reporting behaviour over time.

The results from the generalised ordered logit model with thresholds varying by labour force status are shown in Table 4.6. Compared to results in Table 4.5, the cut-points for all labour force groups are now closer, but still much larger for disabled/ill and retired people. The main reason for this difference is that we have now conditioned on objective disability and once this is controlled for the gaps in reported disability between labour force states is now reduced. The differences across labour force groups that we presented earlier in Table 4.5 may be partially explained by true disability differentials. The remaining differences shown in Table 4.6 are therefore due to systematic reporting behaviour.

Table 4.6 Generalised ordered logit with thresholds varying by LFS

	β	α_1	α_2	α_3
Stress	-2.5847**			
Visits	-1.5533**			
Female	-0.0762			
Married	0.0822			
Self employed	-0.0795			
Secondary Education	0.3647**			
Third Level Education	0.5356**			
Employed		-5.7191	-3.8335	-3.3835
Unemployed		-5.2298	-3.1153	-2.9409
Disabled/ill		-2.7367	-0.0762	0.3242
Retired		-3.8075	-2.6601	-2.2878
Other		-5.0188	-3.3297	-2.9983
Pseudo R^2	0.1536			
Log likelihood	-15173.189			
N	33126			

$**p \leq 0.05, *p \leq 0.10$ (Full regression results are in Appendix Table A4.1)

The results from this model are directly comparable to those of the logit model in Table 4.5, but nonetheless show that there is a substantial element of mis-reporting severe and some limitations for individuals in the disabled/ill labour force group. However, as proposed in section 4.3, this model should ideally control for unobserved effects. Once these are included, the extent of mis-reporting is much lower. Results from this model are presented in Table 4.7, showing that the cut-points are now higher for the disabled/ill group compared to the employed. The cut-points for the retired are now slightly closer to those of the employed, suggesting that unobserved effects do play a role but not to the same extent as for the disabled/ill group.

Table 4.7 Generalised ordered probit with unobserved effects

	β	α_1	α_2	α_3
Stress	-1.1356**			
Visits	-0.5778**			
Female	-0.0665			
Married	0.0689			
Self employed	0.1573			
Secondary Education	-0.0425			
Third Level Education	-0.0345			
Employed		-5.0278	-3.8321	-3.4971
Unemployed		-4.6383	-3.6388	-3.3505
Disabled/ill		-3.9309	-2.2732	-1.8685
Retired		-1.0618	-0.8477	-0.8675
Other		-0.5217	-0.1931	-0.1825
Log likelihood	-12661.092			
N	33126			

**$p \leq 0.05$,*$p \leq 0.10$ (Full regression results are in Appendix Table A4.2)

Following Kerkhofs and Lindeboom (1995) we now compute cleansed measures of disability status. This is achieved by computing what individuals' responses would have been, had they been employed. Figure A4.1 graphs the differences between actual and average predicted probabilities of reported disability status for each labour force group. Without unobserved effects this illustrates that on average the unemployed and other group are more likely to report their disability status the same as if they were employed, throughout the period 1995-2001. Conversely, we find that the disabled/ill and retired would be much less likely to report a severe limitation if they were employed. The disabled/ill and retired groups would have a higher probability of reporting no disability. If we look at each category of disability in more detail, the unemployed would be more likely to report no limitations instead of some limitations.

Using the model with unobserved effects, a set of cleansed measures of disability are constructed and Figure A4.1 shows that mis-reporting is now lower, in particular for the disabled/ill group. Our results are consistent with similar research in the Netherlands by Lindeboom and Kerkhofs (2002). The latter paper concludes that bad health was mis-reported by two thirds of the disabled group – our results indicate that severe or some limitations are also over-reported by about two thirds of the disabled/ill group[22]. Their later paper (2002) demonstrated that without unobserved effects the extent of mis-reporting may be overestimated – we find similar results for the disabled/ill group.

Overall, the results in this paper suggest that reporting disability does depend on labour force status. In particular, we find that compared to the employed, the retired and disabled/ill are prone to over-reporting their disability[23]. In interpreting their results, the authors assume that labour force status sufficiently describes the effect of financial incentives in the Netherlands social welfare system. The same interpretation is applied to our model so we conclude that economic incentives do influence reported disability status.

We also explore whether or not the reporting behaviour changed in any year. For a few reasons, it is possible that there were changes in mis-reporting over the years

[22] It is difficult to precisely compare the impact of unobserved effects between the two papers by Lindeboom and Kerkhofs (1995,2002) because they use self assessed health in the first paper and work limiting disability in the second. Nonetheless, their results are broadly similar to ours – when they do not control for unobserved effects, approximately three quarters of the disabled group are found to mis-report bad or sometimes bad self assessed health – this compares to a similar proportion of individuals in our disabled/ill group mis-reporting severe or some limitations when we do not control for unobserved effects.

[23] We also estimated a model that compared reporting behaviour to the disabled/ill group. Results suggest that if the employed reported severe disability status as if they were in the disabled/ill labour force group, then the magnitude of mis-reporting is the same – i.e. the employed would have almost 10 times as many people reporting a severe disability in the model. This compares to our finding of the disabled/ill group reporting 10 times less disability if reporting as if employed, confirming that our results are a measure of relative magnitude.

1995-2001. Economic incentives may play a role, and we discuss two possible influences that may have affected reporting of disability over 1995 to 2001. Firstly, in 1996 the administration of Disability Allowance was transferred from the Department of Health to the Department of Social, Community and Family Affairs. The purpose of this was to integrate income maintenance payments and to streamline the process for social welfare payments for the disabled more generally. Before 1996, an individual may have mis-reported disability but post-1996, the incentive to do so may have been reduced as the social welfare process may have become more efficient. It is possible that non-working people with disabilities would give incorrect reports of disability, but for employed people their reports of disability should be correct. Kreider (1999), analysing the effect of 'biased' disability limitations on non-work, assumed that workers report correctly but non-workers do not.

