Redistribution in the Irish Tax-Benefit System

Cathal Gerard O'Donoghue
B.Sc. (NUI), M.Sc. (Oxon.), M.A. (NUI), C.Stat.

Thesis submitted for the degree of Ph.D. in Social Policy,
London School of Economics

Autumn 2001

DESCRIPTION OF THESIS (C. O'Donoghue)

The primary objective of the thesis is to study the degree of redistribution in the Irish Tax-Benefit System. The first part of the thesis (*chapter 2*) describes the main features of the system and examines the potential redistributive effect of the system. It also sets the system in its historical context by charting the development of the system in the post war era.

Chapter 3 examines the redistributive effect of the sub-components of the tax-benefit system separately on a cross-section of the population by decomposing standard redistributive and progressivity measures. This chapter examines in detail the effect of the reforms from 1987 to 2000.

The use of a short accounting period such as a month will tend to exaggerate the degree of redistribution within a tax-benefit system. It is desirable therefore to examine the degree of redistribution over a measure such as lifetime income, as this more fully reflects the standard of living an individual faces. As lifetime income data is not available, a dynamic microsimulation model has been constructed to generate synthetic life histories of a sample of the Irish population, so that lifetime incomes can be constructed. A number of chapters then describe the characteristics of this model. *Chapter 4* considers the main issues involved in designing a dynamic microsimulation model and assesses how the main dynamic models internationally have dealt with the issues discussed. *Chapter 5* describes how this model dealt with these design issues. *Chapters 6 and 7* respectively describe the behavioural equations used by the model to simulate demographic/education and market behaviour respectively.

A number of analytical chapters have been included using the dynamic microsimulation model. *Chapter 8* examines the degree of redistribution over life-cycle. *Chapter 9* analyses the redistributive effect of taxes and benefits over the lifetime. *Chapter 10* examines the degree of intra versus inter personal redistribution in the tax-benefit system.

The previous chapters examine the redistributive effect of the tax-benefit system in isolation by considering its effect in a steady state world. However neither the world nor the tax-benefit system are in a steady state. The system has evolved over time. In *Chapter 11*, we examine the degree of inter-generational redistribution of the Irish Welfare State since the foundation of the state in 1921.

DECLARATION OF NUMBER OF WORDS FOR MPHIL AND PHD THESES

This form should be signed by the candidate's Supervisor **and returned to the University with the theses**.

Where a candidate wishes to exceed the word limit for a thesis specified in the College Regulations, the candidate enquire at his/her College about the procedures to be followed. Any such enquiries must be made **at least six months** before the presentation of the thesis. The Examiners may reject a thesis exceeding the prescribed word limit.

I confirm that the following thesis:

1) Does not exceed the word limit prescribed in the College's Regulations*

or where the College does not prescribe a limit

2) Does not exceed 100,000 words (PhD thesis)*

~~60,000 words (MPhil thesis)~~*

* Please delete as applicable

Name of Candidate CATHAL O'DONOGHUE

Thesis Title REDISTRIBUTION IN THE IRISH TAX BENEFIT SYSTEM

College LONDON SCHOOL OF ECONOMICS

Approximate Word Length (where applicable)

Signed .... Date 30.11.01
Candidate

Signed .... Date 23/10/01
Supervisor

Statement

I declare that the contents of this thesis are entirely my own work.

Signed

....

Cathal O'Donoghue

31st October 2001

Note: The Thesis utilises components of the EUROMOD Tax-Benefit Model to simulate Income Taxes, Social Insurance Contributions, Social Assistance Benefits and Child Benefits. While I programmed these instruments. I recognise the legal rules, data and validation support provided by the Economic and Social Research Institute as well as access to the general computer code provided by the EUROMOD Partners.

Acknowledgement

There are very many people whose help, advice and support I would like to acknowledge. My first thanks go to my supervisors at the London School of Economics, Jane Falkingham and Celia Phillips for their support and helpful advice and comments during the thesis. I gratefully acknowledge financial assistance from the Postgraduate Fellowship of the Economic and Social Research Institute (ESRI), Dublin as well as use of the 1994 *Living in Ireland Survey*, and the 1987 *Survey of Life-style and Usage of State Services*. My thanks also go to Prof. Tim Callan with whom I first started working in the field of microsimulation. Throughout the writing of this thesis I worked at the Microsimulation Unit of the Department of Applied Economics at the University of Cambridge. I would like to acknowledge the flexibility and support of Holly Sutherland, the Director of the Unit as well as the helpful discussions with my colleagues, especially Paul Kattuman, Sonia Bhalotra, Maria Laura Di Tommaso and Luisa Corrado. Thanks are also due to the members of the EUROMOD research project from whom I learnt a great deal about microsimulation. I am also grateful to the Dynamic Microsimulation Community internationally for all their help and encouragement. Thanks especially go to Steven Caldwell of Cornell University, Rick Morrison and Denis Chénard of the DYNACAN project. I have also benefited greatly from the helpful comments and discussions with my colleagues on the Pensim2 team at the Department for Work and Pensions in London.

I owe a great deal to Francesca Utili and Herwig Immervoll who collaborated with me on numerous pieces of work over the last 6 years. Their influence has been felt throughout my work. I have learnt a great deal from our lengthy discussions down through the years.

I am grateful for comments from conference and seminar participants at the Nordic Microsimulation Workshop in Copenhagen, the University of Cambridge, the London School of Economics, the International Conference of the Applied Econometrics Association, Brussels, the National University of Ireland, Galway, the Irish Economic Association, the University of Bologna, the Athens University of Business and Economics, and the Statistical and Social Inquiry Society of Ireland.

Finally my greatest thanks go to my mother and Oli, whose constant support and encouragement has helped throughout the long years of this thesis.

Table of Contents

List of Tables

List of Figures

Notes

1. Table and Figure numbers have throughout the thesis been labelled with their chapter number. However when they referred to within chapters, the chapter number is omitted.

2. Acronyms used:

   - OECD – Organisation for Economic Co-operation and Development.
   - ESRI – Economic and Social Research Institute, Dublin.
   - CSO – Central Statistics Office
   - DoF – Department of Finance

Chapter 1. Introduction: Redistribution in the Irish Tax-Benefit System

1.1 Introduction

Redistribution can be classified as the mechanism by which the distribution of income is changed. It is this topic with which we are interested in this study. There are a number of objectives of welfare states including the provision of public goods, acting as a social safety net, as insurance instruments for unexpected life events, for correcting for poor inter-temporal decision making and for correcting market failures. Many of these objectives employ some element of redistribution, defined here as the transfer of resources between individuals at one point of time or across an individuals lifetime. Within the redistributional heading, redistribution can broadly be classified under a number of headings including (a) income smoothing, (b) insurance, (c) vertical redistribution and (d) horizontal equity (see Barr, 1993).

One of the main reasons for redistribution is to smooth income over the life-cycle. Rowntree (1902) cycle of "want and plenty" was one of the first illustrations of life-cycle needs. This cycle highlighted that individuals often fell into poverty during childhood, escaped poverty during their 20's until they have children and then experience poverty again until their children earn, before falling again into poverty in old age when they can no longer work. Much of the early welfare state instruments focused on reducing life-cycle needs such as pensions paid to the elderly, child benefits paid to families with children and pensions paid to widows. Glennerster (1995) points out that the social policy as a counter-life-cyclical device was an important determinant of the Beveridge report in 1942, that influenced post-war social policy developments in both Britain and Ireland.

As an insurance mechanism, policy instruments insure against unforeseen income reductions such as unemployment, sickness or the death of a spouse, conditions that existed in the social insurance system in Ireland since before the establishment of the Department of Social Welfare in Ireland in 1947. Vertical redistribution refers to the transfer of resources from rich to poor, while horizontal redistribution, redistributes towards people with needs due to e.g. age, family size, disability. All of these mechanisms can be regarded as being redistributive, whether between persons (inter-personal) or across an individual's life-course (intra-personal). All mechanisms are also overlapping somewhat. Being poor may be because of an unforeseen life event, while income smoothing may involve horizontal redistribution. Horizontal redistribution may also have a vertical redistributive effect if groups who are targets of this type of redistribution also tend to be poor as in the case of the elderly.

The welfare state is the chief mechanism used for redistribution in public policy. However because the operation of instruments within public policy often move in different directions or have effects that are hard to measure it can be difficult to determine the extent of redistribution. These issues are described in more detail below. We also briefly consider the rationale for the state to carry out redistribution and to make other interventions in the market under three main headings, the achievement of efficiency gains, the pursuit of social justice and the exercise of self-interest through the political process. Finally we consider some practical issues related to the measurement of redistribution.

The primary mechanism for redistribution in a state apparatus is the *welfare state*. It is however difficult to define clearly what the welfare state is. It is usually the term used for the state's involvement in the areas of health, education, cash benefits and other services such as housing, personal social services and food.

Welfare state services can be categorised as either publicly or privately financed and provided (See Barr, 1993). Examples of publicly provided services include employment services or public libraries and museums. Some services have a mixture of public and private provision and financing. For example, some public provided services may be privately financed completely. Partial subsidisation as in the case of university education, will involve in some degree of redistribution of resources. On the other hand, some welfare services are privately provided, but publicly financed as in the case of GP services. Finally some degree of redistribution may result from welfare services that are both privately financed and privately provided. This is a result of the use of regulation as a redistributive device. Examples include the recent legislation in Ireland that new private housing developments include social housing.

This study focuses on a narrow set of welfare state instruments, personal taxes, social contributions and social benefits. Taxes and benefits contribute to each form of redistribution described above. As an insurance benefits can be designed to redistribute towards individuals who have unforeseen life events as in the case of invalidity or unemployment benefits. As an income-smoothing device, they can redistribute from working lives to retirement as in the case of old age pensions. By means testing benefits they can be used as a form of vertical redistribution. Additional payments to cover child dependants, old age or sickness can serve to horizontally redistribute to individuals with different needs. Turning to the redistributive impact of taxation, as an insurance mechanism it primarily serves a financing purpose, although through horizontal measures such as provisions such as widow's and disabled persons tax allowances may aid the insurance mechanism. As most income tax systems are progressive, there is a strong vertical redistributive mechanism, where for a given revenue constraint, the richer pay higher taxes. The progressivity of taxes also acts as a source of income smoothing as during periods of higher income, individuals pay proportionally higher taxes than during periods of lower incomes. Again horizontal measures such as old and family tax instruments aid the income smoothing objective.

Over the last 15 years, there have been numerous studies into the standard of living in Ireland. The primary focus has been on the measurement of poverty, deprivation and inequality (See for example Callan and Nolan, 1993 and 1999). A branch of this research has focused on the impact of government policy on these measurements (Callan, O'Neill and O'Donoghue, 1995), while another branch has focused on the impact of policy on work incentives (Callan and Doris, 1999). Because of the data available, the welfare measures considered have typically been based on a short accounting period of either a week or year. As a result it has not been possible to examine the redistributive impact of public policy when considering longer-term welfare measures. Also as the surveys that have been used thus far have been mainly of cross-sections of the population, the redistributive effect of policy that has been examined has been between people. Intra-personal redistribution has been ignored. In general, the impact of government policy has been investigated in aggregate such as the impact of all taxes and benefits on poverty or inequality. At the other extreme, the minutiae of particular policies or reforms have been examined. There has however been no systematic description or analysis of all the main components of the tax and benefits systems. The objective of this thesis will be to fill in some of the gaps in the research agenda relating to the redistributive effect of government tax and benefit policy. The principle objectives will be to:

- Describe the tax-benefit system and how it reached its current state,
- Examine in detail the contribution of the components of the tax-benefit. system contribute to redistribution using traditional methods of cross-sectional analysis.
- Investigate the level of redistribution over the life-course.
- Examine the redistributive nature of the system using, longer term measures of welfare.
- Investigate the actual level of redistribution between persons as compared to intra-personal redistribution.
- Study the trend in government policy over time and the resulting impact on inter-generational redistribution.

The purpose of the this chapter is to describe the background to the set of analyses considered in this study, to examine the nature of redistribution and to summarise the main methodological hurdles necessary for this research. Section 2 shall discuss the rationale for redistribution. Section 3 shall describe some methodological issues, while section 4 will summarise the main analyses carried out in this study.

1.2 Rationale for Redistribution

We now ask, what is the rationale for redistribution? Rationales can be divided into, efficiency, ethical and political reasons.

Efficiency

Although economists often discuss an equity/efficiency trade-off, there are situations where on efficiency grounds alone, there is a rationale for redistribution. Barr (1993) gives a good survey of the efficiency rationale for redistribution. The invisible hand theorem states that the market will be optimal if a number of conditions hold, that there is perfect competition, no market failures and perfect information. When some or all of these conditions do not apply, then there is a reason for the state to intervene on efficiency grounds.

Intervention can be efficient where perfect competition fails, as in the case where price taking doesn't exist in a monopoly situation. In these cases, regulation such as price ceilings or anti-trust legislation or subsidies to achieve the socially optimal level of production can be used. Market failures can also occur when there are public goods, externalities or increasing returns to scale.[1] Markets cannot produce public goods, making a case for public production. Externalities occur where an economic agent imposes costs or benefits on society without cost or benefit to themselves resulting in a non-optimal levels of production in a market. If the marginal cost (or benefit) is exceeded by the average cost (or benefit) at all levels of output, then increasing returns to scale takes place, resulting in an industry going bankrupt or become monopolised by a single firm. There is therefore a case for intervention by the state through use of a lump-sum subsidy or for the industry to become nationalised.

Perfect information breaks down where consumers have imperfect knowledge about quality and or prices or the future. As Barr (1993) outlines, markets are generally more efficient, the better consumer information is, the more cheaply and effectively it can be improved, the easier it is for consumers to understand available information, the lower the costs of choosing badly and the more diverse are consumer tastes. If one of these assumptions breaks down, then there may be a case for state intervention. Producers and consumers can suffer from imperfect information, for example insurers may not have full information about riskiness of applicants for insurance or consumers may not be aware of the preparation process for foods. Similar arguments regarding price information relate to individuals' information about their future. The efficiency advantages of perfect competition depend on perfect information.

Another rationale for state provision occurs where insurance markets are inefficient[2], namely adverse selection, moral hazard and probabilities of the risks being realised being close to 1. Adverse selection occurs where individuals take out insurance knowing that they are bad risks without the insurer knowing this. In an unemployment insurance market it would not be possible to tell an individuals risk without knowing their employment record, which is costly and difficulty to verify. Even if known, it is not necessarily a good indication of risk. In a private insurance market, people with a higher risk of unemployment are more likely to seek insurance, the opposite is true for

[1] For a good to be classified as a pure public good, it must satisfy the following conditions, non-rivalness in consumption, non-excludability and non-rejectability. Non-rivalness implies that the marginal cost of an extra user is zero, non exlcudability, means that no one can be excluded from consuming, and so cannot be charged.

[2] Insurance has two purposes. Firstly it as a means of protection against unforeseen risk such as unemployment or sickness or an actuarial mechanism which insures against foreseeable risks such as old age or death. Individuals are prepared to pay for insurance because they are risk averse.

those with low risk, thereby putting up premia. By making unemployment insurance compulsory for everyone adverse selection is avoided. Moral Hazard relates to the extent to which individuals can control their entrance to and exit to an insurable event such as unemployment. It is not possible to distinguish between individuals who are unemployed out of choice and those who are unemployed because there are not enough jobs. Exogenous events are insurable, but those which result from choice are not, making it impossible for private insurance markets to offer insurance. Whereas compulsory insurance can overcome problems associated with adverse selection, it cannot overcome moral hazard completely. Insurance schemes can however guard against moral hazard to some extent through availability for work requirements, contribution conditions and benefit duration. The final reason why it is necessary for unemployment insurance to be provided by state or quasi state institutions is that insurance companies would have little incentive to offer insurance at an affordable cost to individuals who have a probability of unemployment of close to one.

Another example of the inefficiency of the market relates to time preferences. Individuals may prefer to consume now rather than investing and thereby achieving a sub-optimal equilibrium for society as a whole. Expenditure on public education illustrates this point. The social rate of return to education is higher than the private rate of term, which implies if left to market forces, education expenditure would be insufficient, implying that human capital accumulation would be lower, in turn reducing economic growth.

Voluntary redistribution, or altruism, is a source of efficiency gain. In this case it is perfectly rational for higher income to voluntarily transfer resources to lower income people. A number of criticisms outlined by Barr include the free rider problem which gives an incentive for the rich to vote for redistributive taxation and also the fact that in voluntary redistribution is optimal only if the optimal redistribution is what the rich are prepared to give. Amiel and Cowell (1992) have done some empirical work on preferences with regard to redistribution and found that a substantial minority would be prepared to have some people become worse off if certain groups' income increased, indicating the existence of an income externality.

Ethical Grounds

The next rationale for redistribution is on ethical grounds. Boadway and Keen (1999) in their survey of redistribution that there can exist a desire for redistribution as a form of ethical behaviour not explicitly governed by economic behaviour. Individuals can be considered as if they have two personalities, a selfish one that guides their actions in day to day economic activities and the second, a selfless, ethical perspective, that guides their participation in social decisions.

Barr (1993) describes some of the different theories of social justice, Collectivist, Liberal or Libertarian. Each has different views as to the degree of redistribution is desirable. Collectivists desire that the distribution of outcomes should be equal and thus wealth should be redistributed on ethical grounds. Liberal or utilitarian theories of society argue that the objective of public policy should be to maximise the utility of the members of society and as a result as the marginal utility of income falls with income, under most social welfare functions, some degree of redistribution is optimal. Finally even Libertarians, who *see the optimal distribution as the result of competitive market force on legally acquired endowments* (Barr, 1993), advocate a certain amount of redistribution to prevent destitution and for the policing of the market.

Political Grounds

Boadway and Keen (1999) argue that except for Pareto improvements, redistribution involves the *exercise of coercion and sovereign power and in that sense [redistribution] is an inherently political matter.* This study asks the *what* and *how* questions. What level of redistribution is there in the system? How is the level of redistribution achieved? A political approach would ask, *why*? For example as shall be shown in Chapter 2, the period from the 1950's in Ireland saw a large increase in the redistributive impact of public policy, with benefit levels rising and coverage expanding. On the revenue side, the weight of financing shifted from regressive indirect to progressive income taxes. It would be interesting the question what political forces drove these changes.

Boadway and Keen (1999) survey some of the political reasons for the existence of redistribution. They classify three forms of decision-making, direct democracy, representative democracy and interest groups. Much of the literature on public choice focuses on decision making using majority voting rules. In the case of redistribution, it is argued that majorities will vote to have resources transferred from the minority to them. Full redistribution towards inequality does not occur it is argued because of efficiency losses due to high taxation, greater power of the wealthy and also because it maintains an incentive for the poor to become rich. However in practice, it is rare that such issues are placed directly to a plebiscite, rather decisions are made through the use of elected intermediaries. In representative democracies, what is important is that prospective governments carry with them as broad a coalition of interests as is necessary to achieve election and stay in power. Political parties will also tend to have their own particular set of policies, which although broadly tradable in order to get elected will serve as a general guide to policy action if possible. Party loyalties will also have an effect. In the case of a single policy issue, where there is uncertainty of the preferences of the electorate, then parties will adopt a platform between their preferred options and that of the median voter.

In Ireland, there have been a number of clear political pressures on redistributive policy over time. During the economic downturn of the 1930's, the Fianna Fail party campaigned on a platform of rescinding reductions made by the previous government in pensions and unemployment benefits. An example of the effect of majority voting is the acceptance of the population of relatively high personal taxes relative to corporate taxes. This would seem to be indicative of both the traditionally high unemployment risk, which has lead to high migration levels and the relatively high proportion of self-employed in the Irish Labour Market. Also, in Ireland where nearly 85% of the population are owner occupiers, attempts to introduce property and wealth taxes have seen massive political opposition (See Sandford and Morrisey, 1985). The constitutional requirements can also have an influence on redistributive policies as for example provisions that protected the family have prevented married couples being treated less favourably than cohabiting couples (See Kennedy, 1988). Membership of the European Union has also seen equality legislation resulting in discriminatory elements of the benefits system being reformed.

The influence of interest groups has a number of notable examples. For example, the Catholic church in the 1950's strongly opposed the establishment the introduction of free health care for mothers and children as they opposed the intervention of the state in the life of families.[3] This resulted in a dramatic backdown by the government of a key government policy (See, Lee, 1989). The influence of the agricultural sector meanwhile saw the elimination of work tests for farmers claiming unemployment assistance (See Callan et al., 1996). In industrial relations, unions recently have been able to negotiate

[3] This is a policy on which the church has changed their policy in recent times as groups such as the Conference of the Religious in Ireland (CORI) has been a strong advocate for redistributive policies.

favourable tax-benefit reform in exchange for wage restraint in national wage bargaining agreements (See, O'Donnell and O'Reardon, 1996).

Increased provision of welfare services in neighbouring countries can result in changed preferences and an increased demand for them in a country. We can see this in the relationship between the UK and Ireland. Because of the large-scale migration both to and from Britain, many families have close links with Britain.[4] The media also carries many news items from the UK. Therefore, policy developments in the UK have had a very strong influence on redistributive policy in Ireland (See, Lee, 1989). For example, the Beveridge reforms of the post-war UK influenced the formation of the Department of Social Welfare in 1947, and the subsequent benefit reforms in 1953. In recent times, a clear objective has been to bring Irelands personal tax system in line with the UK's[5]. A separate reason that has resulted in similar redistributive systems in Ireland and Britain is due to the objective of unification with the Northern Ireland (Department of Social Welfare, 1992).

1.3. Methodology – Measuring Redistribution

In this section, we consider some of the methodological issues related to the measurement of redistribution. Issues considered here in relation to the measurement of redistribution include, the accounting period used for measuring this transfer, the groups of people between whom resources are transferred, the institutional factors that contribute to this redistribution of resources.

Redistribution and the Accounting Period

The accounting period used can influence the degree of redistribution measured. The use of short accounting periods will tend to increase the degree of income inequality measured within a population. This is because of the nature of short-term mobility and life-cycle effects. For example, students may be classified as currently poor but in fact have be rich over the entire lifetime. At the other end of the life-cycle, pensioners will tend to be lower down the income distribution, but yet during their working lives, may have been higher up the distribution. Panel studies have shown that there is considerable income mobility over time. For example Jarvis and Jenkins (1998) found that in Britain

---

[4] The UK and Ireland since the independence has had a free trade and movement area covering the whole British Isles. There was also a currency union until 1979.

[5] In various Budget Speeches by the Finance Minister.

only 37% of the poorest decile group were still in the bottom decile after 4 years, 1991-1994. For these reason a number of writers have advocated that long term income measures are better measures of welfare. Friedman (1957) advocated the use of a permanent income concept which ignored the effect of temporary income changes and life-cycle effects.

Fiscal policy instruments that depend on income also tend to use short accounting periods (i.e. of a year or less). For example, benefits and social insurance contributions depend on weekly income and income taxes, annual income. Therefore during *poor* periods of the life-cycle individuals will tend to be net beneficiaries from redistributive polices and net losers at other times. However, when one factors in the points about life-cycle income mobility, the redistributive effect of taxes and benefits may be less strong if a longer accounting period were used. The existence of social insurance where contributions are paid during working periods and benefits received during non-working periods is an example of redistribution over life-cycle. The social insurance system using a short accounting period will be seen to be quite redistributive, but much less so when a lifetime perspective is used. While longer accounting periods highlight the degree of total redistribution between individuals over the lifetime, shorter accounting periods are more appropriate for measuring issues related to short term need such as poverty analyses.

Intra-personal versus Inter-personal Redistribution

In the previous section we highlighted that life-course redistribution and income mobility over the life-cycle would reduce the degree of redistribution one sees in a system when longer accounting periods are compared with shorter accounting periods. The reason for the fall in the degree of redistribution is due to the level of intra-personal redistribution, or redistribution over an individual's lifetime from periods of high income to periods low income. For example, pensioners are one of the largest net beneficiaries from the tax-benefit system in any one period. As most pensioners receive contributory benefits, receipt of benefit represents a return on contributions made during the lifetime rather than as a pure distribution from rich to poor. Similarly short term unemployed may end up paying more back into the system when in work than they received out of work. Finally there are also life-cycle effects on earnings, with those with more experience receiving higher earnings. Because of the progressive nature of the income tax system, they will tend to pay a higher average tax rate during periods of their lifetime when in receipt of higher earnings.

Other than for classification purposes, why is there an interest in intra-personal redistribution? The existence of intra-personal redistribution in tax-benefit systems implies that such objectives could be achieved through private savings mechanisms. Feldstein (1997) argues that doing this would raise the economic welfare of the population because the rate of return to private investments is higher than the rate of return implicit in an unfunded benefits system.[6] Thus, it would cost less to provide the same degree of transfers than a public system, reducing total tax rates and related distortions created by the tax system. Another objective is that enforced state decisions about transfers over ones lifetimes reduces individual choice and thus total welfare. As much of the intra-personal redistribution results from income related instruments such as means tested social benefits and progressive income taxes, administrative costs due to income testing may well be higher for the public provision of intra-personal redistribution. Conversely, private savings instruments may require higher administrative costs to management and promotion purposes.

There are a number of problems however. Much of the intra-personal redistribution occurs during the early years of one adult life, when attending university, receiving relatively lower incomes because of seniority rules or having children. Without state guarantees to allow savings to go negative for these objectives as in the case of student loans, capital market imperfections are likely to limit this type of income smoothing. Miles and Timmermann (1999) point out that a move to private insurance with higher returns is likely to lead to higher risk. Thus whereas on average the population would be able to have the same benefit coverage for a lower contribution rate, there could be substantial numbers of losers. Furthermore moving to a private pension system will involve transition costs, as current generations save for themselves, but also meet the liabilities of the currently retired. In addition, many risks covered by public transfer programs are uninsurable.

Redistribution Between Generations

So far we have considered redistribution between different people alive at the same time and over individual's lifetimes. Another type of redistribution is between generations.

For example, like other, governments, Ireland has very often run a current budget deficit, borrowing money to pay for current expenditure, therefore redistributing from future generations to earlier generations.

One of the main motivating factors in the study of intergenerational redistribution is the effect of demographic ageing where due to the increased size of elderly populations relative to the working population, tax-burdens will have to increase to finance pensions. Fahey and Fitzgerald (1997) found that in Ireland over the medium term, the fiscal pressure due to demographic factors will actually improve, due to fewer elderly and children. Studies that focus on later periods such as the Department of Finance (1998), have however found that fiscal pressures will increase sharply after this period, due to the size of the birth cohorts that will retire, coupled with a decline in the working population due to a fall in fertility rates. The Budget Strategy of Ageing Group of the Department of Finance (DOF) find that the cost of ageing is set to rise by 7% of GNP over the next half-century (DOF, 1999).

Kessler (1996) argues that during "*the decades to come there will be much debate, criticism and questioning about the whole issue of intergenerational transfers*". If one generation gains significantly more than another, then there is potential for generational conflict. This is the case currently in the USA, where much coverage has been given to intergenerational tensions. Many of the younger generation in the USA find themselves with falling real earnings, while their baby boom elders experience the fruits of the longest boom in American history. At the same time they are faced with financing the baby boom generation in retirement as the social security system reserves end in the next two decades: "*we fear for the future...our generation labors in the expanding shadow of a monstrous national debt....those in power have practised fiscal child abuse, mortgaging our future*"(Third Millennium, 1999). Furthermore intergenerational conflict also worsens not only from the cost of the ageing electorate but also due to the ageing of the electorate and the increased number of elderly voters, who have the incentive to vote to increase the share of resources going to them.

We must consider the notion of intergenerational equity. Clearly policy makers do not aim to have complete intergenerational equity, the idea that each generation is as well off as another. Assuming a constantly rising level of wealth, this would require huge

[6] The implicit rate of return in a publicly funded pay as you go benefit system relies on a combination of the labour-force growth rate and the growth rate of earnings.

transfers from future generations to earlier generations. Instead the most that redistributional policies aim for is that at any point in time intergenerational inequality is lessened. For example an objective of government policy has been to ensure that pensioners also benefit in terms of increased pension payments from economic growth. Pensioners in Ireland can thus expect to receive more than they put in. Hughes (1985) who found that the rate of return received by pensioners in Ireland was on average much higher than that received by investors highlights this. Each generation receiving more from the state than they put in is however not necessarily a problem for the public finances for as Samuelson (1958) pointed out that each generation can receive more than they contributed if economic growth outpaces population growth. However if public net expenditure rises much faster than the rate of economic growth as happened in the 1980's and may happen this century, then public expenditure becomes unsustainable.

Unit of Analysis

An issue raised by Falkingham and Hills (1995) relates to the incidence of the instruments simulated. For example who actually benefits from social transfers received by an individual in a household? In Ireland, most benefits are paid to a claimant but depend on the characteristics of others in the family unit. We assume that benefits are shared equally between adults in the family. FH also highlight the question of what should be done about child benefits, whether they should be considered incident on children or parents. We assign child benefits equally to the parents. Income taxes in Ireland until 2000 were assessed optionally on a joint basis. These are assigned within a family proportionally to market income. Another unit of analysis issue relates to the fact in the current version of the model used to produce life-course income trajectories, we do not simulate the standard of living of the parents of the members of this cohort. As a result, we cannot measure the standard of living of the individuals' childhood. Our measure of lifetime income refers therefore to the period from 18 to birth.

Measures of Redistribution

This section describes the measures used to measure the redistributive effect of the tax-benefit system. In this thesis, we use measures based on the Lorenz Curve to examine the degree of these phenomena.[7] The Lorenz Curve for pre-tax market income is simply

[7] The methods described here are standard methods for examining the degree of redistribution and progressivity in tax-benefit system (See for example Palme 1996 and Decoster et al. 2000).

a graph of the cumulative population share versus the cumulative income for population ranked by order of their income. The Gini coefficient is a standard index of inequality, defined in equation (1):

$$G_M = 1 - 2\int_0^1 L_M(p)dp \tag{1}$$

where p is the cumulative population share and $L_M(p)$, the Lorenz Curve at point p. A population with no income inequality would have a Lorenz Curve of 45° and therefore a Gini of 0. If Lorenz Curve A lies completely inside curve B, then it is possible to say that population A has greater inequality than population B, with $G_A > G_B$. However if the Lorenz Curves cross, it is not possible to make inequality comparisons without using a value judgements. The generalised Gini coefficient due to Yitzhaki (1983), defined in equation (2), allows value judgements to be taken into account. In this case higher values of v indicate greater weight being placed on those in the lower end of the income distribution. If v = 0, then social welfare function is unconcerned about inequality, always taking a value of 1 regardless of the distribution. When v = 2, G(2) is the same as the standard Gini coefficient, while as $v \rightarrow \infty$, all the weight is placed on the lowest income, to produce a Rawlsian social welfare function.

$$G_M(v) = 1 - v(v-1)\int_0^1 (1-p)^{v-2} L_M(p)dp \tag{2}$$

The objective of this paper is to examine the impact of the tax-benefit systems on inequality. The measure used here is the generalised Reynolds-Smolensky index, which is defined as the difference between the generalised Gini coefficients for market income and post-instrument income, defined in equation (3).

$$\begin{aligned}\Pi_A^{RS}(v) &= G_M(v) - G_{M+A}(v) \\ &= v(v-1)\left(\int_0^1 (1-p)^{v-2}[L_M(p) - L_{M+A}(p)]dp\right)\end{aligned} \tag{3}$$

This effect is known as the redistributive effect. Palme (1996) however argues that it should be known as an equalising effect. This because the difference of two Gini-coefficients does not imply a redistribution of income as it is not necessarily the case that both Lorenz Curves on which they are based, have the same ordering of units. "*More specifically, the difference for a certain proportion of individuals cannot be* *interpreted as the share of income redistributed from those on the right side of the point to those on the left as the two groups do not necessarily consist of the same individuals when comparing the two Lorenz curves".*

The generalised Reynolds-Smolensky index of redistribution can be decomposed into the redistributive effect before reranking (the difference between the Lorenz curve for market income and the concentration curve for post instrument income) and the reranking effect of the instrument (the difference between the concentration curve and the Lorenz curve) as highlighted in equation (5). Equation (5) can be further transformed in equation(6) into three components, the progressivity (or departure from proportionality)($\Pi^{K}(v)$), the relative size of the instrument in question ($a/(1+a)$) and the horizontal or reranking effect ($D(v)$) (see Kakwani, 1984). Progressivity is a measure of the difference between the level of redistribution of an instrument relative to an instrument with the same revenue effect but where the effect is proportional to income. It is therefore a measure of the incidence of an instrument. If an instrument is disproportionally focused on the lower (upper) half of the distribution, then it is *regressive (progressive).* If an instrument is regressive (progressive), the concentration curve for the instrument will fall outside (inside) the Lorenz curve of market income. If the instrument is proportional to income, the concentration curve will be exactly the same as the Lorenz curve for market income. In terms of income taxes, progressivity relates to the ability-to-pay principle, whereby those with higher incomes are more able to pay higher taxes. A progressive income tax is therefore redistributive and thus inequality reducing. On the other-hand, benefits are redistributive if they are regressive, so that those with lower incomes receive higher benefits. In this paper we use the Kakwani index of progressivity, which is the difference between the Lorenz curve for income and the concentration curve for the instrument in question. In addition, by using the generalised version of the index, we can examine the sensitivity of the results to different assumptions about value judgements.

$$\begin{aligned}\Pi_A^{RS}(v) &= G_M(v) - G_{M+A}(v) \\ &= (G_M(v) - C_{M+A}(v)) + (C_{M+A}(v) - G_{M+A}(v))\end{aligned} \tag{5}$$

$$\Pi_A^{RS}(v) = \frac{-a}{1+a}\Pi_A^{K}(v) + D(v) \tag{6}$$

If tax-benefit instruments are based on characteristics other than income then income units may have a different order of incomes before and after the operation of the instrument. For example in Ireland, social benefits usually have extra components for dependants. After the operation of the benefit, families will shift up the distribution relative to single people. Similarly, the existence of joint taxation may result in lower tax liabilities for married couples than single people with the same income. This type of redistribution is known as horizontal redistribution. Changes in the order of income units in a distribution will result in the Lorenz curve of post instrument income being different to its concentration curve. The Atkinson-Plotnick reranking index, which is the difference between the Lorenz and concentration curves, is the measure of horizontal equity we use. There have been a number of criticisms of this measure. For example Kaplow (1989) agues that it does not measure well the degree of horizontal redistribution as it ignores large changes in the distribution that do not affect the ordering of households, while small changes in income that result in reranking result in a change in horizontal equity. Palme (1996) points out that using the Gini coefficient will give highest weight to the area, typically around the median where the most observations occur and where because of a higher density, reranking is more likely to occur. He suggests that using the generalised index allows one to place a higher weight on other areas of the income distribution.[8]

In order to explain the reasons for changes in the redistributivity of the system as a whole it is necessary to look at what has been happening to sub-components. Equation 7 demonstrates how the redistributive effect of sub-components A and B, using the Reynolds-Smolensky index can be aggregated to produce the redistributive for a broader instrument C. Similarly, the progressivity of different sub-components can be aggregated to produce an aggregated Kakwani index.

$$\Pi_C^{RS}(v) = \frac{-(1+a)\Pi_A^{RS}(v) - (1+b)\Pi_B^{RS}(v)}{1+a+b} - (G_{M+A+B} - C_{M+A+B}), a \neq -b \quad (7)$$

$$\Pi_C^{K}(v) = \frac{a\Pi_A^{K}(v) + b\Pi_B^{K}(v)}{a+b}, a \neq -b \quad (8)$$

where a and b are the average rates of instrument A and B (negative if the reduce income).

[8] See Atkinson, 1980, Auerbach, and Kaplow 2000 for further critiques of measures of horizontal equity.

So far we have discussed the redistributive effect of instruments with respect to original market income. This however may produce results different to what one might necessarily expect in the literature. This is because very often the income base for an instrument may differ from market income. This is particularly true for income taxes. The income base on which income taxes are based are often extended beyond market incomes in that other components of the tax-benefit system are taxable in the case of benefits and in some countries, other components are deductible from the tax base in the case of social contributions. In addition other expenditures such as mortgage interest payments or medical insurance are deductible, while other allowances may reduce the tax base further. Pfähler (1990) outlines a method to decompose the progressivity of gross income taxes Π_T^K into the progressivity of its components Here we adapt the method so that the progressivity of income taxes can be decomposed into the progressivity of the rate structure relative to the tax base (market income plus taxable benefits minus allowances), ${}_{M+B-A}\Pi_R^K$, allowances (A) and the progressivity of the additional components of the tax base (B). Equation (10), described the decomposition for the Reynolds Smolensky Index.

$$\Pi_T^K(v) = {}_{M+B-A}\Pi_R^K(v) - \frac{a}{1-a+b}\Pi_A^K(v) + \frac{b}{1-a+b}\Pi_B^K(v) \tag{9}$$

$$\Pi^{RS} = \frac{(1-a+b-t)\Pi_R^{RS}}{1-t} + \frac{[t(1-a)/(1-a+b)]\Pi_A^{RS}}{1-t} - \frac{[t(1+b)/(1-a+b)]\Pi_B^{RS}}{1-t} \tag{10}$$

Decomposing Inequality/Redistribution by Population Characteristics

In addition to identifying the redistributive effect of different policy instruments, we would also like to identify individual and household characteristics, such as education, age, family structure, age at death, lifetime labour market characteristics that drive redistribution. Because of the difficulty in decomposing measures based on the Gini index, we use a slightly different methodology here.

Many inequality measures can be decomposed into population groups. Morduch and Sicular (1998) however argue that decomposition by population groups is dependent on sample size, so that the use of many sub-categories often is not feasible given data constraints. This method makes it difficult to examine the influence of variables such as age, which might be more properly regarded as continuous variables. Use of large numbers of categories, also make the calculations quite difficult.

Because of these problem related to this method, they introduced a regression-based method to investigate the contribution made by population factors. Their method starts with a decomposition of total income *Y*, into a regression equation as detailed in formula (11).

$$Y = X\beta + \varepsilon \tag{11}$$

Where X is an $n \times M$ vector of attributes described in table 2 and ε, an $n \times 1$ vector of residuals. The next step involves splitting for each unit, i, total income into the component Y_i^m, accounted for by each independent variable β_i as defined in formula (12).

$$Y_i = \sum_{m=1}^{M+1} Y_i^m \tag{12}$$

where $Y_i^m = X_i^m \beta^m$, For m = 1,..., M

$Y_i^m = \varepsilon_i$, For m = M + 1

Instead of using a decomposition method for population groups, we can therefore use a decomposition method for income characteristics. Inequality is broken up into the "absolute factor contribution", S_f is defined in equation (13).

$$I = \sum_f S_f = \sum_f I\rho_f \chi_f \sqrt{II_f} \tag{13}$$

where ρ_f is the correlation between component f and total income and $\chi_f = {\mu_f}/{\mu}$ is factor *f's* factor share.

It is necessary to employ an inequality index that is robust to the existence of zero incomes such as I_2, half the squared coefficient of variation, $\left(\sigma^2 \big/ 2\mu^2\right)$ (See Jenkins, 1995). It also has the advantage of being easy to decompose. We m ${}^2 \big/ 2\mu^2)$ however, that it gives less weight to poorer individuals than indices such as t l L and T indices.[9] In this way, from (13) above, total income variability can be decomposed into its components accounted for by these independent attributes as described in (14).

$$I = \sum_{m=1}^{M+1} I\rho_m \chi_m \sqrt{I.I_m} \tag{14}$$

$$\text{where } I_m = \frac{\sum_{i=1}^{n} (\beta^m.X_i^m - \beta^m.\overline{X}^m)^2}{2\left(\sum_{i=1}^{n} (\beta^m.X_i^m)\right)^2}$$

Measuring Inter-personal and Intra-person Redistribution

To examine the variability of incomes between individuals and the variability of incomes over their lifetime, we turn to another method, the decomposition of inequality or variability between population sub-group. If one regards the set of all annual incomes as the total population, where the groups are individuals, then one can decompose total variability of incomes into a factor attributed to between individuals (between group variability) and variability across the life-course (within group variability). Utilising the I_2 index, within group variability is defined in formula (15), between group variability is defined in formula (16).[10] Utilising the fact that the population share is $\left(1 \big/ n\right)$, we see that between person inequality, is in fact the inequality of mean lifetime income.

$$I_w = \sum_j w_j I_j, \tag{15}$$

where $w_j = v_j^2 f_j^{-1}, v_j$ the income share of each person j and f_j is the population share of person, in this case $\left(1 \big/ n\right)$.

[9] We must note however the different conclusions which can be drawn from different choices of inequality indices or decomposition methods.

[10] Björklund and Palme, 1997 use a similar decomposition method but instead use the I_0, Theil L and I_1 Theil T indices.

$$I_b(y) = \frac{1}{2}\left[\sum_j f_j\left(\frac{\mu_j}{\mu}\right)^2 - 1\right] = \frac{1}{2}\left[\frac{1}{n}\sum_j\left(\frac{\mu_j}{\mu}\right)^2 - 1\right] = I(\mu) = \bar{I} \qquad (16)$$

where μ_j is the mean lifetime income for person j and μ the mean population lifetime income.

A measurement problem common to most static distributional studies, is that taxes and benefits are compared to market income to get the redistributive effect. This method therefore ignores the fact that the distribution of market income may be different in the absence of a welfare state. However as it is a standard method to assume, we make the same assumption.