The second potential contributor to reporting behaviour is the Employment Equality Act 1998, whereby disability is one of the grounds on which discrimination in the workplace cannot occur. The effect of this legislation on mis-reporting of disability could work in two ways - previous research has shown negative effects of similar legislation in the US where employers were less likely to hire individuals with disabilities as it became more costly with the new requirements (Acemoglu and Angrist, (2001). In this case demand was reduced, and unemployment for people with disabilities increased. This could influence people with disabilities to underreport. On the other hand, now that people with disabilities may feel they could be less discriminated against by employers, they might be inclined to either report their true disability status or even over-report their disability status. In this case the unemployed may be more likely to mis-report. Employees reporting behaviour should not be affected by the Employment Equality Act 1998 – unless they are in work already and are seeking employment rights as set out by this Act[24]. This is an important assumption in the model outlined earlier - it assumes that currently employed individuals do not respond in anticipation to future events (Lindeboom and Kerkhofs, 2002).

[24] Very few cases of discrimination on the grounds of disability were taken to the Equality Authority between 1998 and 2001 – it is unlikely therefore that employee's reporting behaviour is influenced by the 1998 Act.

Using the generalised ordered logit model, we analyse reporting behaviour for three groups of years 1995-1996, 1997-1998 and 1999-2001. Figure A4.2 includes a comparison of the actual and predicted probabilities if employed, of having a severely limiting disability for group. The differences for the disabled/ill group fluctuate slightly between 1995 and 2001. Looking at predictions of reporting severe restrictions, the graph shows that after 1996 and 1997 there appears to be less over-reporting. This increased in 1998 to 2001. For the retired, there was an increase in the difference between actual and predicted as if employed probabilities again after 1996 and remained much the same up to 2001. However, the extent of over-reporting is greater for the disabled/ill group.

Overall though, the difference between actual and cleansed measures of reported disability barely fluctuated between 1995 and 2001. So, it is unlikely that the change in administration in 1996, or the 1998 Act had any significant influence on the mis-reporting of disability status. It could be that labour force conditions were a driving factor in the majority of mis-reports – for example, as employment levels increased individuals may have reported a disability in an attempt to receive social assistance.

4.6 Additional Evidence of mis-reporting in Ireland

Until recently in Ireland, there was no statistical evidence of overpayments of social welfare for disabilities. In addition to this econometric study in this chapter, the Public Accounts Committee (2006) reviewed a pilot initiative of intensive monitoring of disability payments. The background to this evolved from a finding that lower back pain cases represented 17% of all disability benefit claims in 2002. Resources were then redirected to a pilot initiative that gave priority in medical examinations for these cases. As a result, many cases were found to be capable of working and the success of this initiative suggested that early intervention may be necessary for other ailments. Only 154 of the original 1532 claimants qualified for disability benefit due to lower back pain. In terms of medical assessment, this report recommended that reassessment should take place - 16 claimants of disability allowance were reassessed in 2003 and all were found not qualified, but we should bear in mind that they may qualify for other illness benefits under the social welfare system. For example in 2005, approximately 950 people found capable of work did not go back to work but availed of other schemes. Of course, some may not have been successful in getting employment so this is an issue that needs to be addressed.

There are two plausible explanations for the large number found capable of working, (1) they may have been mis-reporting disability or (2) the large proportion found capable may be partially due to the backlog of medical examinations so that individuals have recovered by the time their medical examination took place. It is likely though that people found capable of working then claimed other social welfare benefits – so even though overpayments had been made, the overall expenditure saving was minimal. Nonetheless, the department of social welfare spends in excess of €23m each year on fees to medical practitioners in respect of certificates and medical reports – whereas the total cost of medical assessment is about €3.6 m per year – the Public Accounts Committee believed that if the department had a process of reviewing certificates by GPs, particularly against the opinion of the subsequent medical assessments, then money could be saved.

4.7 International Comparisons of Mis-reporting

The findings from our econometric study are quite similar to those found by Kerfhofs and Lindeboom (1995, 2002). In their 1995 paper they assess the magnitude of mis-reporting of self assessed health and find that about three quarters of all individuals who state their labour force group as Disabled/Ill would not report bad or to some extent bad health, if they responded as employed. Although we measure mis-reporting of a slightly different variable, i.e. self reported limitations, we find that about the same proportion of the Disabled/Ill labour force group would not report a severe or to some extent limiting disability/chronic illness, if responding as if employed. When we introduce unobserved effects into the model and control for the fact that mis-reporting may be due to some unobserved individual characteristics such as previous investments in health or education, we find the same result as Lindeboom and Kerkhofs (2002). These results are even more comparable because they focus on work limiting disability in their 2002 paper. Both models find that approximately 60 per cent of the disabled group over-report having a severe or to some extent limiting disability. This reduces the proportions in similar magnitudes, so the differences in the prevalence of disability across countries remain the same. If we suspect that differences in disability rates across countries are due to the presence of different social security systems, then we would expect that in the Netherlands there should be more mis-reporting than in Ireland. However, we have only discussed the differences within the disabled/ill group and we would need exact figures of actual reported disability across each labour force group, to precisely calculate differences across countries in the overall rate of reported disability.

Our findings for the retired group are different to those from the Netherlands – we find that there is substantial mis-reporting among the retired. About one fifth of those who report a disability would do so if they were employed. In the Netherlands however the level of reporting for the early retired group is quite similar to that of the employed. It is possible that differences in mis-reporting between the retired and disabled group arise in the Netherlands, because of different economic incentives for each group. Early retirement schemes were very popular in the 1980s and 1990s in the Netherlands as a means of encouraging people to leave the workforce to make room for a younger workforce. This means that older workers would not need to mis-report a disability in order to leave the workforce, as the direct retirement route was clearly possible. Given the changing demographics this is no longer necessary and the Dutch social partners have agreed that incentives for early retirement need to be reduced. Early retirement schemes are slowly being replaced by pre-pension arrangements shifting the burden of the cost from employers to the individual worker making the decision. Still, the OECD (2003) has reported that more needs to be done to reduce the incentives for early retirement. This may have implications for future mis-reporting of disability. In Ireland however, the incentives are similar for everyone up to age 66, so perhaps the retired group are simply a subset of the disabled/ill groups in terms of their reporting behaviour. Unless we analyse a harmonised dataset, we cannot precisely compare across different labour force groups, and even at that cultural and social norms will play a significant role in responses to similar questions. Kapteyn *et al.* (2004) found that for the same level of actual work disability, Dutch respondents have a lower response threshold in claiming disability than American respondents. Their evidence shows that especially in the more subjective health problems of pain and emotion, Americans use a tougher standard when assigning work disability status. Why these differences exist is another question, to some extent it may be due to differences in social welfare and/or social norms.