1.4. Objectives, Implementation and Thesis Outline

As described in the previous section, there are a number of gaps in the study of the redistributive effect of the tax-benefits system in Ireland. In this section we will outline some of the objectives of this thesis, that hope to fill some of these gaps and discuss the primary implementation methodology, microsimulation.

The primary objective is to study the size of redistribution in the Irish Tax-Benefit System. The first step therefore is to describe the principle components of the system. In writing this thesis, the author had to pull together information together from many different sources, from publications of the Irish Revenue Commissioners, The Department of Social Welfare, consultations with practitioners and reports and studies by academics, as there is no centrally located description of the Irish tax-benefits system. *Chapter 2* describes the main features of the system. It also tries to set the system in its historical context by charting the development of the system in the post war era. When one examines the impact of a system on a whole population, it is easy to miss the detail of the system. A third objective therefore of this chapter will be to examine the redistributive forces of the tax-benefit system, independent of the existing population structure. The chapter examines the changing generosity of particular instruments for different types of family by following the trend in the implicit equivalence scale used in the system. Replacement rates are used to highlight the generosity of the system relative to existing standards of living in the country over the period examined. The chapter also considers the degree of insurance cover within the system and finally examines the way in which instruments interact to produce redistribution.

As outlined above, quite a number of studies in Ireland have examined the redistributive impact of the whole tax-benefit system in Ireland. There however has been no comprehensive examination of the impact of the sub-components separately on the redistributive effect. *Chapter 3* attempts to do this by composing standard redistributive and progressivity measures of the whole system into the effect of the individual instruments such as tax allowances, schedules and particular benefits on the redistributive impact of the system on the population. As we shall see in Chapter 2, there has been quite a degree of tax-benefit reform over time. This paper will examine in detail the reforms from 1987 to 2000, where the tax system moved from being a joint tax system with the use of tax allowances to an individualised system that uses tax credits. The benefit system meanwhile moved from a situation with much differentiation between benefits, favouring those with insurance records and those on long term receipt of benefit to one whereby the level of the poorest has risen the most. In order to examine the effect of different policies and to isolate the impact of particular sub-components, a static microsimulation model, partially developed by the author has been used. This model takes as a basis a representative sample of the population and thus allows the redistributive impact of the system on the whole population to be examined.

Chapter 3 examined the redistributive effect of the tax-benefit system between individuals at one point in time. However as argued above, the use of a short accounting period as a week or month will tend to exaggerate the degree of redistribution within a tax-benefit system. It is desirable therefore to examine the degree of redistribution over a measure such as lifetime income, as this more fully reflects the standard of living an individual faces.

The components of lifetime income or the life cycle transitions are another very important area of investigation. Insurance systems attempt to cope with negating the costs of short term risks. For instance any examination of the effectiveness of a social security systems would need to look at how adequate the system coped with risks. Lifecycle studies like these allows one to examine taxes paid and benefits received over an individuals lifetime. As a result it is possible to disentangle the lifetime redistributive nature of a welfare system; intra-personal redistribution versus inter-personal redistribution. Inter personal redistribution is what has been traditionally investigated in cross-section analyses, namely how much is redistributed from one category of individual to another. Intra-personal redistribution on the other hand focuses on the redistribution which takes place over the life cycle from periods of wealth such as at the height of ones earning ability to periods of need such as when bringing up children.

Longitudinal data sets are required to carry out analyses of this kind. Harding (1990) gives a description of types of data sources used in longitudinal analyses. Panel data is one of the most useful forms of longitudinal data, however there are not many sources available. The main datasets are household panel surveys, which ask the same questions year after year of households, so that transitions can be studied. Examples include the Michigan Panel Study of Income Dynamics (PSID), the German Socio-Economic Panel (GSOEP) and the British Household Panel Survey (BHPS). In a number of Scandinavian countries, detailed administrative data is available which contains economic and social characteristics over their lifetime (for example Andreassen et al., 1996). In 1994, however the a new panel study began in virtually all of the member states of the European Union[11], the European Community Household Panel Survey (ECHP).

Unfortunately, when one wishes to examine periods as long as a lifetime, most panel data sets are insufficient as most cover too short a period. An exception is the work done in Sweden by Björklund (1993) who because of the availability of sufficiently long panel data was able to empirically look at the distribution of lifetime income. Björklund and Palme (1999) using the same data were able to examine the redistributive effect over this accounting period of the tax-benefit system in Sweden. Normally therefore, in order to examine such a distribution of income, it is necessary to use simulation.[12] Dynamic microsimulation models can be used to generate synthetic life histories of individuals, in effect simulated panel datasets, so that these issues can be examined.

---

[11] All except for Sweden.

[12] Other ways of producing longitudinal data include synthetic cohorts and pseudo cohorts. The former refers to a cohort, which is generated from one cross-section survey. The characteristics of the different age cohorts of the cross-section are used to represent the life cycle of the cohort. Pseudo cohorts refer to attempts to combine different cross-section surveys conducted in different years to produce a single data set. It is not a panel survey because the same people are not interviewed year on year, but it has the advantage of having interviewed the same cohort year on year. Thus, the average characteristics of a particular cohort can be tracked over time.

Microsimulation is a methodology for carrying out an economic analysis by simulating the economic factors of interest at the micro level. Microsimulation models, which study fiscal and social policy take a micro-dataset and simulate the impact of government policies at the individual, family or households level. A dynamic microsimulation model ages a sample over time, modelling life course events such as demographic changes like marriage and giving birth, educational achievement or labour market changes such as movements in and out of employment or changes in earnings. In this way a synthetic panel data set is generated for each individual in the base sample.

Dynamic microsimulation has existed for over thirty years, having started with Guy Orcutt in the 1960's at Harvard (Orcutt et al, 1961). However the perceived benefits did not outweigh the very high costs of the technique. As a result dynamic microsimulation models were only built in a very small number of countries (USA and Germany). The cost of computing was very high; running a dynamic model required a mainframe computer. Computer programming was also at its infancy; for example the development of the first DYNASIM model was an advancement of computing technology in addition to being an advancement in economic modelling (Lewis and Michel, 1993). Panel data required to estimate the transition equations were also rare. In recent years computing costs have decreased dramatically and panel data has become more widely available which has allowed for an increase in the number of models. Data limitations, a lack of knowledge and the problems with projections over long periods of time still make the approach often inappropriate for detailed public planning. However the approach can be a very useful tool in addressing many policy issues, providing the answers to *"what...if"* questions rather than to "what will happen" questions.

Studies which have concentrated on two types of investigation, lifetime income and intra-personal redistribution include Wolfson, (1989), Harding (1993) and Falkingham, Hills, Lessof (1995) have used what is known as a dynamic cohort model. These are the analyses considered here. Cohort models age a single cohort over its entire lifetime, predicting each individual's major lifecycle events. Dynamic population models meanwhile age entire cross-sections and have focused on analyses of future populations such as the impact of demographic changes on the income distribution, (Galler and Wagner, 1986 and Wertheimer et al., 1986).

In order therefore to examine the redistribution over the lifetime and the degree of intra-personal redistribution of the Irish tax-benefit system, it has been necessary to construct a dynamic microsimulation model for Ireland. The bulk of the thesis relates to the construction of this model and its use for empirical analysis of the redistributive effect of the tax-benefit system. *Chapter 4* considers the main issues involved in designing a dynamic microsimulation model and also considers how the main dynamic models internationally have dealt with the issues discussed. As part of this chapter a short description of the main models is included in an appendix. *Chapter 5* describes how this model dealt with the design issues. One of the conclusions is that if flexibility is not built into the model design, dynamic models despite large time investments can quickly become redundant. Therefore in order to avoid these problems and allow the model to continue to be used post PhD and to be expanded to allow for improved data and behavioural equations, a flexible and robust design framework is described.

However, the model framework is merely the skeleton of the model. The meat is the behavioural equations incorporated. These are described in *Chapters 6* (Demographic and Education Processes) and *7* (Labour Market and Capital Processes).

Chapter 8 studies the impact of the tax-benefit system over the life-course. It considers the degree of redistribution for individuals of different ages and life-course characteristics. *Chapter 9* analyses the redistributive effect of taxes and benefits over the lifetime. Firstly the impact of different personal characteristics on lifetime income is examined. Nextly we investigate the distribution of lifetime income and the impact of the tax-benefit system over the distribution. This effect is also decomposed by personal characteristic. Finally we consider the effect of life-course income mobility and the resulting lifetime income distribution. We examine the relative degree of intra versus inter personal redistribution in *Chapter 10*. Intra-personal redistribution is largely driven by life-course factors. We also examine the effect personal characteristics have on intra-personal redistribution.

The previous chapters examine the redistributive effect of the tax-benefit system in isolation by considering its effect in a steady state world. However neither the world nor the tax-benefit system are in a steady state. The system has evolved over time. In *Chapter 11*, we examine the degree of inter-generational redistribution of the Irish Welfare State. Because of the evolving nature of the tax-benefit system, it is impossible to examine this by itself. Instead we examine the impact of the entire tax and public expenditure system over time. Utilising assumptions about the age-incidence of taxes and public expenditure, we are able to examine the differential level of public expenditure for different birth cohorts in Ireland and thus investigate which cohorts did relatively better and which worse as the system has developed. Lastly we consider the sustainability of the whole system, utilising forecasts of the economy and a method known as generational accounting.

Chapter 2. Redistributive Forces of the Irish Tax-Benefit System

2.1. Introduction

This chapter describes the Irish personal tax-benefit system and examines the forces within the system, which drive redistribution within it. The Irish tax-benefit system is in many respects typical of the Anglo style of welfare state, with relatively insignificant social insurance systems, where means testing and progressive income taxes are more important (Esping-Andersen, 1996). There are a number of important differences between the UK and Irish tax-benefit systems. Firstly means testing tends to be more important in the Irish case (See Evans et al., 2000). Social insurance is less well developed than in the UK, with benefits payable at a flat rate and with no earnings related components. Although flat rate benefits tend to be of higher value than in the UK (See Callan, 1997), the absence of an earnings-related old age pension results in lower social insurance contributions. Having a larger self-employed population, the coverage of social insurance also tends to be lower. Structurally, means tested benefits are designed differently to the UK. Instead of almost universal coverage for a common means tested benefit, Income Support, Ireland has a set of categorical instruments covering contingencies such as unemployment, old age disability, lone parenthood etc., with different means tests and eligibility conditions, but similar levels of benefit. Together however, the system covers the same set of contingencies as in the UK. This reflects the incremental expansion of coverage of social benefits since the foundation of the state, at which point both countries had almost identical tax-benefit systems, largely having no sweeping reforms such as the UK's *Beveridge* and *Fowler* reforms. Like the UK, Ireland has a form of in-work benefit payable to families with children in work. Housing Benefits are less important, but growing in importance with the high house price growth currently in the country. Income taxes until 2000 differed from the UK in that, couples can optionally have their income taxed jointly.[13] Another difference is that workers on average wages tend to have higher marginal tax rates, although again more recently these have fallen towards UK levels. Like the UK however the taxbase tends to

[13] This feature is being abolished from the 2000 budget.

be wider than in other countries with less reliefs. For example, social contributions are not deductible from the income tax base.

This chapter describes the development of the Irish tax-benefit system in the modern era (from 1955-2000). Ireland has seen some of the biggest changes in Europe both socially and economically over this period. These changes have been accompanied by large changes in the tax-benefit system. Although this thesis primarily focuses on the redistributive power of the Irish tax-benefit system as it currently stands, this chapter provides some of the historical context in which the system developed. Section 2 describes the principle trends in revenue and social expenditures over the period. Section 3 describes the structure of the Irish tax-benefit system and the main changes that occurred over the period. Section 4 describes changes the implicit equivalence scales or in effect the official view on the economies of scale of living in multi-person households, in the system over time. Section 5 catalogues trends in the replacement rate over time. The replacement rate measures the ratio of incomes when out of work to in work. It is therefore a measure of the generosity of benefits compared to prevailing standards of living. Section 6 considers the importance of insurance element of the system. Section 7 combines all the components of the system together and examines how different instruments interact.

2.2.Revenue and Expenditure 1955-1998

Table 1 describes trends in expenditure on welfare benefits and revenue from income taxes and social insurance contributions in Ireland between 1955 and 1998. Over the period, benefits rose from a relatively low base of 4.8 per cent of GNP in 1955 to a peak in the late 1980's before falling back in the 1990's. In the context of the classification, here into social insurance, assistance and universal child benefits, insurance benefits are the most important.[14] Being the dominant expenditure, the trend in insurance benefit expenditures mirrors the trend in total expenditure. This however disguises the fact that assistance benefits too increased in value over the 1970's and 1980's, while there has only been a limited decline in total expenditure in the 1990's. Child Benefits on the other hand have been very stable at about 1 per cent of GNP from 1955 to the present.

Reasons for these trends are now examined. One of the main reasons is the change in the structure of the tax-benefit system. The period from 1950's until the 1980's, saw the

[14] In relative terms, these are much less important than in other European countries.

expansion of the role of social insurance, from a less important position than social assistance in 1955 to being nearly twice as important in 1980. The introduction of widow's (now survivor's) and old age pensions in the 1950's and 1960's were the main factors. Unemployment insurance benefits existed from the foundation of the state, but too rose over this period, partly because of generous indexation. A more important reason however is due to the expansion in "demand", especially in the 1970's for unemployment benefits and in 1980's for invalidity benefits. Both these factors can be explained by the severe economic position of Ireland during the late 1970's and during the 1980's. Rising numbers of unemployment initially increased unemployment insurance payments. As these benefits only last for 15 months at most, the continuing recession resulted in greater numbers having to rely on assistance payments. Youth unemployment also increased and thus the numbers without sufficient contributions increased. Furthermore, the poor economic position had the effect of discouraging individuals from seeking employment, resulting in the increase in invalidity benefits over this period.

The decline in the relative importance of insurance benefits in the 1990's has resulted from a number of factors. Firstly, demand has fallen because of higher employment levels. In addition, the cohort in retirement in the 1990's is quite small due to migration in the 1950's, hence the fall in survivor's and elderly insurance benefit expenditure. There has also been less generous indexation and a number of structural changes. For example, pay-related unemployment and disability benefits were abolished. On the assistance side, the peak for expenditure occurred later, as the longest out of work, who are more likely to be receiving assistance benefits, were the last to experience the impact of the improved economic position of the country. Poor economic conditions in the UK also resulted in a large number of unemployed people returning from the UK to higher benefits in Ireland, but without sufficient contributions to be entitled to unemployment insurance. Government policy also aimed to reduce the difference in the rate of payment between different benefits and thus the less generous (mainly assistance) benefits were increased at a faster rate. Finally increasing family breakdown and extra-marital births has resulted in an increase in the demand for lone parent benefits.

On the revenue side, total taxes increased over time from about 15% of GNP in 1955 to 37% in 1987, falling back in the 1990's to about 34%. During this period, Ireland moved from a system typical of developing countries, where indirect taxes are more important than direct income-related taxes and contributions, to a European style system, where the direct taxes are more prominent. Prior to the 1980's, indirect taxes were more important that direct taxes, moving from two thirds of total taxes[15] in 1955, to below half of all taxation in the post 1980 period.

The 1955-1987 period, therefore has seen a large expansion in the tax-benefit system and thus an increase in the potential for redistribution. Social benefits typically are more redistributive either due to targeting through the use of means testing or through the categorical nature of the benefits that tend to focus expenditure on groups likely to be poor such as the elderly, unemployed or disabled. On the taxation front, the move to progressive direct taxation from regressive indirect taxation will also tend to increase redistribution, thus levying relatively more taxation on the top of the income distribution.

2.3. Changes in the System: Structural Changes 1955-2000[16]

This section describes the structure of the Irish Tax-Benefit system and explains some of the main changes between 1955 and the present. Prior to the 1951 Social Welfare Act, the benefit system was different, relying on provisions which had existed since before the foundation of the state, back to the Poor Law and the reforms at the start of the Twentieth century. The structure of the income tax system in the pre-1955 period did not change significantly from independence, only rising in value to support increased expenditure during the Second World War.

Income Taxation

Since 1955, the Irish income tax system has moved from a highly patriarchal pre-1980 system to the optional joint income tax system of the 1980's and 1990's, to the planned move to individualised taxation after 2000. Prior to 1980, a wife's income was included with her husbands for tax purposes. Also the income tax system was characterised by a significant number of allowances in respect of dependants. The tax system therefore explicitly made a distinction between the principle breadwinner in the family and their dependants. In 1980, a High Court judgement which abolished the compulsory taxing of women's income with their husbands, allowing couples to decide whether they are taxed individually or jointly (See Kennedy, 1989). Because of the relatively low female,

[15] Total taxes here ignore corporate and capital taxation.

labour-force participation rate in Ireland, many couples continued to have their incomes taxed jointly. Recently, there has been a concern that this joint system has led to work disincentive effects for secondary earners in a couple (typically the wife),[17] a plan was announced in 2000 to move an individual system that makes no distinction as to whether a couple is married.[18]

In this section, we shall discuss in more detail these changes. To aid the discussion, we categorise income taxation into the following components: (a) the tax base and associated allowances/deductions/credits and (b) the tax schedule and marginal relief.

Tax Base, Allowances, Deductions and Credits

Firstly, the taxbase is determined. Allowances and deductions are deducted from taxable income, which consists of gross incomes and most cash benefits. Unlike *continental* systems, there are fewer employment-related deductions. For example, social insurance contributions and, travel to work or other professional expenses are not deductible. In addition, a number of incomes are exempt from income taxation such as a number of social benefits such as child related benefits.

Allowances, deductions and credits are grouped together here because they have similar objectives and in the process of reform underway at the moment, many allowances are being transformed into tax-credits. The principle distinction is that allowances typically have fixed amounts that are deducted from taxable income, effectively operating as a tax band of zero per cent. Deductions are also deducted from taxable income. However they usually depend on expenditure on a particular item such as rent, mortgage interest, health insurance etc. to have a value. While allowances and deductions are deductible from the tax base, credits are deductible from income taxes. The distinction has the effect that allowances/deductions *ceteris paribus* result in higher tax reductions for those with higher incomes than tax credits. This is because allowances and deductions are subtracted from taxable income and thus take a higher value for higher marginal rate of taxpayers, while because tax credits are deductible from income taxes, their values are the same for all taxpayers.[19]

---

[16] The sources used for this section are annual reports of the Revenue Commissioners and the Department of Social Welfare and Budget Statements of the Minister of Finance over the period 1955-2000.
[17] See O'Donoghue and Sutherland (1999).
[18] See Callan and Van Soest (1995) for a discussion of the impact of individualising the income tax on labour supply.
[19] This assumes that taxes paid exceed the value of the credit or allowances.

Throughout the period of study, a single person allowance has existed. This however has decreased from over 60% of the average wage in 1955 to about 40% in 1973 to 20-30% in the 1980's and 1990's.[20] Therefore, the allowance has not kept pace with earnings inflation thus increasing the proportion of workers who pay income tax and because of the progressive nature of the income tax system, increasing the redistributive nature of the income tax system. Over the entire period, allowances have also existed for married couples, widows and the elderly. A number of deductions exist for particular types of expenditure such as rent, mortgage interest, private medical insurance and private pension contributions.

The system has also reduced the number of instruments with horizontal redistributive objectives. In 1955, there were allowances for children, working wives, dependent relatives and for unmarried tax payer's who had a female relative caring for their relatives. The system was therefore similar to present day income tax systems in Southern Europe, that include allowances for dependants of the tax-payer. The system therefore followed a "main breadwinner" type model, reflecting the low female labour-force participation rate in Ireland at the time and supported the role of the family as a social shock absorber. It also reflects "softness" of state institutions, where outside the income tax system, the administrative capacity to deliver targeted family support did not exist.[21] Gradually, these horizontally redistributive instruments were reduced in value through inflation and eventually abolished, so that by 1986 all of these instruments were eliminated, with horizontal redistribution to families accomplished through the benefit system.[22]

Until the late 1990's, allowances and deductions were generally allowable at the marginal rate of tax. In other words the higher the marginal rate of tax paid, the more valuable the allowance. However, in the 1999 budget it was announced that the main tax allowances would become tax credits. This act would tend to increase the degree of progressivity of the income tax system.

Tax Schedule and Marginal Relief

[20] This rate assumes that individuals are at the average wage.

[21] Ferrera (1996) uses this argument to rationalise the structure of tax-benefit systems in Southern Europe, where targeting of resources is achieved through instruments that have the administrative capacity such as income taxation or social insurance.

[22] The main exception is a lone parent allowance introduced in 1980.

Once the tax base has been determined, income tax is levied through the income tax schedule or the system of rates and bands.[23] In addition, for those on low incomes there is a parallel individual/joint system with a separate system of allowances and rates known as marginal relief.