Once the evidence of mis-reporting is established, the next step in terms of policy is to try and reduce this reporting behaviour. In the Netherlands, this proved to be a difficult task and after many policy changes and pilot initiatives, the final outcome was to reduce the number of fraudulent disability insurance applications. In the Netherlands, around 10% of the working age population were collecting benefits in the early 1990s. A major reform of the disability insurance scheme took place in 1993/1994 but there was no sustainable reduction in the numbers entering the scheme. Some of this may be attributed to a buoyant labour market whereby lower unemployment levels mean that individuals are more likely to aim for disability insurance schemes. In addition, they are less likely to loose their job when labour market conditions are good. More stringent measures were introduced in 2002 mainly because of institutional improvements[25] and for the first time in seven years the total number of beneficiaries declined. Some of this decline may be cyclical (Dutch economy was in a period of recession and inflow to unemployment insurance increased) but recent research shows that in fact intensified screening of sickness absence also reduces the number of disability insurance applications, (de Jong, Lindeboom and van der Klaauw, (2006)). The current challenges facing the Netherlands now are to reassess the stock of existing beneficiaries, restrict full benefits to severe cases and reduce access to partial benefits from people with mild disabilities that do not affect their daily functioning and work ability.

In Spain, Jiminez-Martin *et al.* (2006) found that individuals aged between 55 and 59 had a significantly higher probability of receiving overpayments of disability benefit, compared to those aged 60-64. Their results confirm that disability benefits are being used as a way of exiting the labour force before the retirement age of 61. While they do not specifically analyse the award errors for people aged less than 55, it is likely that this may also be a problem in Spain. One of the main sources of income for disabled persons is disability benefits, approximately 35 per cent receive benefits compared to an EU average of about 20 per cent, (OECD 2003). Jiminez-Martin *et al.* (2006) make some recommendations for more medical tests but recognise the

[25] Stricter obligations on re-integration came into force in 2002 for employees on long term sickness benefits. The five disability benefit agencies were merged reducing the influence of sector interests on the disability benefit authority. Penalties for firms became stronger.

expenditure involved. But as we saw earlier the costs are likely to only be a small fraction of the benefits (Netherlands). More recently, the Spanish Observatory of the Social Security System proposed reforms in the regulation of permanent disability benefits. These included approval of a list of occupational diseases and the exclusion of professions that are no longer suited to old-aged workers. In relation to this, they propose to modify retirement benefits by relaxing the restrictions on age for these professions.

In the US, Gruber (2000) notes that the level of disability insurance is 42% of previous earnings on average and mostly non-taxable. They fear that this could be subsidizing early retirement of older workers who have no other reason for retiring. Nonetheless, a replacement rate of 42% is quite low compared to the Netherlands, and this could be a contributing factor to the higher rates of disability in the Netherlands compared to the US. There is also evidence of mis-reporting of disability status among older workers, although there are conflicting results between earlier and more recent studies. Kreider (1999) found that non-workers overreport work limitations. Their main focus was on the consequential econometric issues involved in labour force participation models, rather than the relationship between reporting and social security benefits for disabled people. Bound (1989) found that they were no dis-incentive effects of disability benefit – most people on disability insurance were found to be healthy and half of those who had been rejected disability insurance were then found capable of work. This would suggest that in the US the level of benefits does not contribute to mis-reporting, but moreso that it is a favourable route towards retirement. Benitez-Silva *et al.* (2004) analysed the 45-64 age group during the 1992-93 period and found that a person's evaluation of health is similar to Social Security Award evaluation. Given that expenditure on disability benefits in the US is quite low at less than one per cent of GDP, and the fact that the disability rate is quite low, we should not expect a high level of mis-reporting. Kreider and Benitez-Silva *et al.* give conflicting results but the earlier paper by Kreider only focus on 1992/93 whereas Benitez-Silva *et al.* focus on data up to 1996 – it is possible that the different results are due to cyclical variation.

4.8 Implications for policy in Ireland

The question is what type of policy reform is needed and to what extent this should be monitored. Policy reform (but not effectively monitored), in terms of eligibility conditions, does not seem to be enough according to evidence from the Netherlands. The same level of mis-reporting can be observed in Ireland even though there was not much reform. In Ireland, the disability schemes are targeted towards a diverse group depending on severity and duration of illness/disability and there was little reform in terms of disability policy during the period 1995-2001. Benefits increased in line with other social welfare payments and there were very few institutional changes.

In 1996 the payment of disability allowance was moved from the Department of Health to the Department of Social Community and Family Affairs. The purpose of this was to integrate income maintenance payments and to streamline the process for social welfare payments for the disabled more generally. The expectation was that this might reduce the level of potential overpayments within the system, nonetheless as we saw earlier the number of beneficiaries increased significantly but at the same time the level of mis-reporting only changed marginally. In 2003, a report from the Department of Social Community and Family Affairs reviewed expenditure on illness and disability schemes. One of their main recommendations was to improve the effectiveness and efficiency of the system by introducing a simpler one. But more recently, the PAC reported on the level of overpayments still within the system. The PAC report recognised the level of work that has been done to eliminate overpayments in the social welfare system but recommended that the Department of Social Welfare should introduce further systems of integration with the Revenue Commissioners in order to streamline systems and reduce time taken to detect overpayments. There should also be greater liaison between GPs certificates and medical assessments from the Department. While the level of overpayments may then be reduced it is likely however that individuals no longer entitled to disability payments will seek payment from another social welfare scheme – thus it is important that policy also ensures that individuals are re-integrated in to the labour market once they are capable of working.

The implications from the more stringent measures in the Netherlands and the pilot initiative in Ireland are that this is a successful approach to reducing overpayments of disability welfare and ensuring that the appropriate people receive benefits. A cost-benefit analysis by de Jong *et al.* (2006), shows that the costs of intensified screening are only a small fraction of the benefits. There is a strong case therefore for a similar cost-benefit analysis to be carried out in Ireland and additionally for a nationwide expansion of the pilot initiative. The lesson to be learned from the Netherlands is that reform of the schemes is not sufficient without effective monitoring. It is crucial however that reform does not affect those who are currently receiving disability payments if they are genuinely in need of assistance. An efficient monitoring system should appropriately distinguish between those in genuine need of social welfare and those who are mis-reporting or no longer incapable of work.

4.9 Conclusions

In this chapter, we assessed the extent of differential measurement error in the self-reported disability variable. Mis-reporting of limitations in daily activities was examined, in particular for those who define their labour force status as disabled/ill or retired. The main questions addressed were (1) was there state dependent reporting error and did financial incentives play a role, and (2) did this change over the years 1995 to 2001? Using generalised ordered response models we created a cleansed measure of disability and our results indicate that the disabled/ill and retired groups did over-report. The extent of this mis-reporting is lower when we account for unobserved individual characteristics, so overall the level of mis-reporting could be viewed as lying somewhere between the results from the models with and without unobserved heterogeneity. We take this as evidence of economic incentives influencing reporting behaviour, but should bear in mind that age and year are also found to contribute to the thresholds. Overall though, the difference between actual and cleansed measures of reported disability barely fluctuated between 1995 and 2001.

The policy implications for Ireland are:

- a need for review of the medical assessment procedure in order to reduce waiting times, and to reduce expenditure from Department of Social and Family Affairs to medical practitioners;
- introduce further systems of integration between Department of Social and Family Affairs and Revenue Commissioners in order to reduce time taken to detect overpayments;
- cost-benefit analysis of intensified screening should be carried out;
- effective monitoring of disability benefits is required, perhaps by making the pilot initiative a nationwide policy;
- individuals found capable of work need to be re-integrated into the labour force, so as to reduce the number applying for other social welfare payments.

Appendix 4

Table A4.1 Coefficients from Generalised Ordered Logit Model

	Coefficients on variables not varying by threshold	>=some restrictions (ie. Group 2,3,4)	>=no restrictions (i.e. group 3,4)	No Disability (i.e. group 4)
Stress	-2.5847**			
Visits	-1.5533**			
Female	-0.0762			
Married	0.0822			
Self employed	-0.0795			
Secondary Education	0.3647**			
Third Level Education	0.5356**			
Disabled/ill		-2.9824**	-3.7573**	-3.7077**
Unemployed		-0.4893*	-0.7178**	-0.4426**
Retired		-1.9116**	-1.1734**	-1.0957**
Other		-0.7003**	-0.5039**	-0.3852**
Age		-0.0189**	-0.0296**	-0.0289**
Year		-0.0191	-0.0056	-0.0290**
Constant		5.7191**	3.8335**	3.3835**

$**p \leq 0.05, *p \leq 0.10$

Note: Coefficients are rescaled by $\sqrt{(1+\sigma_a^2}$ before the predicted responses are calculated. We estimate predicted probabilities and find that the actual and predicted probabilities are quite similar, indicating a good measure of fit for our model.

Table A4.2 Coefficients with random effects and correlated heterogeneity

	Coefficients on variables not varying by threshold	>=some restrictions (ie. Group 2,3,4)	>=no restrictions (i.e. group 3,4)	No Disability (i.e. group 4)
Stress	-1.1356**			
Visits	-0.5778**			
Female	-0.0665			
Married	0.0689			
Self employed	0.1573			
Secondary Education	-0.0425			
Third Level Education	-0.0345			
Disabled/ill		-1.0969**	-1.5589**	-1.6286**
Unemployed		-0.3895*	-0.1933*	-0.1466
Retired		-1.0618**	-0.8477**	-0.8675**
Other		-0.5217**	-0.1930**	-0.1825**
Age		-0.0269	-0.0716**	-0.0604**
Year		-0.0132	0.0229	-0.0086
Constant		5.0278**	3.8321**	3.4971**

$**p \leq 0.05, *p \leq 0.10$

Note: Coefficients are rescaled by $\sqrt{(1+\sigma_a^2}$ *before the predicted responses are calculated.*