Much of the progression in the tax system results from a multi-banded increasing tax schedule. This has existed in a permanent form since the Finance Act of 1972. Prior to this, a sur-tax was in operation that included graduated bands for high-income earners. For most taxpayers, income tax was paid at a flat standard rate with reduced rates for those on lower incomes being introduced occasionally. Until 1973, the degree of progressivity in the tax system was expanded as the marginal rate of tax for each band was increased. Since the top marginal rates have tended to fall. The marginal rates for those with lower incomes also fell until 1980, and increased then over the 1980's until the tax reforms of the late 1980's. Over the course of the 1980's, the size and complexity of system of tax bands and rates was reduced significantly. In 1976 there were 6 bands varying from 26 to 77 per cent. The 1990's has seen a relatively stable tax schedule, with tax reduction being focused on increasing the width of the lowest tax bands, effectively reducing the marginal rates for those affected.

Until High Court Judgement of 1980, married women's incomes were taxed with their husband's. Subsequently, as in the case of a number of other European countries such as Germany, France and Spain, Ireland uses a system of joint taxation for married couples (See O'Donoghue and Sutherland, 1999). This system allows married couples to combine their income for income tax purposes. Spouses can transfer unused bands (and also some tax allowances) between each other to minimise their income tax liability.

Peculiarly to Ireland, the income tax schedule changes for those with low incomes. The objective is to take low earning individuals out of the tax net. Figure 1 outlines the difference between tax allowances and tax exemption limits, where the straight line indicates the operation of the existing system, the dotted line the operation of the exemption limit and the crossed line the operation of marginal relief.[24] The exemption limit effectively increases the zero rate tax-band. However, in order to avoid the tax kink indicated by the dotted line, marginal relief is used to smooth this transition. Therefore, tax is paid at the marginal relief rate until it is equal to tax paid under the

[23] Capital gains and bequests are taxed separately.
[24] Note the tax schedule used here is a hypothetical one, and is not representative of the Irish system. It is used simply for illustrative purposes.

existing system. Tax exemption limits are administratively quite simple and are a cheaper way of keeping people out of the tax net than tax allowances. However as we shall see they, do so at the cost of increased marginal income tax rates.

Summing up the effect of all these changes, figure 2 highlights the operation of the income tax system between 1955 and 1998 for married couples with 2 children as a percentage of the average wage. We notice that income tax originally only applied to families with relatively high incomes; in 1955, a family had to earn more than 150% of the average wage before tax was paid. Gradually then, the tax system was expanded, so that by 1973, those at about 50% of the average wage paid tax. We notice also the increase in the average tax paid at each income level (here as a proportion of the average wage) increasing for all income tax paying levels of income until 1987. Since then reforms have been instituted which have resulted in the average tax rate falling back until the average income tax levels in 1998 are similar across all incomes to the level in 1980. Current stated government policy is to continue to reduce these levels towards levels comparable with the United Kingdom.

Social Insurance System

The current Irish social insurance system was established in 1951, combining a number of existing systems. In 1955, the only contingencies covered by the social insurance system were short-term disability, unemployment and widowhood. Over time, the range of contingencies covered has expanded with the addition of maternity (1953), old age (1961), retirement (1970), deserted wives (1974), long-term invalidity (1974), male survivors (1994) and deserted husbands (1997).

The coverage of the social insurance system has expanded substantially since the 1950's (see table 2). Initially full coverage was limited only to full-time private sector employees, with partial coverage of public sector workers. In addition until the 1970's, non-manual workers earning more than the contribution ceiling were excluded from membership of the social insurance scheme. This resulted in 1955 in a situation with coverage for only about 60 per cent of the work force, with full coverage for just over half. Over time, the proportion of the work force in private sector non self-employed employment has increased, resulting in a gradual increase in the insured population. By 1973 73 per cent of the population were coverage. A number of further structural reforms have resulted in increased coverage. In 1974, the contribution limit was lifted for non-manual workers, increasing total coverage to nearly 85 per cent in 1975. The main effect of this reform was to nearly double the coverage for partial benefits within the public sector. Recent structural reforms have further increased coverage, including the extension of partial cover to the self-employed with earnings over a threshold in 1988. Part-time workers were included in the system in 1991. New public sector workers from 1995 will be covered for all benefits. In recent years, the dominant force in the expansion in the numbers covered by the social insurance system has been demographic and economic as both the working age population and the labour force has increased dramatically in size. This is witnessed by the doubling of the insured population in the years, 1980-1998.

Despite these reforms, there are a number of significant gaps in coverage. In 1998, only 75 per cent of those covered were covered for all benefits, with the rest being made up of self-employed, low-wage workers and existing public sector workers. Also there are a number of groups completely excluded from coverage. Those within the labour market excluded from membership include those earning less than the contributory threshold, the self-employed in receipt of unemployment assistance, some participants on social employment programs and relatives assisting self-employed. There is also a substantial proportion of the population not participating in the labour market, such as those in education or with home responsibilities. Unlike in countries such as Britain and Germany, they are not credited with contributions during these periods.

Turning to the structure of benefit payments, benefits have generally consisted of a flat rate payment (that varies by contingency) and unrelated to previous earnings, with extra payments for dependants.[25] Long term benefits typically also vary to a small extent by the number of contributions paid.[26] Extra payments are also payable for those living alone and those aged 80 or more.

Contributions have moved from flat rate payments, which existed until 1978 to firstly a partially earnings related system in 1974, to a wholly earnings related contributory system in 1979, *Pay-Related Social Insurance* (PRSI). Total contributions are divided between employee and employer contributions that are paid into the social insurance

[25] For a period from the late 1970's to mid 1990's, there existed a small earnings related component in Unemployment and Disability Benefits. Subsequently, a component has been retained so that benefits are adjusted to limit the replacement rate of those with very low previous earnings. Maternity benefits continue to be earnings related subject to maximum and minimum payments.

[26] The relationship between the number of contributions is quite tenuous as, for example, an average of 24 weeks of contributions per year, entitles a single person to a pension of 94 per cent of the maximum retirement pension received for an average 48 contributions per year. Also for no extra contribution, additional payments are made in respect of adult and child dependants of the claimant.

fund and income levies paid into general taxation. PRSI is paid by workers on earnings up to a ceiling subject to an allowance that varies for different types of workers. Income over the ceiling faces a marginal rate of zero. Employer contributions (ERSIC) for employees have a similar structure except for employees with earnings below the ERSIC reduced rate limit who face a lower ERSIC rate. Flat rate Health Contribution Levies, Education and Training Levies are also paid by individuals who have earnings above an exemption limit. This movement from flat rate benefits and contributions to flat rate benefits and earnings related contributions benefits have resulted in a social insurance pension system thus is highly redistributive, reducing the pure insurance element of the system.

Figure 3 highlights the trend in the system of social contributions 1955-1998. In 1955, 1965 and 1973, social contributions were flat rate, not varying by income until the upper earnings ceiling was reached.[27] At this, level workers paid no social contributions. This ceiling as well as the payment as a percentage of the average wage increased by 1965. This ceiling fell back by 1973, so that those on the average wage paid no contributions. We notice in 1980 the impact of introducing pay related social insurance (PRSI) over the 1970's. Those on very low pay were excluded, while PRSI was paid proportionally to income until the upper earnings limit was reached. At which point, the marginal rate drops to zero. The introduction of the income levies, resulted in the highest average rates being paid in 1987. By 1994, low wage earners were made exempt from these levies and were extended to cover higher earning workers on all incomes. The introduction of a PRSI allowance and the reduction of the marginal rate reduced the PRSI rates by 1998.

Non-Contributory Benefits

Like social insurance benefits, social assistance benefits in Ireland are contingency based, with most contingencies being covered by the system.[28] Means–tested benefits in Ireland are relatively more important than in most other countries (See Callan and Nolan, 1993). Part of the reason is a result of the structure of mainly flat rate social insurance benefits. Earnings related insurance benefits will tend to have higher payments and thus correspondingly reduce the means tested benefits as a proportion of total benefits. This is only part of the story however. Much of importance of social

[27] This ceiling existed for non-manual workers.
[28] The excluded categories are those who, although capable of work, do not seek employment including those in education.

assistance results from gaps in the coverage of social insurance. In addition to those who are not actually covered by social insurance at all, many such as the long term unemployed exhaust entitlement to insurance benefits and become reliant on assistance. Another source includes contingencies that are not covered by insurance such as lone parenthood and low income if in work. Also in the past, the insurance system did not cover the contingency of old age and thus due to the relatively late introduction of social insurance pensions, many elderly people are reliant on assistance. Another source of assistance expenditure is as a farming support, as witnessed by the substantial numbers of farmers on low income receives smallholder's unemployment assistance. Finally, relatively high benefit rates (See Callan, 1997 and Eardley et al., 1996) result in the higher average expenditure.

Benefits can be classified into five types of cash payments, out of work payments, in work benefits, universal child benefits and housing benefits. There are also a number of in-kind benefits provided under the social assistance system including butter vouchers, fuel allowances and free transport payments for extraordinary expenses.

Out of Work Benefits

Most contingencies such as unemployment, old age, survivorhood and disability were covered by the assistance system at the start of period we are studying. A number of other contingencies were added over time including deserted wife's (1974), lone parents (1973), early retirement (1994) and carers (1994). More recently, a number of benefits have been introduced to assist in reintroducing the long-term unemployed to work.[29] Contingencies not covered by the above payments are met by the Supplementary Welfare Allowance.

Like the social insurance system, if an individual is entitled to a means tested benefit then they will be entitled to a personal rate for themselves as well as possible additional payments for adult and child dependants.[30] In addition elderly recipients are entitled to extra payments if they live alone or are aged over 80. The total amount of benefit paid depends on a means test. In general, the unit of assessment used for means is the nuclear family. This unit is narrower than the household and as a result individuals living in

[29] Benefits include the Back to Work Allowance, the Part-time Job Incentive Scheme, the Back to Work Enterprise Allowance and the Back to Education Allowance.

[30] An exception occurs if both individuals are entitled to the Old Age Non-Contributory Pension. In this case both will be entitled to the full personal rate, rather than a personal rate payment and an adult dependent payment (See Callan et al, 1996).

households at the top of the income distribution may be eligible for social assistance. Therefore, social assistance may be less redistributive at the household level than would be expected under a household level means test (See O'Donoghue and Evans, 1999 for a discussion). An exception is in the case of unemployed people, where the income of people with whom they share accommodation can be counted as means (See Callan et al., 1996).

Means tests can be classified into four generic types used in unemployment assistance (UA), old age assistance (OANCP), lone parent (LPA), carers allowance (CA) and dependent payments means test.[31] In general, incomes counted towards means include all sources of earnings, imputed income value of assets (See O'Donoghue, 1998 for a description). Social welfare incomes do not count as means. The five types are described as follows:

- The UA means test depends on income net of taxes and contributions and a small earnings disregard.[32] Recently the withdrawal rate has been reduced from 100 % to 60 % on the recipients own income. Recently also the means test applied to spouses income has fallen from 100% to 50%, subject to an earnings disregard.

- The Old age means test depends only on gross income. The withdrawal rate is 100% while both spouses have a disregard of £6 pw. As both spouses can be eligible in their own right for OANCP, if a spouse receives the benefit individually, then their means are half the sum of both spouses incomes.

- The lone parent means test has changed in the late 1990's in an effort to encourage increased labour force participation. It moved to a net income basis and from a withdrawal rate of 100% to 50%. In addition, the earnings disregard has been significantly increased.

- The Carer's means test is based on net income, has a withdrawal rate of 100% and has a small earnings disregard per child.

- A spouse of a benefit recipient can have income up to a limit with the couple still receiving an extra payment for the spouse. Until the late 1990's, if the income exceeded this amount then the dependent adult payment and half of any child payment was withdrawn. Now, these extra payments are gradually withdrawn.

---

[31] See Callan et al. (1996) and Callan and Nestor (2000) for a description of these means tests.

The operation of these means tests in 1998 is shown in Figure 4 for families with 2 children.[33] The graph plots gross earnings as a percentage of the maximum value of each particular benefit versus the benefit as percentage of this maximum. Therefore the actual value of the X-axis will be higher for higher valued benefits such as Old Age Non-Contributory Benefit (OANCP). Also all means tested benefits at zero earnings will be 100% of the maximum.

Here, we notice the attempt to reduce the disincentives to work inherent in the system. In 1994, the means test for Unemployment assistance was similar to the Carer's allowance (lines with squares), where the benefit was largely withdrawn pound for pound with net income. In the intervening period, a lower withdrawal rate of 60% was introduced (dotted line), so that the benefit in 1998 is not completely withdrawn until income reaches just over 250% of the maximum value of the benefit.

The changes made to the Lone parent benefit means test (dark line) have even been greater. Here the test moved from a 100% withdrawal rate based on gross income (like the Old age assistance means test (lines with crosses) to a means test based on net income with a withdrawal rate of 50%. Also a larger income disregard was included as seen by the flat section for those on low benefits. In 1998, one-parent families could then earn £6000 per year without their benefit being affected. This combined with the more generous taper, means that the benefit would not be fully withdrawn until earnings reached over 400% of the original benefit.

Finally, we notice the impact of a spouse of an unemployed person earning in UA Spouse (Circled Line). Here, we notice that after a short period where income is disregarded, the spouse extra payment (and half the child payment) is rapidly withdrawn. By the time the working spouse earns 80 per cent of the UA, the benefit received becomes less than UA received if the working spouse had been the one claiming the UA (the dotted line) as part-time workers can claim UA, however the benefit is assessed for the family. At this point perversely, it would make more sense to shift the claim from the "unemployed" spouse to the working spouse.

In-Work Benefits

[32] Allowable on a claimant's own income if no children are present

[33] All families except for the lone parent benefit/one parent family benefit are assumed to be a married couple.

The Family Income Supplement is a payment to those who are in work, is similar to Family Credit (now Working Families Tax Credit) in the UK and Earned Income Tax Credit in the USA, and was introduced in 1984. It is payable to families with children who work more than a certain limit. In 1994, this limit was 20 hours per week, reduced from 24 hours per week in 1987.[34] All gross income (before tax or social insurance contributions are subtracted) including earned, unearned and transfer income is counted as means.[35] Families with income below certain limits, dependent on the number of children, are entitled to FIS if they meet the conditions set out above. The amount of FIS payable is 60% (up from 50% in 1987) of the difference between the limit and family gross income, subject to a minimum payment.

Callan et al (1995) examined the impact on the marginal effective tax rate of the interaction of FIS with other instruments such as income tax and social insurance contributions. Recommendations resulting from this report resulted in the income base for Family Income Supplement moving from pre-tax and contribution income to net income in 1996. This is highlighted in figure 5, which takes the FIS in 1994 with 4 children and simulates a budget constraint for a family with 4 children. In the system based on gross income (black line), we notice the severe poverty trap faced by the family, caused by the interaction of income taxes, social insurance contributions and FIS. Here income after FIS actually fell from around £8500 p.a. to £13000 p.a. Moving to a net income base reduces the effect of the poverty trap.

Housing Benefits

The housing benefit scheme in Ireland was introduced in 1977 under the act that instituted the supplementary welfare allowance (SWA) (See DSW, 1995). It covers rent, mortgage interest and household insurance. According to DSW (1995), "*the SWA scheme was originally devised so as to provide a residual and support role within the overall income maintenance structure by guaranteeing a standard basic minimum income and by assisting those confronted with exceptional needs. However the increase in the volume of rent and mortgage supplementation in recent years has affected this role.*" In 1995, 36,700 people were in receipt of the benefit split 30000 covering rent (one-third of the private rented sector) and 6700 for the mortgage interest. As the means tests described above there is only limited information available about the actual

[34] In the case of two parents living together, their hours worked could be added to reach this limit.

structure of these housing benefits.[36] Firstly, all families regardless of income are responsible for part of their housing costs (about 10% of value of SWA). Housing allowances cover remaining housing costs up to a limit which depends on the family composition and location. Families are allowed disposable income equivalent to the SWA, before they have to make any further contribution. Pre-tax income above this amount is withdrawn at a 100% withdrawal rate.

2.4. Assumed Need - Implicit Equivalence Scales 1955-1998

In the last section, the rules of the tax-benefit system were described. Here, we examine how changes over time influence trends in needs implicit in the tax-benefit system; the weight placed by the system on the extra costs resulting from the existence of dependants. To do this we consider the concept of implicit *equivalence scale* within the system. In other words, the extra percentage of benefit or tax allowance received relative to the amount received if they were single. Except in the case of social insurance where both spouses are entitled in their own right, benefits (and taxes until 1980) apply to the family level. However even in the case of social insurance, if only one spouse is eligible then these instruments too apply at the family level. In other words a member of the family applies for the benefit or pays tax and they get extra payments or allowances for their dependants.

Table 3 presents the trend in the equivalence scale for the main benefits and income taxation for adult dependants and the first child dependant, from 1955-1998. With regard to benefits, we notice the biggest change between 1955 and 1965, where the ratio of benefits given to dependants relative to the claimant rose dramatically. For adult dependants, the ratio increased in each case by over 40 per cent from about 0.5 to 0.71-0.81.[37] Since then, there has been a gradual decline in the adult dependant equivalence scale to 0.58-0.68 in 1998. However, in the 2000 budget it was announced that it was intended to bring this equivalence scale up to 0.7 again. The child-dependent equivalence scale shows a similar movement, with a particularly large fall in the equivalence scale 1980-1987. Since 1994, the child dependent amounts have not increased in nominal terms, as it has been government policy to increase universal child

[35] The principle exceptions are child benefit, carer's allowance, domiciliary care allowance and rent allowance.
[36] See Callan and Nestor, (2000) and DSW (1995).
[37] Recipients of old age assistance payments are entitled to apply individually in their own right and thus the adult dependant equivalence scale has remained constant at 1 over the entire period.

benefits instead. This is because of the disincentives to work for unemployed persons with children.

2.5. Income Replacement

Looking at equivalence scale allows us to examine the need implicit across different family types for specific contingencies over time. However, it does not allow us to compare between benefits or the value of the instrument relative to the standard of living. Also by focusing on only one instrument it ignores the interaction between instruments.[38] Net Replacement rates, which are the ratio of out-of-work to in-work income allow us to do both. With a fixed denominator in a particular year (net average earnings), we can compare between benefits. Thus, higher replacement rates indicate higher benefits. Meanwhile a falling replacement rate over time indicates that the benefit has been falling behind earnings over time.

Table 4, describes the trend in the net replacement rate from 1955-1998. For single persons, replacement rates in general are quite low by European standards, with the replacement rate never reaching 40%, in most cases never reaching 30%, with the lowest replacement rate being 10% in 1955. As the objective of social benefits in Ireland has generally been one of poverty alleviation rather than income replacement, we see that there is provision for dependants. We notice a very dissimilar trend to that observed for equivalence scales. From 1955-1965, we observe a fall in the replacement rate, despite an increase in equivalence scales over the period. This is because single person benefits in general fell with respect to net average earnings and thus despite the increase in the proportion of the benefit relating to dependants replacement rates for families with 2 children fell. By contrast, despite falling equivalence scales for dependants, the replacement ratio rose from 1965 to 1987. This is partly to do with rising benefit levels and partly to do with higher taxation, which reduces the denominator, net average earnings.

Since 1987, falling taxation has resulted in higher denominators, pushing replacement rates up. The most important effect over the period however has been a shift from very variable replacement rates for different contingencies to a more equal distribution of

[38] As in general an individual can only apply for one benefit, the only type of interaction possible would occur if both spouses in a couple were eligible for separate benefits in their own right. In this case The numerator would be higher. At the same time, one might expect that one should consider a higher denominator as one would then be looking at the replacement rate of two income replacement rates and thus should include two wages in the denominator.

benefits. Primarily, this has been accomplished by increasing the lowest valued, mainly short-term and assistance benefits at a faster rate than the others. In 1985, the Commission on Social Welfare (CSW, 1985) recommended a minimum level of benefit to achieve a basic standard of living. By 1999, this had been achieved for all benefits. However despite this achievement, the level of indexing since 1987 has seen benefits over the last decade fall further behind earnings, despite rapid economic growth. This has in turn, reduced the ability to meet another target as part of the National Anti-Poverty Strategy, that relative poverty (as measured by 60% of average income) fall from 15% to 10% by 2007 (Nolan, 1999).

2.6. Social Insurance versus Social Assistance

Section 5 highlights a reduction in the insurance principle within the tax-benefit system. Until the 1980's/early 1990's, contributory benefits were much more generous than assistance benefits. However a deep recession during this period and a concern about the adequacy of some benefits, has seen the higher valued insurance benefits increase at a slower rate than assistance rates. In addition, increasing numbers of people depend on assistance income over long periods. Other changes, which have highlighted the reduction of the insurance principle, include the movement from flat rate contributions and benefits to earnings related contributions and flat rates benefits.