Figure A4.1 Actual v Predicted Probabilities –average of 1995-2001

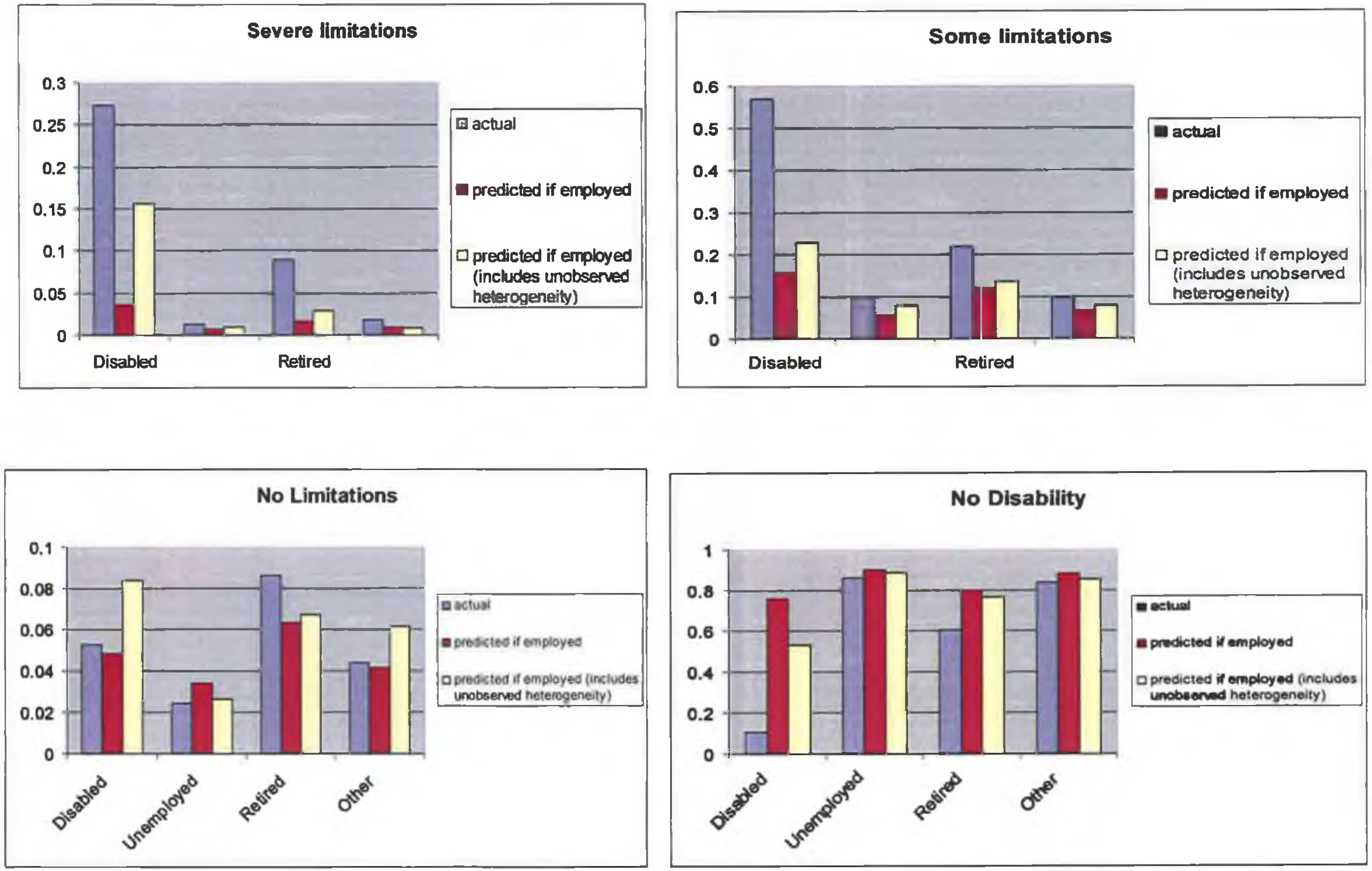
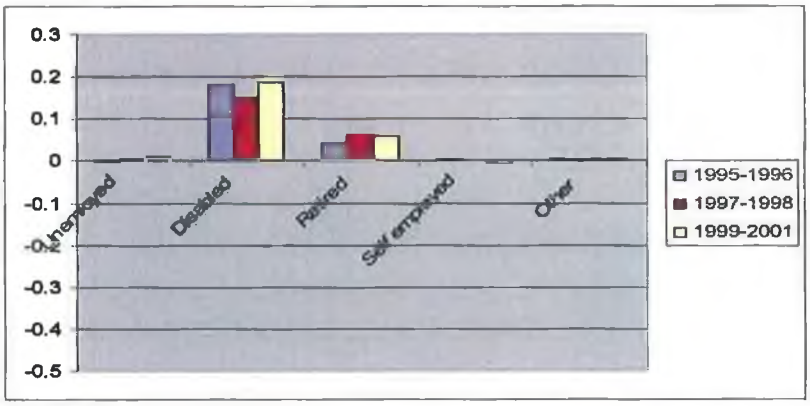


Figure A4.2 Difference between Actual and Predicted Probabilities of Severe Limitations if Employed by Year 1995-2001



Chapter Five

Adjusting for Endogeneity and Measurement Error of self-reported disability in a Labour Force Participation model

5.1 Introduction

Chapter one set out the main estimation issues involved in attempting to find an unbiased estimate of disability in a labour force participation model. In summary, classical endogeneity via unobserved heterogeneity coupled with measurement error (classical and/or differential) in reported disability can lead to biased estimates. Classical measurement error will lead to a downward bias, whereas differential measurement error and classical endogeneity will result in an upward bias. This chapter aims to tackle each of these problems in a complete model of disability and labour force participation. The issue of classical and differential measurement error is resolved by estimating a cleansed measure of disability from a correlated random effects generalised ordered probit model. In Chapter four, I showed that this model predicts that the proportion of disabled/ill people reporting a disability would be halved, if reporting as if they were employed. This chapter now takes the cleansed measure of disability and includes this as an indicator of true disability (relative to the employed) in the participation model. In earlier chapters the disability variable was split into four categories reflecting severe limitations, some limitations, no limitations and the reference group of no disability. We now define disability as a dichotomous variable that equals 1 if an individual is either severely or to some extent limited, and equals 0 if an individual has no limitations or no disability – this facilitates comparisons of our results to those from international research. Similar to the procedure outlined in Chapter three, the presence of unobservables that influence both disability and labour force participation (i.e. classical endogeneity) is controlled for by using the Mundlak (1978) estimator.

This chapter provides results from a complete model of disability and participation. It brings together the endogeneity discussed in Chapter three and the measurement error examined in Chapter four. The contribution of this chapter to the debate on the impact of disability on participation in Ireland is significant. In light of the new results from this chapter, we find that the true impact of disability is to reduce participation by about 15 percentage points. Compared to the baseline estimate of 26 percentage points, we find that about half of the bias is due to unobservables, and the remaining half is a combination of differential and classical measurement error.

In terms of contribution to the international literature, we build on the model presented in Chapter three by adjusting for classical and differential measurement error. Although, the model in Chapter three implicitly controlled for differential measurement error, we did not distinguish between the two different impacts of classical endogeneity and differential measurement error. Furthermore, it did not control for classical measurement error. The difference between the research in this current chapter and the content of previous international research lies in the econometric methodology. For example, Lindeboom and Kerkhofs (2002) model participation and health simultaneously, in order to capture the effect of unobserved heterogeneity. They also include an equation for reported health and include this into their likelihood function. Their overall result would be the same as ours but does not provide a breakdown of the contribution of each type of measurement error and classical endogeneity. The contribution and strength of this chapter is that it provides results that distinguish between the effects of each type of measurement error (classical and differential) and classical endogeneity.

5.2 Theoretical problems with estimation and proposed model

The empirical model is based on the comparisons of utility outlined in chapter one. Statistical problems associated with using a self-reported measure of disability or bad health in a participation model are well known, but often ignored in the estimation of the effect of disability on labour force participation. Bound (1991) documented these issues and some possible methods for correction, in detail. He noted that using an instrumental variables approach cannot completely eliminate the bias introduced by differential measurement error. If the purpose of a model is to accurately estimate the effect of disability and financial incentives on participation, instrumental variables will only correct for the bias in the disability measure but not the bias in financial variables. A further difficulty with the instrumental variables approach is the need for a good instrument of disability. Nonetheless, this method has been widely used in the literature (e.g. Stern 1989, Dwyer and Mitchell, 1999). Very often the instruments available are not satisfactory and/or good instrumental variables are not included in surveys.

A general model of participation is represented by a latent variable equation;

$$y_{it}^* = b_0 + b_1 D^*_{it} + b_2 z_{it} + \alpha_i + \varepsilon_{it} \qquad [5.1]$$

In this model, y_{it}^* is not observed and instead we observe $y_{it} = 1$ if $y_{it}^* > 0$ or $y_{it} = 0$ if $y_{it}^* \leq 0$, where y_{it} is the observed indicator of labour force participation, y_{it}^* is the underlying construct generating y_{it}, and z_{it} represents a range of other variables. The individual time invariant unobserved effect is captured by α_i. True disability is represented by D^* but we do not know the value of this variable in practice, therefore we use an indicator of disability, D^s. As outlined in the previous chapter, this variable is potentially measured with error. If individuals' reported disability is influenced by economic incentives that draw them towards a particular labour force group then reported disability will be systematically biased, and differential measurement error may be introduced into the model. We explore this as follows;

$$D_{it}^s = a_1 D_{it}^* + a_2 y^*_{it} + \xi_{it}, \qquad [5.2]$$

This indicator of disability, D^s then takes the place of D^* in equation [5.1] so our full model is then;

$$y_{it}^* = b_0 + b_1 D_{it}^s + b_2 z_{it} + \alpha_i + \varepsilon_{it} \qquad [5.3]$$

Replacing D* with D^s will lead to a bias in the estimate of disability in the participation model because differential measurement error is introduced by y_{it}^*. Classical measurement error will occur if D^* and ξ are uncorrelated. In summary, classical measurement error leads to an underestimate of the disability effect but differential measurement error tends to bias the estimate of disability upwards. Bound (1991) sets out exactly how both types of measurement error may occur. The overall effect of measurement error therefore may either increase or decrease the base estimate.

As Bound (1991) noted, correcting for *both* classical and differential measurement error in a participation model is not straightforward. Using objective measures to proxy for true disability will underestimate the effects of disability if the proxy is not perfectly correlated with work related disability. Bound also explains in detail the reasons why the instrumental variables approach will obtain consistent estimates of disability but not other variables that may be correlated with disability. To identify the effect of disability and other correlated variables, a second objective measure could be used to instrument the first objective measure. The approach set out by Bound is problematic in two respects –firstly, good instruments are difficult to obtain and secondly, the estimation procedure is complicated.

Following a model proposed by Kerkhofs and Lindeboom (1995), in this thesis measurement error is addressed by creating a cleansed variable of disability. This removes both differential and classical measurement error. The cleansed variable is constructed following estimation of a correlated random effects generalised ordered probit model and the predicted probability of reporting a disability as if employed is calculated as;

$$\Pr(D_{it}^{*} = j) = \Pr(c_{j\_work} < f(D_{it}^{0}, x_{1it}) < c_{j+1\_work}) \qquad [5.4]$$

In the above equation, D_{it}^{O} is an objective measure that may be viewed as an instrumental variable for self-reported disability, and therefore controls for classical measurement error. The probabilities are calculated as if employed (the cut-points of the employed in the correlated random effects generalised ordered probit model are applied) and this controls for differential measurement error. This model and estimation procedure is described in detail in Chapter four of this thesis. The final cleansed measure is an index of the probability of having a severely or to some extent limiting disability.

However, it is important to note that the cleansed measure may itself suffer from classical endogeneity. The measure of true disability could still be correlated with unobserved effects that influence labour force status. Our model outlined above does not control for this classical endogeneity. Lindeboom and Kerkhofs (2002) deal with the problems of endogeneity and measurement error by jointly estimating the participation and objective health equations. In this chapter, we propose a new approach. We use the Mundlak estimator, similar to the Wooldridge approach adopted in Chapter three. The distribution of the unobserved effect is conditional on the time-averages of any potentially endogenous variables;

$$\alpha_i = \alpha_0 + \alpha_1 \bar{z}_i + a_i \qquad [5.5]$$

In summary, a model with cleansed disability removes classical and differential error, and unobserved heterogeneity is controlled for via the Mundlak estimator. In Chapter four, the Mundlak estimator for reported disability controlled for endogeneity (this could include differential error), but not classical measurement error.

For simplicity in this chapter we focus on a static model of labour force participation, first using the self-reported disability variable, and then replacing this with the new indicator that has been corrected for classical and differential measurement error. The difference in the disability estimate from the first two models represents the combined effect of classical and differential measurement error effect [model 1 v model 2]. The third model controls for the correlated individual effects using the cleansed measure [model 3]. This is our best estimate of the effect of disability on labour force participation. For comparison purposes we also estimate the Mundlak model with reported disability. The difference between this estimate and that obtained from the first model, gives an indication of the overall unobserved effects. In model 4, we get an estimate of the reported disability after controlling for unobservables. Comparison of model 4 with model 3 gives us the extent of classical measurement error, which can be used in conjunction with model 3 to gauge the importance of differential measurement error.

We can conclude that the true impact of disability is given by model 3. This is the net effect of disability, but we should also compare models 2 and 3 to get an estimate of the impact of unobservables associated with cleansed disability and participation.