Another difference between the operation of public schemes and private savings mechanisms relates to the link between the amount of contributions and benefits received. Social insurance payments for retirement, old age and invalidity depend only on the number of contribution.[39] However, again this link is quite tenuous, as the difference between minimum and maximum benefit levels is very small. Individuals with the minimum per year receive pensions of about 95% of those with maximum contributions (48 per year).[40] Although most recipients get the maximum rate, significant numbers receive less than this; in 1995, 38%, 41% and 11% respectively received less than the maximum payment of the old age, retirement and survivor's pensions.

This emphasis on poverty reduction rather than income replacement means that for higher earning families, the social welfare system does not provide sufficient income for retirement and long-term illness. Therefore, private provision of income replacement

[39] Payments of invalidity to under 65's are however at a lower rate.

mechanisms for retirement and long-term illness is quite important with about half of all workers covered for these risks.

2.7. Interacting Instruments in the Tax-Benefit System

Having described the main features of the system, we now pull the strands together to consider the system as a whole. We shall firstly describe the interaction of the different components before comparing the impact on different types of families, different annual systems and the impact of new back-to work incentives.

Figure 6 describes how the different income components of the 1998 system interact to produce disposable income for a single earning married couple with 2 children on the minimum hourly wage.[41] The grey band represents child benefits, the white band unemployment benefits, the check pattern, family income supplement, the horizontal stripes earnings after taxes and contributions and the black band housing benefits. We notice first that as universal benefits, child benefits do not vary with income. Unemployment Assistance (UA) is withdrawn until 3 days work (24 hours pw) has been reached. At this point the Family Income Supplement (FIS) is received. As the incomes are plotted cumulatively, the upper bound of net earnings represent pre-housing benefits disposable income. Except for a kink when a family moves from UA to FIS, disposable income rises with hours worked. The kink occurs because the value of UA at 24 hours of the minimum wage is greater than the equivalent value of FIS. Housing benefits being withdrawn pound for pound with disposable income result in a flat profile of final income, with a family having to work 70 hours at the minimum wage before disposable income exceeds that of a family not working. We shall see however that both these issues have been alleviated through the introduction of back-to-work benefits. In addition, housing benefits have in the past been relatively unimportant. Recently however, housing benefits have become more important and thus the disincentive effects have become more important. Currently, therefore the scheme is being examined to see if a less severe withdrawal rate could be introduced.

We now consider the treatment of different families. Figure 7 plots gross income versus disposable income per annum for 4 different family types (not receiving housing benefits), single, lone parent with 2 children, married couple with no children (M0K), and married couple with 2 children (M2K). The tax-benefit system is progressive for

---

[40] More generous contribution records are required for the survivor's pension.

each type across the whole range of income. Married couples without children have higher disposable incomes than single people with the same earnings. For those receiving benefits because of the presence of adult dependant additional payments and for those higher up the income scale because of the existence of joint taxation, which reduces tax liabilities for the couple. Families with children married and unmarried have higher disposable incomes than families without children. Initially married couples with children have higher disposable income because of higher benefits. However, because of the more favourable means test as outlined in section 2, lone parents eventually receive more benefits. However married couples (with and without children) eventually pass the disposable income of the lone parent at about £25k p.a. because of their lower tax liabilities, again because of the existence of joint taxation.

We now turn to the trend in tax-benefit incidence over time. Figure 8 plots the budget constraint, a graph of disposable income versus gross income (as a percentage of the average wage), faced by married couples with 2 children for the period 1955-1998. At the bottom of the income distribution, we notice, the impact of rising benefit levels, especially 1955-1973 and 1987-1998. Also, we saw the effect of the change in the unemployment assistance means test, with flat disposable income in 1955-1987, as a £1 of benefit is withdrawn for every £1 of income. In 1998, this *poverty trap* has been eliminated as now disposable income rise with gross income. Above 50% of the average wage, we notice the effect of the rising tax-burden 1955-1987, as the budget constraint is lower for each year examined. This trend has been reversed by 1998.

As highlighted above, it is not sufficient to focus on a budget constraint at one point on time. A number of instruments are time dependent. In particular, the back-to work allowance (BWA), which allows individuals to retain some benefits on returning to work reduces in value. Figures 6-8 show the situation where individuals receive the out of work benefit, unemployment assistance until they work 20 hours per week and an in-work benefit, the family income supplement thereafter. The budget constraint also depends on the average hourly wage. Figure 9 demonstrates the impact of the family choosing instead to take-up the back-to work allowance. Here we look at a single earning married couple with 2 children. The figure demonstrates the choice facing the family currently without employment income if they decide to take up work at the minimum hourly wage this year, a year after taking up employment, 2 years after and 3 years after. If the family choose not to work more than 20 hours, then they will be

[41] It is assumed that they pay a private sector rent of £105 pw.

eligible for some unemployment assistance. However if they choose to work more than this then they will be able eligible for both family income supplement and the back to work allowance, which falls in value over time. In year 4 we notice the existence of a poverty trap. This is because of the interaction of the new unemployment assistance (UA) means test and the family income supplement (FIS). For a family on the minimum wage working 20 hours per week, they will get more UA than FIS. However after 3 days work per week (24 hours), the family would no longer be eligible for the benefit. Figure 10 highlights the additional impact of housing benefits. Here we see the effect of the withdrawal of housing benefits once income reaches £250 per week. In year 1 therefore there is no incentive to work more than 30 hours per week, in year 2 this shifts to 40 hours as the BTWA is reduced and thus housing benefits can be held onto longer. However by year 4 there is no incentive to work on the minimum wage, if the household is eligible for housing benefits. Of course it is a pre-condition of eligibility for benefit to be seeking work. Nevertheless despite recent benefit reform there still remains substantial poverty and unemployment traps.

Redistribution over the Lifetime

In addition redistribution between different income groups at one point in time, the insurance system for example with earnings related contributions and flat rate benefits, redistributes from rich to poor over the lifetime. Therefore those with lower lifetime earnings will have higher returns (See Hughes, 1985).[42]

Figure 11 compares the return of the tax-benefit system over a lifetime relative to a private savings instrument. In each case we consider the case of a single male earning varying proportions of the average wage. The graph reports the ratio of benefits received to taxes and contributions paid if they lived their entire life in a world where a particular years system applied.[43] Clearly, no individual lives in such a world, however the steady state assumption allows one to study the effect of each system in isolation. Assuming a growth rate equal to the interest rate, a private savings instrument in the absence of management fees would give a return equal to 1. For each of the tax-benefit systems examined, we notice the strongly redistributive nature of the system, where those who on average have lower incomes receive relatively more benefits than pay taxes. We also notice that much of the earnings distribution have returns significantly

[42] This effect is reduced because of the existence of an upper earnings limit.

below 1. In fact, only in the case of 1998 and 1995, do we see returns in excess of unity for those with low average wages. For the other years, those with average lifetime earnings that vary from 40% to 300% of the average wage have returns below unity. We see a trend of falling returns from 1955 to 1973, before rising again to 1998. This effect is a result of a mixture of changes in taxes and benefits.

Examining men who remained single their whole life, never having children or experiencing spells out of the labour market between leaving education and retiring is quite an extreme case. The presence of spells out of work increases the redistributive effect even further for those lower down the income distribution. Also, working women who tend to have lower average wages, will on average have higher returns for the same number of years worked. However many women will not work sufficiently long to be eligible for benefits and thus in aggregate may in fact have lower returns. It is necessary to look at the distribution of lifetime incomes to consider this issue in more detail. Families who work for shorter periods will also have higher returns from the tax-benefit system. As noted above, although contribution related, the difference in benefit level for families with the maximum contribution record and the minimum contribution record is very slight. In any case, assistance benefit levels are not much lower than the lowest insurance pension level. Also as Hughes (1985) pointed out, those who were early recipients of the insurance pension had higher returns as they were required to have had lower contribution records. In addition, married couples and families with children will have higher returns due to the existence of adult and child dependent payments in the benefits system.

2.8. Conclusions

This chapter outlines the main characteristics of the Irish tax-benefit system and describes the main trends in the components since 1955. The main forces driving the institutional reforms have been an expansion of *social rights* (O'Connell and Rottman, 1992), a greater degree of targeting to focus on poverty reduction culminating in the Anti-Poverty Strategy and a concern to improve work-incentives.

Over the period, income taxes have gradually increased in importance, reaching a peak in the late 1980's before falling back during the 1990's. The social insurance and assistance systems have also expanded both in terms of the coverage of the population,

[43] We assume that the system is neutral and so subtract taxes that are used for other non benefit

the demand for benefits and the value of benefits. Again these trends levelled off in the 1990's.

One of the main distinguishing features in the Irish Tax-Benefit System relative to other European tax-benefit systems is the almost complete absence of an insurance component in the benefit system. Although the largest benefit instruments are nominally called insurance benefits and depend on the payment of insurance contributions, the objective of these instruments are primarily redistributive (in the narrow sense of vertical redistribution) rather than income replacement. For about 15 years earnings replacement benefits were included for the unemployed and for the disabled. However these were gradually reduced in importance and finally abolished by the 1990's. However, for longer term contingencies such as old age, the provision for income replacement is left to the private sector. The introduction of an earnings related element into the state pension system however has been examined periodically over the last thirty years. In 1976, the government issued a discussion paper which recommended the introduction of an earnings related scheme on the basis that the existing scheme could not meet the income needs in retirement of many people (Department of Social Welfare, 1976). In 1984, the government announced plans to publish a plans for a national pension (Ireland, 1984). This was never published due to the establishment of the National Pensions Board who subsequently analysed a proposal for such a scheme (NPD, 1993). They however recommended that a state income related pension should not be established due to the potential impact on competitiveness and employment and also due to a lack of research into the adequacy of the existing flat rate pension in maintaining in work incomes. However given a recent decline in private pension coverage rates and the very strong state of the economy, there may be a case

In this chapter, we have noticed the gradual change in the tax-benefit structure over the last 15 years in order to improve work incentives. Firstly the family income supplement was introduced to negate the *unemployment trap*, created by the value of unemployment benefits relative to in work incomes for families with children. This however introduced a *poverty trap* further up the income distribution as families faced a withdrawal rate of over 100 per cent (see Callan et al., 1995). As a result, the means test for FIS was made dependent upon income after taxes and benefits. This reform was effective in eliminating the poverty trap resulting from FIS. However around the same time effort was made to reduce the poverty trap faced by those on unemployment assistance who

---

expenditures.

faced a 100% withdrawal rate. Moving to a 60% withdrawal rate for this benefit has eliminated this poverty trap, which in turn reintroduces the poverty trap for those on FIS as a family working 24 hours per week on UA will receive more than a family working 25 hours per week on FIS. The back to work allowance (BTWA) removes this poverty trap for 3 years, but however for families who have to rely on the minimum wage, the long term poverty trap. Lastly the increased reliance on housing benefits with its 100% withdrawal rate further exacerbates these problems. This process of temporary responses to particular problems in the system has resulted in one of the most complicated benefit systems in Europe.[44] This level of complexity, besides the in built poverty traps, causes itself negative behavioural disincentives. At one extreme the complex benefits system reduces the likelihood that families will claim the benefits they are entitled to. At the other extreme, families will spend so much time claiming the benefits they are entitled to that they will not have time to look for work.[45] It is therefore time, to carry out extensive co-ordinated reform of the entire system. For example, as highlighted in O'Donoghue (2000), insurance benefits perform a similar degree of redistribution to means tested benefits, but without many of the disincentives of means tested benefits.

[44] An example of this complexity is that in the Europe-wide Tax-Benefit model partially written by the author, the Irish benefits module takes longer to carry out a calculation than any other countries benefit system.

[45] In Dublin city a family who is unemployed has to sign on the unemployment register at the Department of Social Welfare to receive unemployment benefits, go to the health board to claim heating vouchers, visit the community welfare officer to receive housing allowances, the city council to deal with social housing claims, the training and employment authority to seek work and finally to the post office to receive the actual benefits!

Tables and Figures

Table 2.1 Irish Tax-Benefit System: Revenue and Expenditure 1955-1998 (as % of GNP).

	1955	1965	1973	1980	1987	1994	1998
Universal							
Child Benefit	1.0	1.0	1.2	0.8	1.2	0.8	0.9
Insurance							
Ill	0.6	0.8	1.1	1.1	2.1	1.3	1.0
Unemployment	0.4	0.4	0.5	1.5	1.5	0.7	0.5
Survivor	0.3	0.5	0.8	1.0	1.2	1.0	0.9
Old	0.0	0.7	1.1	1.7	2.2	1.8	1.6
Other	0.2	0.1	0.1	0.1	0.2	0.2	0.2
Total	1.4	2.5	3.6	5.4	7.1	5.0	4.3
Assistance							
Unemployment	0.2	0.2	0.7	0.9	2.3	2.7	1.5
Survivor	0.3	0.2	0.2	0.2	0.2	0.2	0.1
Old	1.8	1.2	1.2	1.6	1.6	1.0	0.8
Other	0.1	0.0	0.2	0.2	0.5	1.0	1.6
Total	2.4	1.7	2.4	2.9	4.6	5.0	4.1
All Benefits	4.8	5.2	7.2	9.1	12.8	10.8	9.3
Tax and Contribution							
PRSI	1.0	1.5	2.1	4.4	5.3	5.3	4.8
Income tax	4.5	5.4	8.2	11.3	14.8	13.0	12.9
Indirect tax	10.2	10.6	14.5	15.2	16.7	15.2	16.4
Total	15.6	17.4	24.8	30.9	36.8	33.5	34.1

Source: Statistical Abstract, Central Statistics Office, *various years.*

Figure 2.1 Exemption Limit and Marginal Relief (Married Couple 2 Children)

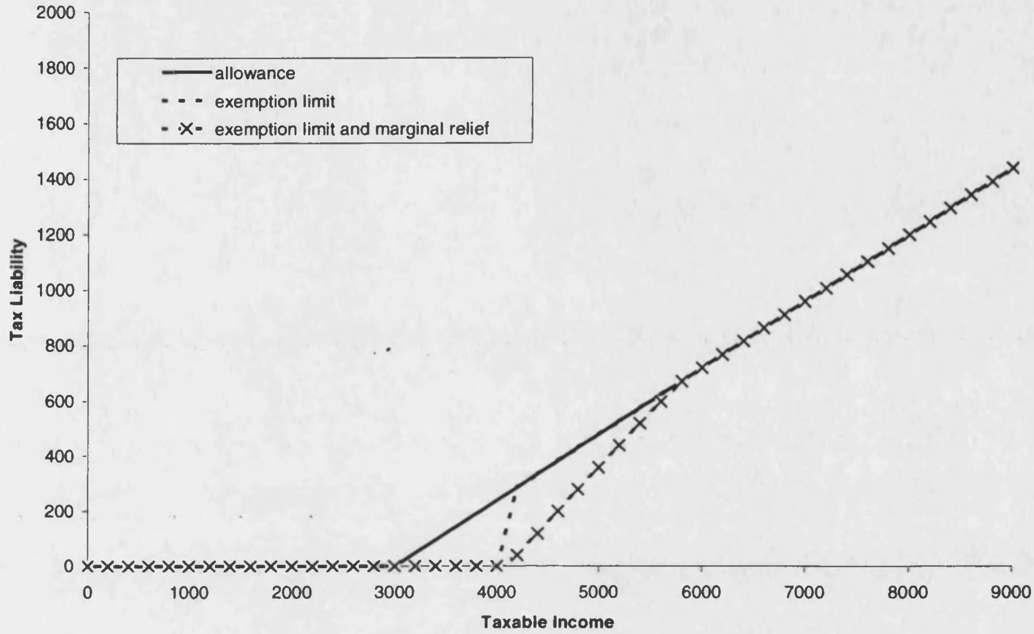
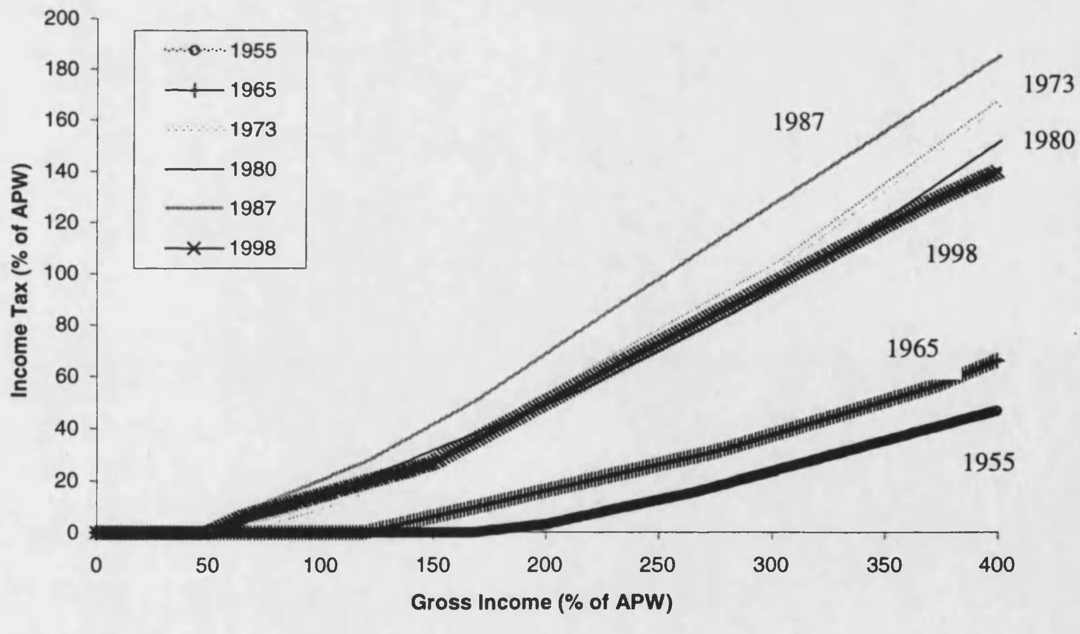
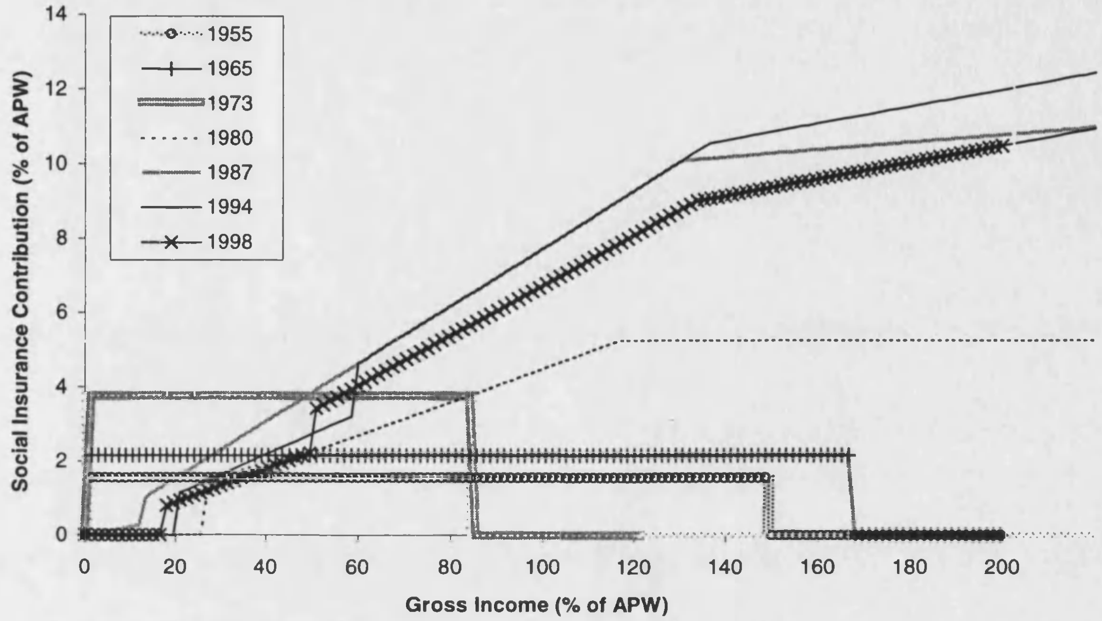


Figure 2.2 Income Tax 1955-1998 (Married Couple 2 Children)



Note 1: APW means Average Wage of a Production Worker

Figure 2.3 Social Insurance Contributions 1955-1998



Note 1: APW means Average Wage of a Production Worker

Table 2.2 Coverage of Social Insurance: Number of Members[1]

Year	Total Insured	Workers Fully Covered	Workers Partially Covered
1955	726	639.2	86.8
1965	744	671.2	72.8
1973	815.7	742.9	72.8
1980	1023.4	837.3	186.1
1987	1343.2	1103	240
1994	1769.9	1322	448
1998	2106.8	1574.3	532.5

Sources: Reports of the Department of Social Welfare, various years. Statistical Information on Social Welfare Services various years. Hughes (1985)

Note 1. Thousands of workers.

Figure 2.4 Means Testing of Social Assistance 1998.

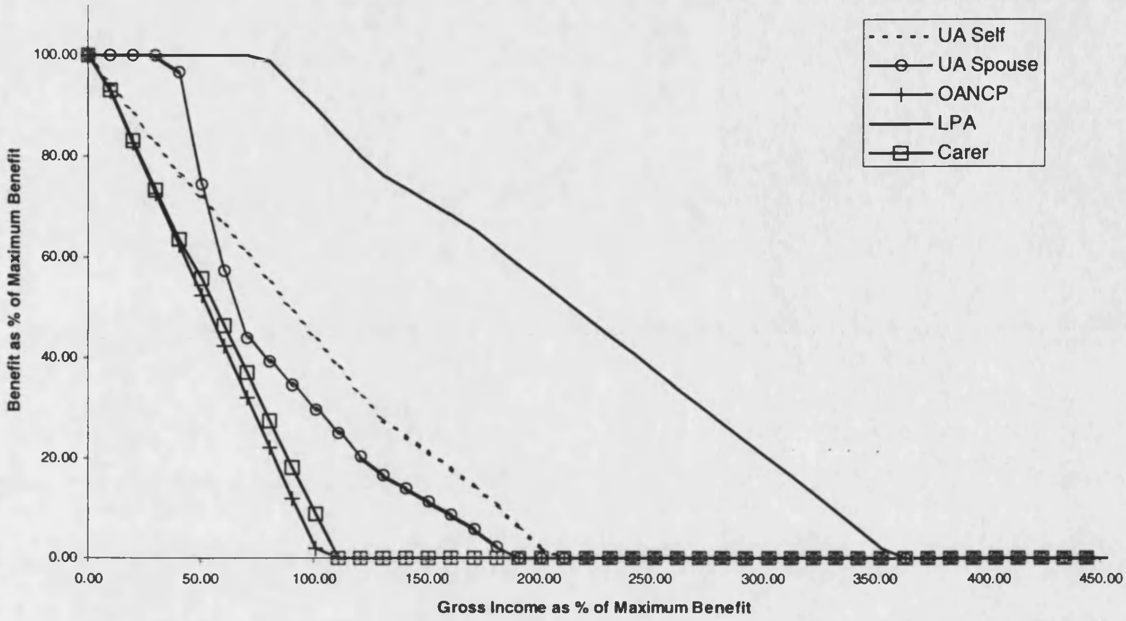


Figure 2.5 Family Income Supplement Reform

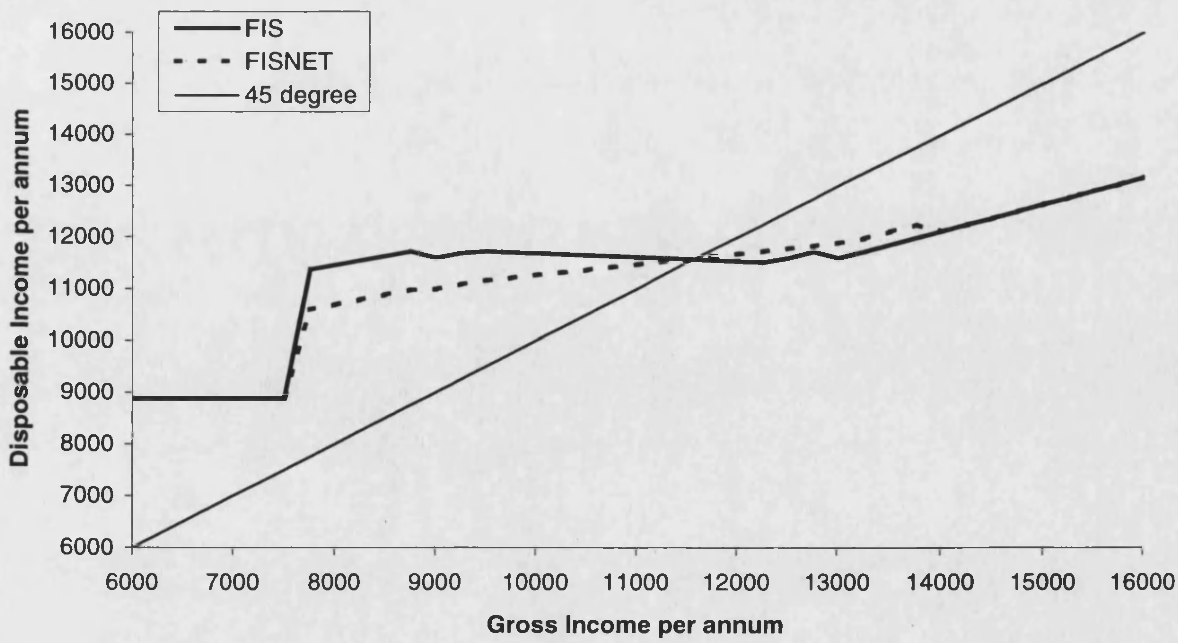


Table 2.3 Equivalence Scales Additions for Dependants

	Adult							1st Child						
Year	1955	1965	1973	1980	1987	1994	1998	1955	1965	1973	1980	1987	1994	1998
Unemployment Benefits	0.500	0.706	0.649	0.648	0.648	0.600	0.584	0.267	0.306	0.282	0.291	0.229	0.216	0.187
Unemployment Assist.	0.556	0.810	0.729	0.721	0.721	0.621	0.602	0.222	0.345	0.308	0.335	0.239	0.224	0.193
General Assistance (SWA)					0.726	0.621	0.602					0.247	0.224	0.193
Short Term Ill Contrib.	0.500	0.706	0.649	0.648	0.648	0.600	0.584	0.267	0.306	0.282	0.291	0.229	0.216	0.187
Old Age Contrib.	0.000	0.792	0.646	0.639	0.746	0.718	0.686	0.000	0.217	0.257	0.261	0.198	0.183	0.183
Old Age Assistance	1	1	1	1	1	1	1	0	0.417	0.268	0.271	0.204	0.216	0.182
Long Term Ill Contrib.	0.000	0.000	0.000	0.649	0.471	0.600	0.644	0.000	0.000	0.000	0.290	0.167	0.216	0.211
Long Term Ill Assistance				0.600	0.569	0.600	0.660				0.319	0.193	0.216	0.187
Survivor's Contrib.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.267	0.335	0.326	0.333	0.259	0.264	0.229
Survivor's Assistance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.311	0.278	0.325	0.329	0.251	0.249	0.216
Lone Parent Assistance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0	0.329	0.251	0.249	0.216

Notes: 1. The recipient of the benefit is assumed to be one equivalent adult and has the modal age for that benefit (e.g. does not receive additional payments for very old age or lower payments for being < 18). Certain long-term benefits also have additional payments for living alone, which is ignored here. 2. Adult dependants are assumed to have the same age as the spouse. The payment for spouse can also vary by age. 3. Child payments may also vary by number of children. 4. All payments are assumed to be for households living in urban areas. 5. Unemployment assistance is assumed to be for long-term recipients. Lower rates apply for short-term recipients.

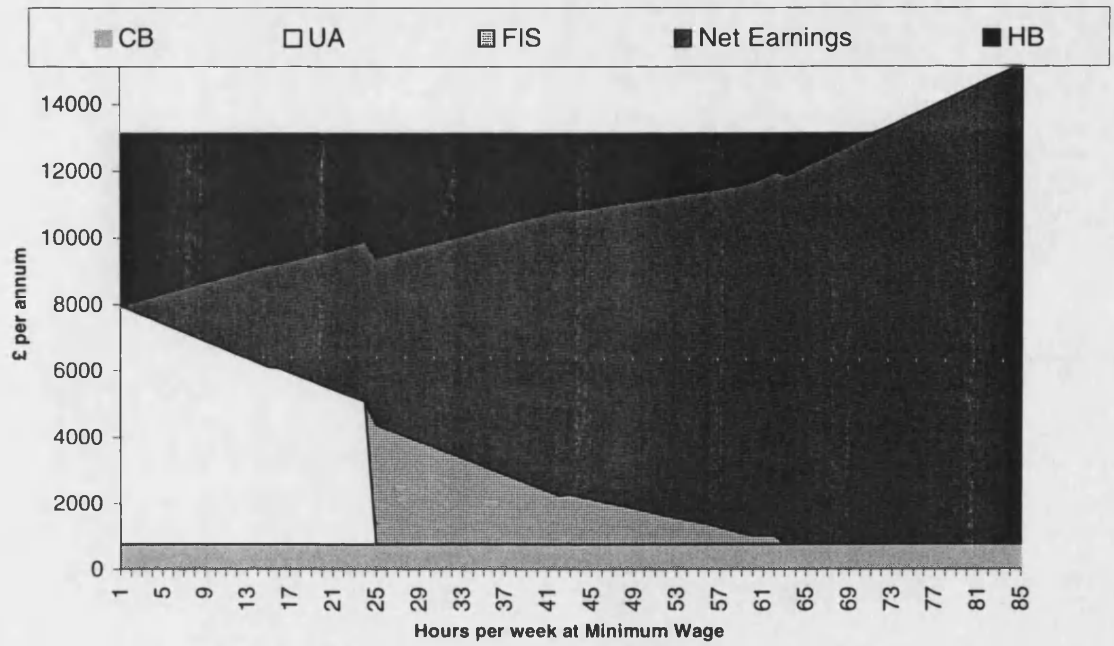
Table 2.4 Out of Work Replacements Rate.(as a percentage of Average Wage)

Family Type	Single							M2k[1]						
Instrument	1955	1965	1973	1980	1987	1994	1998	1955	1965	1973	1980	1987	1994	1998
Unemployment Benefits	17.6	15.3	23.9	25.5	30.1	31.0	28.4	34.5	31.3	48.3	52.0	57.3	58.6	52.5
Unemployment Assist. LT	10.6	10.4	19.5	21.2	26.9	31.0	28.4	20.9	23.4	42.2	45.8	53.8	58.6	52.5
Unemployment Assist. ST	10.6	10.4	19.5	21.2	24.2	29.9	27.5	20.9	23.4	42.2	45.8	49.4	57.6	51.8
Supplementary Allowance	10.6	10.4	19.5	21.2	24.2	29.9	27.5	20.9	23.4	42.2	45.8	49.4	57.6	51.8
Short Term Ill Contributory	17.6	15.3	23.9	25.5	30.1	31.0	28.4	34.5	31.3	48.3	52.0	57.3	58.6	52.5
Old Age Contributory	0.0	21.6	26.3	30.6	39.2	36.1	33.4	0.0	42.0	51.6	59.9	78.0	75.4	69.0
Old Age Assistance	14.1	17.1	22.5	26.2	33.5	31.0	29.2	27.5	33.3	51.8	60.4	71.7	69.3	64.0
Long Term Ill Contributory	0.0	0.0	0.0	27.5	34.5	31.8	29.1	0.0	0.0	2.9	55.8	64.6	63.1	56.3
Long Term Ill Assistance	0.0	0.0	19.7	25.3	31.7	31.0	28.4	0.0	0.0	42.4	51.2	56.2	58.6	52.5
Survivor's Contributory	17.6	15.3	24.1	28.1	35.2	32.8	29.8	26.4	23.0	37.1	43.3	48.6	47.3	42.2
Survivor's Assistance	13.2	12.9	22.5	26.2	32.9	31.0	28.4	21.2	16.9	34.7	40.3	45.7	44.2	39.7
Lone Parent Assistance	0.0	0.0	0.0	26.2	32.9	31.0	28.4	0.0	0.0	2.9	40.3	45.7	44.2	39.7
Gross Average Wage (Male)	7.68	13.8	36.01	112.4	237.1	298.4	353	7.68	13.82	36.01	112.4	237.1	298.4	353
Net Average Wage	6.99	11.7	27.44	80.08	140.5	196.7	248.3	7.56	13.51	30.94	94.8	176.2	233.9	296.2

Source: Author's calculations

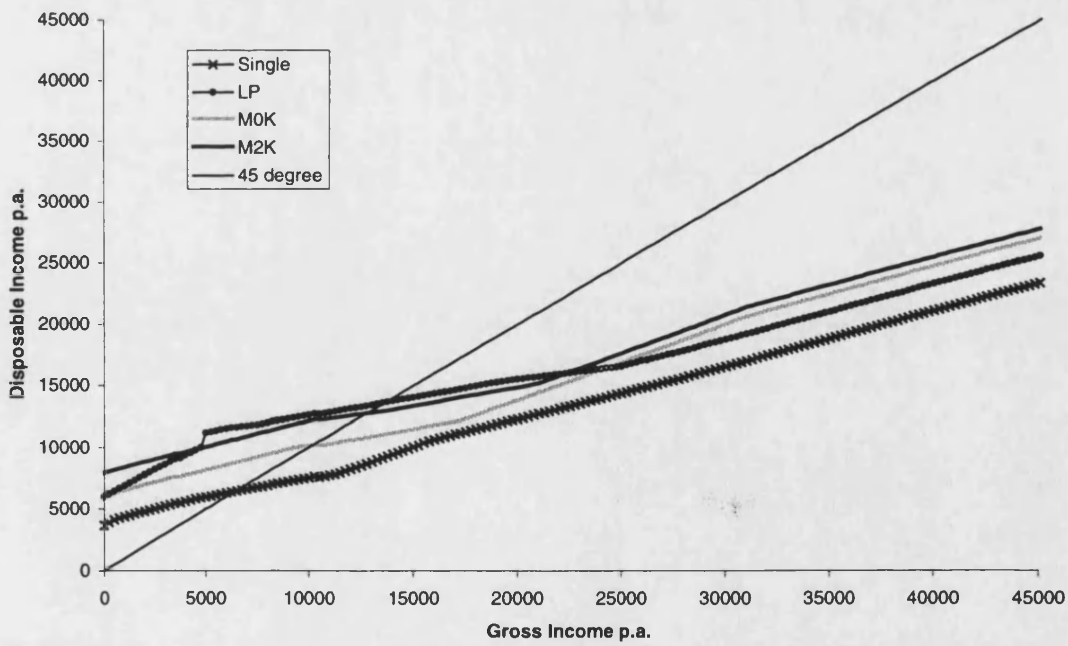
Notes: 1 M2K means married with 2 children, except in the case of single person payments such as lone parent and survivors' payments where it refers to those with 2 children. 2. Replacement Rates are net of taxes and other benefits such as child benefits. 3. ST means short-term and LT means long-term.

Figure 2.6 Interaction of different benefits 1998 (Married Couple with 2 children)



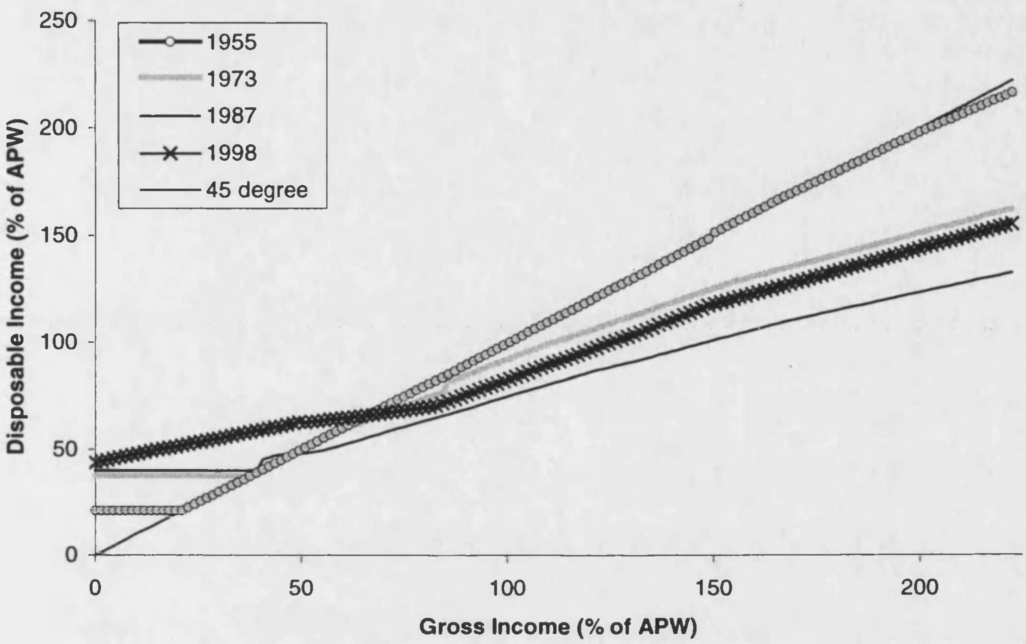
Source: Author's calculations

Figure 2.7 Irish Tax-Benefit System 1998. (No HB)



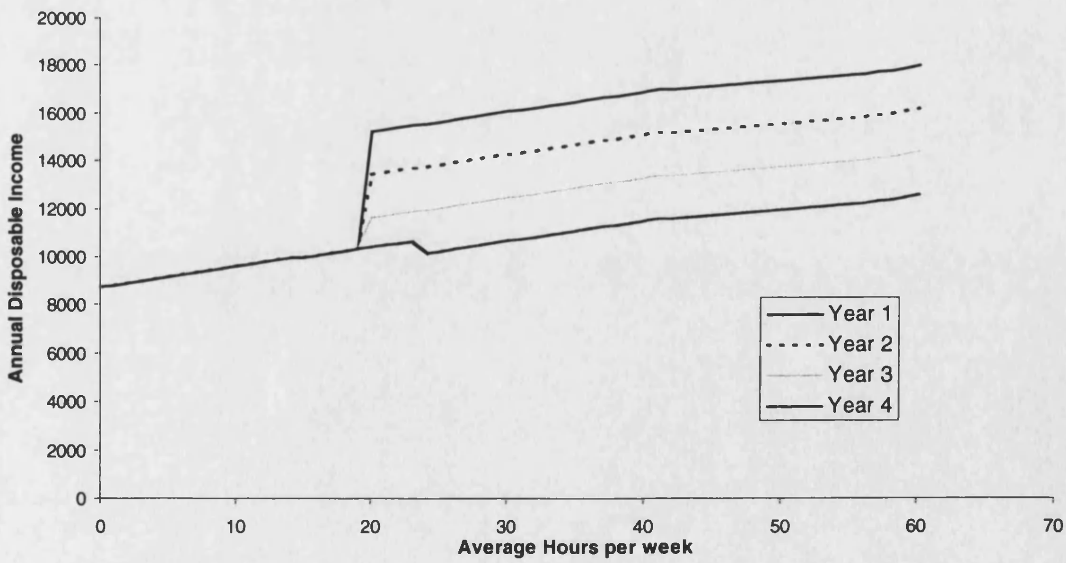
Source: Author's calculations

Figure 2.8 Irish Tax-Benefit System 1955-1998 (Married Couple, 2 Children)



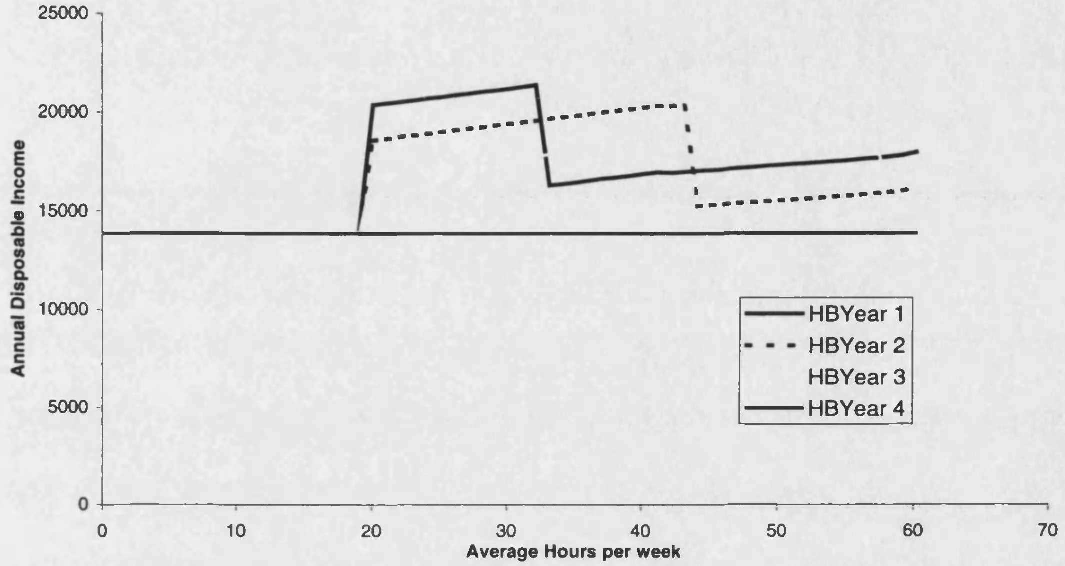
Source: Author's calculations Note 1: APW means Average Wage of a Production Worker