5.3 Data

The data on disability and labour force participation in Ireland are again taken from the Living in Ireland Survey 1995-2001. To recap on the approach adopted in chapter four, we created a cleansed measure of disability based on predicted probabilities of having severe or some limitations in daily activities, if individuals reported as if they were employed. These are calculated from the correlated random effects generalised ordered probit model, and the mean of this new index of disability is 0.07, i.e. 7% of the sample has a severe or some limitation once we correct for measurement error. Our dichotomous variable of reported disability (i.e. severe or some limitations) has a mean of 0.10, indicating that 10% of the sample report having severe or some limitations. This is our uncorrected measure of disability. As in the previous chapter, our sample relates to individuals under 65 only, and once we account for missing observations the final pooled sample is 33,126.

5.4 Results

We estimate pooled static models of participation and present results in Table 5.1[26]. The first model shows baseline coefficient estimates using the dichotomous variable that equals 1 if an individual reported having a severe or some limitation. The second model describes results from a similar equation, but now replaces the disability variable with our new cleansed index of disability. In order to facilitate comparisons between estimates of this index and those provided by model 1, we re-scale the coefficients from model 2. This is achieved by multiplying the coefficients obtained in model 2 by the average difference in the value of the cleansed disability index, between those reporting a disability (i.e. severe or some limitation) and those not reporting a disability (i.e. they report no limitation or no disability). The difference is 0.14. The third model then uses the cleansed disability index but also controls for unobserved heterogeneity. Again, the coefficients are re-scaled.

Model 1 indicates that disability significantly reduces the probability of participation, even when we control for age, gender, education and marital status. This is the effect of reported disability on labour force participation, but as noted earlier this estimate of -

[26] In chapter three we demonstrated that a random effects probit model would be preferable if disability is strictly exogenous. We tested for strict exogeneity of the old disability variable and the new index, and in both cases found this hypothesis was rejected. Therefore, we concentrate on pooled models.

0.7260 suffers from three potential biases, i.e. classical and/or differential measurement error and classical endogeneity. Model 2 estimates the impact of the new cleansed disability index (based on predictions as if employed) and the estimate of disability now has a lower effect on participation, now at -0.6158. This suggests that due to measurement error (the combined effect of classical and differential), the original estimate of self-reported disability was overestimated. At this stage, we do not know the type of measurement error that has biased the original impact of -0.7260. But the fact that the original estimate was higher suggests to us that measurement error is largely due to differential reporting behaviour as opposed to classical measurement error. In order to determine the magnitude of each type of measurement error, we will need to introduce unobservables into both of these models. This will allow us to distinguish between the unobserved heterogeneity and each type of measurement error. In the third model, unobserved heterogeneity is controlled for and this lowers the estimate of cleansed disability to -0.4726, indicating that unobserved individual effects are a large component of the original disability estimate (either reported or cleansed). It is possible though that much of this unobserved effect arises from previous non-participation due to earlier disabilities – this is a strong result found in chapter three. This is our best estimate of the effect of disability on labour force participation.

For comparison with results in chapter four, model 4 controls for unobservables using the Mundlak approach but with reported disability. This is the static equivalent of the model used in chapter three. In the presence of endogeneity only, models 3 and 4 would yield similar results. More specifically, endogeneity accounts for approximately 50-60% of the baseline estimate in model 3. The fact that our estimate in model 4 is actually lower than that of model 3 reflects the downward bias associated with classical measurement error.

Table 5.1 Estimation Results - Pooled Probit Models

	Model 1 Reported Disability	**Model 2** Cleansed Index (rescaled)	**Model 3** Cleansed Index (rescaled) and Unobservables	**Model 4** Reported Disability and Unobservables
Disability	-0.7260**	-0.6158**	-0.4726**	-0.2985**
Age	0.1728**	0.1754**	0.2277**	0.2221**
Age squared	-0.0022**	-0.0022**	-0.0022**	-0.0022**
Female	-1.0802**	-1.0579**	-1.0630**	-1.0936**
Secondary Education	0.3613**	0.2157**	0.0315	0.0239
Third Level Education	0.9992**	0.8115**	0.4419**	0.4279**
Married	-0.2047**	-0.2527**	-0.0064	-0.0200
Time averages				
Age			-0.0531**	-0.0488**
Married			-0.2574**	-0.2025**
Secondary Education			0.1732**	0.3437**
Third Level Education			0.3677**	0.5920**
Disability			-0.2524**	-0.6952**
Constant	-1.8714**	-1.6912**	-1.6637**	-1.8633**
N	33126	33126	33126	33126
Pseudo R squared	0.2167	0.2361	0.2414	0.2249

Note: $**p \leq 0.05, *p \leq 0.10$

The results so far highlight the importance of incorporating measurement error and classical endogeneity of disability into a labour force participation model. These results were presented as coefficients but marginal effects are useful if we want to know the magnitude of the effect of disability on participation. In Chapter two, we estimated a participation model without these two factors and found that the marginal effect of disability was substantial, reducing the probability of participation by 27-30 percentage points, depending on severity of limitations. We now present marginal effects for models 1-4 in Table 5.2. Model 1 finds that reported disability (severe or some limitations) reduces the probability of participation by approximately 26 percentage points overall. The true effect of 15 percentage points is given by model 3, so the overall bias is 11 percentage points. By comparing model 3 and model 4, we get an estimate of 4 percentage points for classical measurement error. Model 2 provides a figure for cleansed disability that removes the bias from both classical and differential measurement error. By subtracting 0.04 from this, and comparing the result to model 1 we infer that 10 percentage points is differential measurement error. Classical endogeneity is obtained by comparing models 2 and 3, and is estimated at 5 percentage points.

Table 5.2 Estimation Results - Pooled Probit Models

	Model 1 Disability	**Model 2** Cleansed Index	**Model 3** Cleansed Index (controlling for unobservables)	**Model 4** Disability (controlling for unobservables)
Disability	-0.26**	-0.20**	-0.15**	-0.11**

Note: $**p \leq 0.05, *p \leq 0.10$

In terms of participation rates, we find that the true rate would be 55 per cent compared to 44 per cent if we use the reported disability variable.