Figure 2.9 Back to Work 1998 system for a married couple with 2 children (no HB)



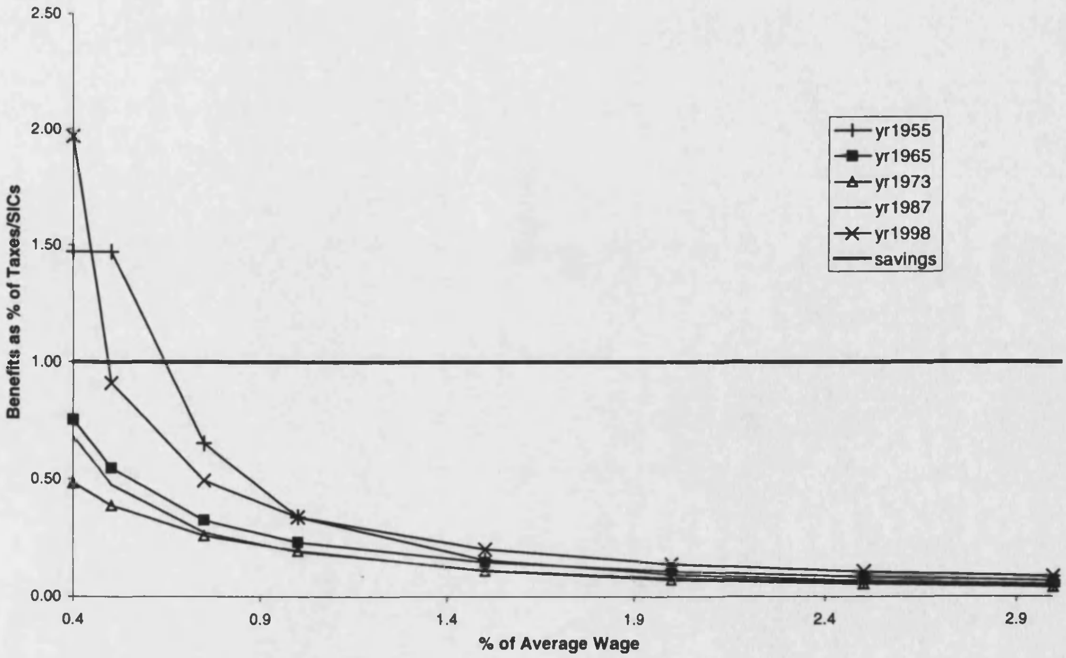
Source: Author's calculations

Figure 2.10 Back to Work (+Housing Benefits) 1998 System for a married couple with 2 children



Source: Author's calculations

Figure 2.11 Lifetime Return from Tax-Benefit System



Source: Author's calculations

Chapter 3. Short-term Redistribution Over the Population

3.1 Introduction

In addition to revenue raising, one of the primary objectives of a tax-benefit system is to reduce the inequality of outcomes of a market economy. This can be done using a variety of methods such as progressive taxation, income related benefits or benefits tied to particular events, which This paper assesses the contribution the Irish Tax-Benefit System makes to Inequality. The objective of the paper is to decompose total disposable income inequality into the impact on inequality of its components, namely, pre-tax market incomes, incomes taxes, social insurance contributions and social benefits. The paper takes data from 1994 for Ireland and compares the redistributive effect of the tax-benefit system for the years, 1987, 1994 and 2000.

The paper is divided into a number of sections. The next section explores the degree of progressivity of income taxes and social insurance contributions. Section 3 examines the degree of inequality of each instrument in turn. Section 4 decomposes total household inequality into components. The next section assesses the contribution household composition has on inequality. Section 6 explores the trade-off between equity and efficiency.

3.2 Background: Redistribution in Ireland

Bristow (1980) complained about the lack of analysis at the micro level of the impact of public expenditure and taxation in Ireland. As Callan and Nolan (1989) pointed out however, this situation largely arose because of a lack of micro-data to be able to carry out such analyses. This situation has largely been reversed in recent years, with the availability of new datasets, namely the 1987 *Survey of Life-style and Usage of State Services*, the 1994 *Living in Ireland Survey* and subsequent waves of the *European Community Household Panel.*

Early studies relied on tabulations based on the *Household Budget Surveys*,[46] carried out in 1973, 1980, 1987.[47] Callan and Nolan (1989) studied the effectiveness of social welfare expenditure in reducing poverty in 1987. Their first result was that despite the existence of a social safety net (the supplementary welfare allowance), a substantial proportion of households (12.3%) had disposable incomes below this safety net income. Of these about 40 per cent were not eligible for benefits, either because of participation in full-time education or employment (a minimum wage did not exist at the time). Of the remainder about a third were Farmers who may have been eligible for benefits, about a third did not claim benefits and a third received benefits lower than what they should have been entitled to. The first two issues relate to a phenomenon known as non-take-up, the non-claiming of benefits one is entitled to, while the latter effect may be due issues such as measurement error in the collection of the data, administrative errors in the calculation of benefit or issues relating the time period of information collected in the survey. There are a number of reasons for individuals not claiming benefits they are entitled to. These include, the stigma of receiving a benefit, but also as Callan and Nolan found for the *Family Income Supplement*, a lack of information of the availability of the scheme. They also compare the efficiency and effectiveness of the benefit system in reducing poverty (See Beckerman, 1979 for a discussion of these measures). They found, using a poverty line of 60% of mean equivalised disposable income, that the system was 76% effective in reducing poverty and in terms of efficiency, 33% of benefits went to those above the poverty line.[48] They also found that in terms of targeting, despite not being targeted using a means test, the targeting of non-means tested benefits compared quite well with means tested benefits.

Nolan (1978), using tabulations from the 1973 *Household Budget Survey* examined the distributional impact of taxes and benefits using Gross Income for ranking purposes. Nolan (1981) meanwhile, using tabulations contained in the CSO, Ireland (1980) examined the distributional impact of taxes and benefits on household income. In terms of the incidence of taxes and benefits, benefits were concentrated amongst lower income households and given the same income, benefits were on average, higher for larger households. Direct taxes, rising with income were found to be progressive, but

[46] Earlier versions of the survey were carried out in the 1950's, but only covered urban areas.

[47] Recently a number of studies, including the work in the ESRI's poverty analysis program and Clarke and ?? (19??) have had access to the data tapes of the 1973, 1980 and 1987 *HBS*. More recently the 1993 *Labour Force Survey* (Murphy and Walsh) and the 1994 *Household Budget Survey* (Baldini et al., 2000) has been made available to researchers.

indirect taxes regressive. Given the progressivity of direct taxes and benefits, *disposable income* (market incomes after direct taxes and benefits) as measured by the Gini and Theil coefficients was found to be less variable than *gross income* (market incomes plus benefits), which in turn was less variable than *market income*. In a comparison with Australia, Sweden and the UK, Australian and UK market incomes were found to be more equal and Sweden less equal, as measured by the Gini coefficient. However in each case, taxes and benefits were found also were found to have a stronger redistributive effect. Using the Suits progressivity index which measures ~~the measures~~ the distance between the cumulative gross income versus cumulative tax-benefit instrument curve and the 45° line, somewhat analogous the Gini coefficient, Nolan found that income taxes were quite progressive with a Suits index of 0.194, while all other taxes (local property taxes and all indirect taxes) were regressive.

O'Connell (1982), using additional tabulations provided by CSO, Ireland, extended Nolan's (1982) analysis to include the income concept, *final income*. This measure includes both indirect taxes and non-cash benefits such as medical services, education, housing and non-cash social welfare benefits, postal and transport services.[49] The impact of adding these instruments was to increase income inequality as measured by the Gini coefficient. O'Connell also examined the effect of tax and expenditure categories on overall inequality individually and found that social welfare pensions, health expenditure had the largest impact, with all benefits (cash and non-cash) benefits reducing inequality with the exception of education expenditures. O'Connell was also able to calculate a Gini coefficient on income where differential household size was taken into account using equivalence scales.[50] He found that the Gini coefficient for final income fell from 37.9 for unequivalised data to 25.1 for equivalised data.

Murphy (1984) examined the trend of income inequality between 1973 and 1980 and. He found that inequality of market incomes rose over this period and that the increasing number of households without market incomes, and those headed by unemployed or retired made the biggest contribution to this trend. Murphy (1985) using actual HBS data for 1973 and 1980, however found that studies using published interval information such as Nolan (1981) and O'Connell (1982) slightly underestimated inequality because of the existence of within group inequality. However, his broad conclusions were

[48] As expected poverty efficiency increased as the poverty line went from 40 to 60 per cent of mean income, while poverty effectiveness decreased.
[49] Typically non-cash benefits were imputed on the basis of average public expenditure per recipient.
[50] O'Connell used the equivalence scale implicit in the Social Welfare system at the time.

similar in that inequality fell most as a result of benefits, less so for taxation, but increased when indirect taxes and the effect of non-cash benefits were included.

Callan and Nolan (1993) examined the trend in inequality over the period 1973-1987. They found that the Gini coefficient of gross incomes rose over the entire period. Like Murphy (1984), they found that rising numbers of unemployed had a large impact on the distribution of gross incomes over this period. The distribution of disposable income however, became more equal indicating the effect of increasing progressivity of taxes and contributions and the rising average tax rate (See table 1). Callan and Nolan (1999) extended this analysis to cover 1994. They found that the income tax and social contribution rate fell between 1987 and 1994, but that the progressivity of both contributions and income taxes continued to rise. Overall however, although the inequality of equivalised disposable income fell slightly (unequivalised rose slightly), the redistributive effect of the system as a whole remained fairly constant.

Callan and Nolan (1999a), meanwhile examined the marginal impact of changes between 1987 and 1994 while ignoring differences in the underlying population. They used the 1994 population and the SWITCH microsimulation model to do this. When comparing different years, prices are different as is the relative wealth of the population. As result Callan and Nolan compared 1987 with both price indexation and earnings indexation. The degree of their results depended on which assumption was made. Taking the price indexation assumption, all equivalised disposable income deciles were found to gain in terms of their tax-benefit position over the period, with the biggest gains at the bottom, less at the top and the lowest gains occurring in the middle of the income distribution. However when earnings indexation was used, gains were substantially less and with the largest gains occurring at the top of the income distribution and the second decile and with deciles 3-6 losing over the period. Thus there would appear to be a redistribution from the lower middle part of the distribution to the top and bottom. Callan and Nolan argue that utilising price inflation results in a non-neutral comparison, because if policy were indexed only to prices, without any other structural changes, then the distribution would change. Employing an earnings indexation assumption, for the period Callan et al. (1999) found that subsequently in the period 1994-1998, policy changes tended to benefit the top of the distribution at the expense of the bottom, with the top 6 deciles gaining over the period and the bottom 4 losing. The 1999 budget was found to benefit the middle the most, but with again the very bottom of the distribution losing out.

These studies therefore have highlighted a system that became more progressive, with greater redistribution over the 1980's, with a slow down of the effect 1987-1994 and with a reversal of the effect 1994-1999. In this paper, we shall examine how particular components of the tax-benefit system effected this trend.

3.3 Changes in the Irish Tax-Benefit System 1987-2000.

This section describes the main features of the Irish Tax-benefit system and details the main changes in the system between 1987 and 2000. For a more extensive discussion of the system and the redistributive forces within the system, see chapter 2. The Irish tax-benefit system is in many respects typical of the Anglo style of welfare state, with relatively insignificant social insurance systems, where means testing and progressive income taxes are more important. There are a number of important differences between the UK and Irish tax-benefit systems. Firstly means testing tends to be more important (See Evans et al., 2000). Social insurance is less well developed than in the UK, with benefits flat rate, with no earnings related components. Although flat rate benefits tend to be of higher value than in the UK, the absence of an earnings-related old age pension means that social insurance contributions are lower. Having a larger self-employed population, the coverage of social insurance also tends to be lower. Structurally, means tested benefits are designed differently to the UK. Instead of almost universal coverage for a common means tested benefit, Income Support, Ireland has a set of categorical instruments, with different means tests and eligibility conditions, but similar levels of benefit. Together however, the system covers the same set of contingencies as in the UK. This reflects the incremental expansion of coverage of social benefits since the foundation of the state, largely having no sweeping reforms as in the case of the *Beveridge* and *Fowler* reforms in the UK. Like the UK, Ireland has a form of in-work benefit payable to families with children in work. The benefit is less generous however, and does not cover child-care costs. Housing Benefits are less important, but growing in importance with the high house price growth currently in the country. Income taxes until 1998 differed from the UK in that, couples can optionally have their income taxed jointly.[51] Another difference is that workers on average wages tend to have higher marginal tax rates. Like the UK however the tax base tends to be wider than in other countries with less reliefs. For example, social contributions are not deductible from the income tax base.

[51] This feature is being abolished from the 2000 budget.

As this paper uses data from 1987 and 1994, we firstly consider principle changes in the system between these years. During this period the principle tax reforms were that the number of tax bands was reduced from three to two. At the same time the standard tax rate was reduced from 35% to 27%, while at the same time increasing the width of this band. The top tax band was abolished, and although the main tax allowance kept pace with inflation, it fell behind wage inflation. The effect of these reforms will have been to reduce the tax rate faced across the whole distribution except for the very bottom who are affected by the relative fall in the value of the tax allowance. The biggest fall in the average tax rate will be at the top of the distribution due both to 10% fall in the top marginal rate from 58% to 48% and the fall in the standard rate and the widening of this band. In addition income tax exemption limits were expanded to have additional amounts for children. The main changes to social insurance contributions are that income levies (2.75% of earnings) have been abolished for those on low earnings and the marginal zero rate for high earners have also been abolished. In the social welfare system, the main changes as outlined in Callan et al. (1996) that heterogeneity of benefit payments both by contingency and family type has been reduced significantly. The lowest payments (such as short term unemployment assistance) have risen at more than the rate of wage inflation, while the highest payments (such as old age contributory pension) have increased the least, although higher that price inflation, lower than the rate of increase in wage inflation. The rates of payments for family dependants have also converged.

Between 1994 and 2000, there were even more substantial changes to the system. This was especially the case in income taxation. The principle change announced in the 2000 budget to be implemented over the following 3 years was that income tax moves from a joint system to individual based system. The objective of this exercise was to allow the standard rate band to be substantially increased so that from a situation in 1999 where 465 of tax payers paid tax at the top marginal rate, after the reform only 17% would. As the implementation of the reform had not been completed when this paper was written, we assume that the standard rate band will expand to be equal to the one that married couples had in 1999. The late 1990's saw a move from allowances and deductions being deductible at the marginal rate of tax to becoming tax credits deductible at the standard rate of tax. The size of these allowances were also increased ahead of the rate of inflation and by 2000 exceeded the value of the income tax exemption limit, for most families. Both the standard and top rates were reduced over this period by 5% and 4%

respectively. The rate of pay-related social insurance contributions for employees was reduced and low wage workers, earning less than £226 pw were made exempt from paying them at all. In addition new public sector workers were brought fully into the social welfare system. By 2000, the rates of payment for the lowest benefits had reached the minima set by the *Commission on Social Welfare* in 1986. For most benefits, the rates of payment converged to a certain degree, although in later years during the period, the rates for old age and survivor's contributory pensions expanded at a faster rate to the other benefits.

For the purpose of this analysis, we break the tax-benefit system into a hierarchy of levels, described in figure 1. The very top level (0) is the tax-benefit system taken as a whole. Level 1, disaggregates this into broad sub-components, social benefits, social insurance contributions. In the next level, we break up social benefits into, universal benefits such as child benefits, means tested social assistance and social insurance benefits. Contributions are broken up into the effect of the lower earnings ceiling, the upper earnings ceiling and the rate schedule. Income taxation is divided up into the effect of individualised income taxes and the tax reducing effect of joint taxation. At Level 3, insurance and assistance benefits are decomposed into the impact of the personal rate for the claimant and dependent amounts for their dependants. Individualised income taxes are divided into allowances/credits/ deductions, tax schedule, exemption limit and additional components of the taxbase not contained in market income such as taxable benefits.

3.4 The Data

The data used in this paper come from the 1994 *Living in Ireland Survey* (LII) made available by the Economic and Social Research Institute, Dublin. The 1994 survey is described in Callan et al. (1996). It formed the first wave of the Irish component of the *European Community Household Panel Survey* (ECHP). It is a household survey, collecting information on incomes, labour market status and demographic information, with 4048 responding households and a response rate of 57.1%. Although the primary income collected in the ECHP is annual income from 1993, additional data was collected in the LII, so that current income from 1994, which is used here, is also used. The use of a short accounting period such as current income, which is based on income in the last week or month, will tend to have a greater degree of variability than income measured over longer accounting periods. In this case, the fact that current income is likely to be more accurate than the recollected income from the previous year, results in the decision being made to use current income in this analysis. The sample has been reweighted using the Census of Agriculture (to account for an under-representation of small farmers) and the Labour Force Survey. The sampling frame for the survey is the electoral register.

In order to look at the impact of sub-components of income taxes, contributions and benefits on inequality and redistribution, it is necessary to simulate tax and benefit instruments. For this purpose, we use a microsimulation framework constructed by Immervoll and O'Donoghue (2001). The framework has been used to simulate the Irish Tax-Benefit system for 1987, 1994 and 2000 and can take the 1994 dataset as input. The instruments simulated include, income taxes, social insurance contributions, social insurance, assistance and universal benefits. However because we simulate the tax-benefit system for years other than contained in the data, we need to transform the data to account for differences over time. In this paper we utilise a method similar to Callan et al. (1999) who used the earnings index to uprate data as they regard purely indexing to account for price changes does not result in a neutral comparison of policies. In using simulated instruments there will be a number of differences between what is simulated and observed benefits and taxes. In simulating instruments we do not factor in tax evasion or benefit take-up issues. As a result, both benefits and taxes may be over stated in the simulation. However these are areas where little research has taken place in Ireland and rather than making general assumptions, we ignore the issues.

3.5 Results: Distributional Impact of Policy Change 1987-2000

Before examining the redistributive effect of the Irish tax-benefit system using statistical methods, we shall firstly examine graphically the effect of changes to the tax-benefit system between 1987 and 2000. We note however that the system considered in 2000 is not the actual system in 2000, but the set of announced changes to the system which were to take place in the years subsequent to this budget. Figure 2 describes the proportional change in equivalised, household disposable income, by decile of the same income measure for 1987. The grey bars represent the percentage change in equivalised income between 1987 and 1994, the black bars, the percentage change between 1994 and 2000 and the stripped bars the percentage change between 1987 and 2000. In order to compare different years, we use growth in average earnings as a deflator. We notice that policy changes over time, both between 1987 and 1994 and between 1994 and 2000 have resulted in a relatively improved position for those with higher incomes. Between 1994 and 2000 gains have tended to improve the position of those in middle of the distribution most. During both periods, the bottom 3 deciles have actually lost out, while for higher deciles, there have been proportional gains.

The principal forces, in both periods, driving the redistributional changes have been reduced levels of income taxation and social insurance contributions. On the benefit side, during the period 1987-1994, the lower benefits such as unemployment assistance and supplementary welfare allowance increased more than other benefits and in fact more than the rate of increase of earnings. Higher value benefits such as old age means tested and contributory benefits fell relative to earnings over the period. Payments in respect of dependants also fell back during this period and thus the rise in the relative standard of living of families in receipt of benefits was lower than for other categories of recipient.

The results reported here differ from those for 1987-1994 described in Callan et al (1999a). There are a number of reasons for this. Firstly, the assessment unit is different. Callan et al. compare nuclear families, while this paper compare the position of households. In many countries, this is not a major issue in many countries, where the distinction between household and family is not important. However, in Ireland the average household size is about 60 per cent higher than Germany and other Northern European countries. This is a result of both higher numbers of children, but also the increased incidence of people living with their grown up children, elderly parents or other relatives. As a result when the one examines the distribution of households rather than families, one can get quite a different picture. In the Callan et al. work the bottom two deciles gain between 1987 and 1994. This is principally because of the existence of single unemployed people and couples in these deciles. Their incomes increased during this period. Pensioners who receive higher amounts, but who lost out between 1987 and 1994 are in the next two deciles and therefore relative disposable income for these deciles fell in their study. In our analysis, because the elderly are often quite likely to be living in households with other people, the average household income tended to fall and thus they were more likely to be in the bottom of the distribution and thus here we found that bottom deciles lost.

Secondly, the equivalence scale used is different, taking the square root of the number of person in the household to be the equivalence scale, places the same weight on children as adults and thus in our distribution, these families are more likely to be lower down the distribution. Also because the relative gain is lower for these families (and for families with 3 or more children, a relative loss), they reduce the gain for the bottom deciles.