5.5 Conclusion

This chapter brings together the analyses from the earlier chapters on unobserved heterogeneity and measurement error. Using a cleansed measure of disability the labour force participation is re-estimated and results indicate that true impact of disability is to reduce participation by 15 percentage points. The bias introduced by the original estimate of 26 percentage points is a combination of an upward bias from classical endogeneity and differential measurement error and a downward bias introduced by classical measurement error. We find that approximately half of the original bias is due to unobserved effects and half due to a combination of classical and differential measurement error. Our results show that the original estimate of -26 percentage points was overestimated by 10 percentage points due to differential error and was underestimated by 4 percentage points due to classical measurement error. Classical endogeneity led to an overestimate of 5 percentage points.

In general, research using data from other countries has found similar results in terms of unobserved effects – these results are discussed in Chapter three. The only other paper to deal with both measurement error and unobserved effects was by Lindeboom and Kerfhofs (2002). The results from their model did not distinguish between the level of measurement error and unobservables. In that context, this chapter contributes significantly to the international debate on the endogeneity and measurement error in a labour force participation model. These results are of crucial importance to policy makers in the light of the recent legislation on equality and the campaign for civil rights for people with disabilities.

Chapter Six
Conclusions

6.1 Introduction

People with disabilities face many barriers to full participation in society, not least in the labour market. The extent and nature of participation in the labour market has a multitude of direct and indirect effects on the living standards and quality of life of people with disabilities, and is thus a critical area for investigation and policy concern. The aim of this thesis is to provide a detailed description of the labour market situation of people with disabilities in Ireland, and an analysis of factors associated with participation. The main question addressed is, what is the impact of disability on labour force participation? These benchmark levels are of crucial relevance to disability and employment policy in Ireland. This thesis also contributes to international research by applying the latest econometric methodologies to analyse the relationship between disability and labour force participation.

This chapter concludes the thesis by describing the policy recommendations that are based on the findings of this research.

6.2 Policy Implications

In terms of formulating disability and employment policy, a key issue is to firstly survey the extent of non-participation by people with disabilities in the labour force, and to gauge how this differs by various individual circumstances. Chapter two provides baseline estimates that indicate the high level of non-participation (40 per cent of individuals with disabilities participate compared with 70 per cent of people without disabilities), which in itself is an important contribution to disability and employment policy. These estimates will form the benchmark for ongoing monitoring of the prevalence of participation levels for people with disabilities in Ireland. The description of disability and work transitions deepen our knowledge and understanding of the impact of disability on employment in a dynamic context. Furthermore, they quantify the impact of disability onset, exit and persistence of disability on employment probability, having taken other characteristics of the individual and their household into account. Results show that not only persistent disability but also disability onset are associated with a very substantial reduction in the likelihood that someone will be in employment. The diversity of people with disabilities is highlighted in this chapter, in particular the duration of disability. This poses a major challenge for policy in relation to tackling the many-faceted barriers to obtaining and maintaining employment for people with disabilities. If data from the Survey of Income and Living Conditions[27] is available for research, a comparative analysis with other European countries could contribute significantly to the study of the interaction between disability, participation and the social welfare systems of each country.

Policy implications from Chapter three focus on the channels by which current and previous disability influence current labour force participation. The results add to the evidence from previous research about the impact of persistent disability on the probability of being in work. We find that past participation is also an important factor in the labour force participation decision for disabled people, and the effect of past disability on past labour force participation is relevant in this context. The results highlight the difference in effects between longer term and short-term disability. The effect of past disability may have a continued effect through state dependence in labour force participation, even after recovery from the disability. Therefore, the focus of disability policy should be on early targeting of disabled individuals into employment.

The dis-incentive effects of disability benefits may also play a role here and these factors are investigated in chapter four. The results indicate that there is substantial mis-reporting among the disabled/ill group and this is most likely largely motivated by accessible financial incentives. Policy should therefore be targeted on more effective monitoring of disability benefits and medical examinations. This is the main conclusion brought out in the international comparisons of mis-reporting in chapter four. An effective strategy is required, bearing in mind the fact that such monitoring is resource intensive – requiring targeted interventions at the individual level, as well as further integration of government departments.

Chapter five highlights the policy implications of knowing the extent of measurement error and the subsequent effect on participation figures. The results suggest that a more

[27] This survey is a successor to the ECHP data, and only recently available for academic use.

accurate participation level for people with disabilities is in the region of 55 per cent, compared to level of about 40 per cent revealed in chapter two. The original impact of disability on participation is partly due to observed characteristics (approximately half), unobserved effects (approximately quarter) and classical and differential measurement error (approximately quarter). Nonetheless the difference to the participation rates of non-disabled at 70 per cent is still substantial and employment policies should be directed to integrating those who wish to work into the labour force. Solutions to increasing labour force participation for people with disabilities would therefore involve a combination of policies, including for example, more effective monitoring of disability recipients, training for those who wish to re-enter the labour force in a different job and disability friendly workplaces to encourage people with genuine disabilities to work.

6.3 Conclusion

The in-depth research that lies behind this thesis has been brought to the attention of the relevant policy makers in Ireland[28]. One of the main conclusions from earlier research (presented in chapter two) highlighted the need for a large scale survey on disability in Ireland. After much discussion between all the relevant stakeholders, this survey is currently being conducted by the Central Statistics Office. In addition, the National Disability Authority hosted a roundtable discussion with many government agencies and stakeholders, in late 2005. The aim was to determine the best way forward for greater social inclusion for people with disabilities. Some of the figures from this thesis were quoted at this discussion, and provided the baseline data to inform the debate from which recommendations were collated and later presented to the National Anti-Poverty Strategy. It is a source of much personal satisfaction to see that my research applying the most recent developments in econometric methodology is being used by government departments and agencies to support their proposals and to influence social inclusion.

[28] Presentations have been made to policy makers at the launch of the report titled Disability and Social Inclusion, (June 2005), at the NDA conferences 2004 and 2005, and policy analyses in chapter four will be presented at the Budget Perspectives Conference 2007 (October 2006).

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