Results for 1994-2000 however are similar in distribution to those reported for 1994-1998 in Callan et al. (1999b), indicating the results are quite robust to differences in measurement assumptions. Here the regressive nature of the policy changes is clearer.

3.6 Results: Redistribution and Progressivity

We now consider in more detail using progressivity and redistribution indices, the impact of particular policy instruments on the degree of redistribution.

Table 2 describes the overall measure of inequality as measured by the generalised Gini coefficient for the three years examined in this study. The clear result of this table is that regardless of what value judgement one makes, the tax-benefit system reduces the level of variability of market incomes and that changes in the tax-benefit system over the period 1987-2000, have resulted in increasingly higher levels of inequality. Taking the parameter of the generalised Gini coefficient, v to be 1.8 or placing a higher weight on higher incomes, we see that the inequality of market incomes is measured as 0.520, falling to 0.294 after taxes and benefits using the 1987 system, to 0.309 in 1994 and 0.331 in 2000. As 1994 data is used throughout, the baseline inequality of market income does not change. It would be interesting to investigate the joint effect of changing market incomes and tax-benefit systems. For each value of v, the degree of inequality of post tax and benefit incomes is higher in 1994 than in 1987 and for 2000 than in 1994. Therefore the Lorenz curves may not cross and that one can say that the 1987 system dominates from a inequality perspective the 1994 system and the 1994 system dominates the 1987 system. For each welfare value taken, the biggest rise in inequality occurs after 1994. Over the whole period, inequality as a result of changes to the tax-benefit system rose by about 14 per cent, confirming the effect seen in figure 2. This trend is in sharp contrast to the trend found in other tax-benefit systems over time. Atkinson (2000) found that on the contrary the tax-benefit system over the last 20 years in industrialised countries has tended to offset rises in the inequality of market incomes. In fact as Callan and Nolan in their various studies found, this had tended to be the impact of the Irish Tax-Benefit system before 1987. Recent studies of tax-benefit reform in Europe in the 1990's such as Palme (1996) in Sweden, Decoster et al. (2000) in Belgium and Immervoll et al. (1999) in the UK have found that tax-benefit reform has continued to reduce inequality and favour the poorest. What reasons can one give for this opposite process in Ireland? According to Economic theory, the marginal utility of income falls with income and as a result, it is optimal to distribute to the poorest. One potential reason for reversing this process is if the poor gained relatively more in the past. We saw in chapter 2, that the replacement rate for benefits gradually rose over time until 1987 and that subsequently only the lowest value benefits rose. Therefore the 1987-2000 position has seen a reversal of this trend. At the same time tax rates rose. Even after nearly 10 years of declining in tax rates Ireland in 1997 still had the second highest marginal tax rate and the fourth highest average tax rate faced by someone on the average wage (O'Donoghue and Sutherland, 1998).

Level 0 Instruments: the entire tax-benefit system

In Table 3 we consider the redistributive effect of the tax-benefit system utilising the Reynolds-Smolensky generalised redistributive indices respectively. The table is divided into columns signifying the average net tax rate of the system, the redistributive effect of the system as a whole and a decomposition of the redistributive effect into progressivity and reranking components. We examine these measurements under different welfare evaluations. The first effect is that the system has become as a whole more generous over time relative to the 1994 population. This is because the system has gone from having a negative net tax-benefit rate in 1987 to an increasingly positive one in 1994 and 2000. We must remember that this measure has been estimated while holding the underlying population constant. Although, we increase incomes at rate of income growth, this will not take into consideration, the impact of falling unemployment levels and rising employment levels. As a result even allowing for earnings indexation, changes in the underlying population during the period may in fact have reduced the total demand for benefits and kept the whole system in a deficit. We ignore the Kakwani progressivity measure as it is quite sensitive when measuring the progressivity of the net tax-benefit system, especially when the net tax-benefit rate, r is small. As r tends to zero, the Kakwani index will tend to $\pm\infty$. Thus with a low value of r as in 1994, then the Kakwani index will be high. Examining the Reynolds-Smolensky index, we find unsurprisingly that the redistributive effect of the system as a whole fell over time. Decomposing into progressivity and reranking components , we find that both components fell over time. The progressivity of the system refers to what we have examined so far, that the rich have become gradually better off relative to the poor. The reranking component on the other hand relates to the degree to which households move in the income distribution relative to each other. A falling reranking effect indicates that the system causes households to move less relative to each other and thus horizontal equity increases. It is difficult to say what are the reasons for this change in horizontal equity. A priori, one would assume that the abolition of joint taxation and the reduction in the value of benefit payments for dependants to be important determinants.

Level 1 Instruments

We now try to decompose the total redistributive effect of the system into the effect of the sub-components of the system. As the distributive effect has been so clear regardless of welfare judgement made, we ignore welfare judgements in the remainder of the analysis, using a value of v = 2, so that the generalised indices are the same as the standard indices. Table 4 examines the effect of the Level 1 instruments described in Figure 1. This level of instruments consists of the aggregated effect of income tax, social insurance contributions and benefits separately. We indicate taxes and contributions with a negative sign and thus, we see that the average tax and contribution rates are negative and the average benefit rate is positive. All three instruments have fallen relative to market income over time, with the biggest drop in importance occurring in income taxes, which fell from 23.7% to 15% during the period. Employee social insurance contributions/income levies and benefits both fell by about 2 percentage points, leaving the benefit and contribution system broadly unchanged. Thus the resources used to change the net tax-benefit rate by 8 percentage points from negative in 1987 to positive in 2000, were expended in reducing income taxes. Turning to the progressivity of the income tax system, we see that over the period as a whole, the income tax system became more progressive, falling slightly to 1994, but then rising. This is consistent with attempts increase the size of allowances and the standard rate band over time. Despite the increase in the progressivity however, the impact of the fall in the average tax rate dominates, so that the degree of redistribution actually falls. Both the progressivity and the reranking components fell. Turning to social insurance contributions, we see that in 1987, contributions were regressive, having a negative Kakwani index. This is as a result of the existence of a marginal contribution rate of zero for those on high incomes and flat rate contribution on all incomes below the upper earnings limit. However, the introduction of exemptions for low income workers and allowances resulted in change from the instrument being regressive to being progressive by 1994 and increasingly progressive by 2000. In this case, we note that the progressivity effect dominates, so that the redistributive effect, albeit small increases over the period. The impact on horizontal equity as measured by the reranking component is extremely small as a result of the instrument being individual based. The small degree of reranking results from the fact that capital income are not levied social contributions. As benefits are typically targeted on the poor, benefits are usually regressive and thus we see here that the sign of the Kakwani index is negative. Over the period, benefits have become slightly less regressive. As both the average benefit rate fell and benefits became less regressive, it is clear that the redistributive power of the benefits system fell. Of the three instruments groups, benefits are the most important from a redistributive perspective. We notice that in addition to have the largest redistributive effect, benefits have the highest reranking effect. The fall in the redistributive effect in absolute terms is slightly more than the fall in income taxes and has been accompanied by falls in both the progressivity and reranking components of benefits.

Level 2 Instruments

One of the objectives of this study is to examine the effect of more detailed changes to the system. We now consider level 2 instruments (See Table 4). We divide income taxes into the effect of individualised and joint taxation. Here we view the individualised taxation as being the taxation, while the effect of joint taxation is regarded as a deduction from taxes that would be paid if a individualised system existed. We firstly notice that tax reduction resulting from joint taxation fell over time from have a value of about of over a quarter of the whole tax liability in 1987 to one sixth in 1994 to being completely abolished in the 2000 *"announced"* system. From a position where the progressivity of total income taxes was about the same in 1987 and 1994 in Table 4, we see here that progressivity of individualised income taxes rose steadily over the period. Despite the average individualised tax rate falling, progressivity compensates and as a result the redistributive effect is about the same and in fact rises a bit in 2000. However if one looks more closely at the progressivity and reranking components, we see that different reranking is the reason for the difference between what was measured for total income taxes and what we see here for individualised taxation. Because joint taxation is measured as a deduction, the more regressive it is the higher the redistributive effect. Between 1987 and 1994, the tax reduction due to joint taxation in fact became more regressive, but the falling value of joint taxation as a whole resulted in the redistributive effect falling. The impact on horizontal equity is surprisingly quite small for joint taxation. However we must remember that all amounts considered here are based on equivalised income and thus the reranking had already occurred before the redistributive effect was examined. The reranking effect is likely to be quite different if unequivalised incomes were used.

We decompose social insurance contributions into the effect of the rate, the lower limit allowances and exemptions and the upper limit zero rate marginal contribution band. We see that the value of the rate falls over time from 5.9% to 5.1% of market income, while the value of the lower limit rises and the upper limit stays about the same. We also notice that while contributions are progressive, the lower limit and the upper limit are respectively regressive and progressive. While the progressivity of the rate increased slightly from 1987 to 1994, the lower limit had a big fall in regressivity as income levies were eliminated for low wage workers. Therefore between 1987 and 1994, social insurance contributions became more progressive as a result of the rate and lower limit. There was a similar effect on redistribution. Between 1994 and 2000, meanwhile the reduction in the value of the upper limit combined with the introduction of an allowance resulted in total progressivity and redistribution increasing despite no change in the impact of the rate.

Benefits are now decomposed into the effect of social assistance, social insurance and universal child benefits. We notice that social assistance benefits are more important than both social insurance and child benefits combined. Total benefits fell as a proportion of market income between 1987 and 1994, however the types of benefits have been affected in different ways. Until 1994, social assistance benefits actually rose as an emphasise was placed on increasing the value of the least valuable benefits. These benefits fell back subsequently as benefit indexation failed to keep up with rises in the standard of living. Social insurance benefits fell as proportion of market income in both periods, while although constant in real terms, child benefits rose relative to market income in the later period. The latter effect is partially due to an emphasise on successive governments in the late 1990's to increase universal child benefits instead of means tested child additional payments. When we examine level 3 instruments next, we will see this effect. Looking at the redistributive effect, we see that the average benefit rate dominates the progressivity in driving the redistributive effect.

Level 3 Instruments

In this last section, we investigate the impact of particular components of instruments already examined. Here we decompose individualised taxation into the effect of the rate schedule, additional parts of the taxbase not contained in market income, allowances/credits/deductions and exemption limits. Of these four sub-components, the allowance and tax credits have the highest redistributive effect. This may be regarded as surprising given the fact that allowances are valued at the marginal tax rate and thus one might expect them to be regressive. In transforming allowances to be tax credits in the late 1990's, this instrument has become more targeted on the bottom of the distribution. Nevertheless because of their falling value, the redistributive effect as a whole has fallen. While clearly the rate schedule is progressive against the tax base, against market incomes the rate schedule is regressive. This is because once allowances have been factored out, benefits, which are not part of market income, become taxable and thus those at the bottom of the income distribution would pay taxes despite having no market income. It is thus the existence of allowances that keeps these people out of the tax schedule. Over time, progressivity increased to 1994 and fell again to 2000. The falling average rate however dominates in driving down the negative redistributive effect. The effect of the exemption limit (described in chapter 2) is also examined. It's objective is to take low income families out of the tax system. The redistributive effect is quite small and fell over time. Between 1987 and 1994, the value of the instrument fell, but became more targeted, while between 1994 and 1998, the instrument became less targeted as mainly only elderly people were eligible, while the average value only decreased a little. Turning to the sub components of benefits, we find that the impact of the sub-components mirrors that of social insurance and assistance in aggregate. We notice however that dependent payments are more important for social assistance. This partly a function of the fact that individuals can receive insurance benefits even if other members of the family have relatively high incomes. In this case the spouse may be ineligible for the adult additional payment. This effect is seen by the fact that assistance benefits are more regressive and thus more targeted than insurance benefits. We also notice the effect of the fall in the child dependent payment, which dominates the fall in the redistributive effect of dependent payments for dependent payments in general in the insurance system. The rise in the value of adult dependent payments however dominates the trend in the impact of dependent payments for assistance benefits.

3.7 Conclusions

This paper attempts to investigate the impact of the Irish tax-benefit system on redistribution over the whole population. In addition the analysis has focused on sub-components of the system to try to learn more about how the system operates when all instruments are integrated together. Also, this paper analysed the impact of the series of policy reforms instituted over the last 14 years and in particular how in practice the aggregate changes were achieved at the level of detailed policy instruments.

As a whole, the Irish tax-benefit system is quite redistributive, transferring resources from rich to poor, however between 1987 and 2000, the primary direction of reforms has been to reduce the redistributive effect of the system as a whole. In fact taking the underlying population as given, disposable income inequality increased by 14% purely on the basis of the policy reforms alone. This trend of these reforms has been in the opposite direction of reforms in other countries. In the future this trend will have to change if the government hopes to achieve its anti poverty targets outlined in its recent National Anti Poverty Strategy (see Nolan, 1999).

Focusing on sub-components, we found that changes to income taxes were the primary force in the aggregate impact of the reform. Due to the improved economic position between 1987 and 2000, the system has become more generous on average by about 8% of market income and thus reforms are not revenue neutral. These increased resources have been transferred in the form of reduced personal taxes and social contributions. Also because of the indexation polices adopted benefits have fallen as a proportion of market income and thus one has effectively seen a transfer of resources from benefits to income tax reduction. Although both income taxes and social contributions have become more progressive over time, the large cut in the value of these instruments has resulted in a lower redistributive effect. The cut in the value of benefits relative to incomes has also seen the redistributive effect of benefits fall.

This paper has examined the effect of the reforms on an unchanging population. Changes in the structure of the population and the underlying distribution of market income may influence the robustness of these results. Further work should be carried out once data for 2000 becomes available in comparing these results when one factors in the effect of population change. Not only may changes in the population drive changes in the tax-benefit system, but also changes in the tax-benefit system may drive changes in the distribution of market incomes. Like other static fiscal incidence studies, this paper has assumed that market incomes are exogenous. It would be interesting to asses the effect of these reforms by applying an optimal tax framework combined with some degree of endogeneity of market incomes, to assess the optimality of these reforms. Another issue relates to the time period. Because we examine the effect of the redistributive effect of the system using a cross-section of the population, this paper may overestimate the actual redistributive effect of the system when one examines longer term income. Because of income mobility, what appears to be redistribution between persons in a cross-section, may in fact have a net effect of income smoothing when individuals are examined over time. In later chapters of this thesis we shall study these issues.

Tables and Figures

Table 3.1 Inequality and Progressivity Measures 1973-1987

	1973	1980	1987	1994
Gini (Market Income)	0.4553	0.4764		
Gini (Gross income)	0.379	0.385	0.398	
Gini (Disposable income)	0.367	0.360	0.352	0.377
Suits (Income Tax)	0.194	0.207	0.275	0.282
Suits (Social Contribution)	-0.074	0.056	0.133	0.148
Average Tax/Contribution Rate	0.098	0.151	0.189	0.178

Source: Callan and Nolan (1993, 1999) Note 1. The values reported here are unequivalised.

Table 3.2 Generalised Gini Coefficients the Irish Tax-Benefit System 1987, 1994 and 2000, Equivalised Household Market and Disposable Income.

V	1.8	2.0	2.2	2.4
Market	0.520	0.561	0.608	0.654
Disposable				
1987	0.294	0.305	0.326	0.351
1994	0.309	0.321	0.344	0.369
2000	0.331	0.347	0.372	0.399
% change 1987-1994	5.1	5.2	5.5	5.1
% change 1994-2000	7.1	8.1	8.1	8.1
% change 1987-2000	12.6	13.8	14.1	13.7

Source Author's Calculations. Note 1. Incomes have been equivalised using the square root of household size scale.

Table 3.3 Inequality, Redistribution and Progressivity in the Irish Tax-Benefit System 1987, 1994 and 2000 Level 0 Instruments.

v	Average Rate	Redistribution (Reynolds-Smolensky)	Progressivity component	Reranking component
1.8				
1987	-0.040	0.226	0.238	0.013
1994	0.002	0.211	0.221	0.010
2000	0.042	0.188	0.196	0.007
2.0				
1987	-0.040	0.256	0.272	0.015
1994	0.002	0.240	0.252	0.012
2000	0.042	0.215	0.223	0.009
2.2				
1987	-0.040	0.282	0.299	0.018
1994	0.002	0.264	0.278	0.014
2000	0.042	0.236	0.247	0.010
2.4				
1987	-0.040	0.303	0.323	0.020
1994	0.002	0.284	0.300	0.016
2000	0.042	0.255	0.266	0.012

Source Author's Calculations.

Table 3.4 Inequality, Redistribution and Progressivity in the Irish Tax-Benefit System 1987, 1994 and 2000 Level 1 Instruments (v = 2.0).

	Average Rate	Progressivity (Kakwani)	Redistribution (Reynolds-Smolensky)	Progressivity component	Reranking component
Income Taxes					
1987	-0.237	0.099	0.028	0.031	0.003
1994	-0.201	0.097	0.023	0.024	0.002
2000	-0.150	0.112	0.018	0.020	0.001
Social Insurance Contributions					
1987	-0.053	-0.021	-0.001	-0.001	0.0001
1994	-0.041	0.016	0.001	0.001	0.00001
2000	-0.035	0.022	0.001	0.001	0.0001
Benefits					
1987	0.250	-0.955	0.182	0.191	0.009
1994	0.244	-0.954	0.179	0.187	0.008
2000	0.228	-0.946	0.169	0.175	0.007

Source Author's Calculations.

Table 3.5 Inequality, Redistribution and Progressivity in the Irish Tax-Benefit System 1987, 1994 and 2000 Level 2 Instruments (v = 2.0).

	Average Rate	Progressivity (Kakwani)	Redistribution (Reynolds-Smolensky)	Progressivity component	Reranking component
Income Taxes					
Individualised Taxation					
1987	-0.327	0.049	0.017	0.024	0.007
1994	-0.244	0.061	0.016	0.020	0.003
2000	-0.150	0.112	0.018	0.020	0.001
Joint Taxation					
1987	0.090	-0.083	0.006	0.007	0.001
1994	0.043	-0.102	0.003	0.004	0.001
2000	0.000	0.000	0.000	0.000	0.000
Social Insurance Contributions					
Rate					
1987	-0.0590	0.0053	0.0002	0.0003	0.0002
1994	-0.0536	0.0066	0.0004	0.0004	0.000
2000	-0.051	0.006	0.0004	0.0003	0.000
Lower Limit					
1987	0.0003	-0.5343	0.0002	0.0001	0.000
1994	0.008	-0.172	0.001	0.001	0.000
2000	0.011	-0.173	0.002	0.002	0.000002
Upper Limit					
1987	0.005	0.290	-0.002	-0.002	0.0005
1994	0.004	0.287	-0.002	-0.001	0.001
2000	0.005	0.261	-0.001	-0.001	0.000

Source Author's Calculations.

Table 3.5 continued.

	Average Rate	Progressivity (Kakwani)	Redistribution (Reynolds-Smolensky)	Progressivity component	Reranking component
Benefits					
Social Assistance					
1987	0.131	-1.006	0.157	0.117	-0.041
1994	0.135	-1.008	0.161	0.120	-0.041
2000	0.123	-1.013	0.152	0.111	-0.041
Social Insurance					
1987	0.104	-0.950	0.125	0.090	-0.036
1994	0.095	-0.942	0.119	0.082	-0.037
2000	0.084	-0.950	0.111	0.074	-0.037
Child Benefits					
1987	0.014	-0.523	0.007	0.007	0.001
1994	0.014	-0.524	0.007	0.007	0.000
2000	0.021	-0.528	0.010	0.011	0.001

Source Author's Calculations.

Table 3.6. Inequality, Redistribution and Progressivity in the Irish Tax-Benefit System 1987, 1994 and 2000 Level 3 Instruments (v = 2.0).

	Average Rate	Progressivity (Kakwani)	Redistribution (Reynolds-Smolensky)	Progressivity component	Reranking component
Individualised Taxes					
Rate					
1987	-0.554	-0.099	-0.136	-0.123	0.013
1994	-0.372	-0.090	-0.063	-0.053	0.009
2000	-0.253	-0.097	-0.037	-0.033	0.004
Allowances/Credits					
1987	0.182	-0.332	0.049	0.051	0.002
1994	0.119	-0.334	0.034	0.036	0.002
2000	0.097	-0.381	0.032	0.034	0.002
Exemption Limit					
1987	0.045	-0.233	0.009	0.010	0.001
1994	0.009	-0.956	0.008	0.009	0.0001
2000	0.006	-0.720	0.004	0.004	0.0001
Social Assistance					
Personal Rate					
1987	0.106	-1.005	0.082	0.096	0.014
1994	0.108	-1.003	0.084	0.097	0.014
2000	0.098	-1.011	0.078	0.090	0.012
Dependent Rate					
1987	0.025	-1.009	0.021	0.025	0.004
1994	0.027	-1.028	0.023	0.027	0.004
2000	0.025	-1.019	0.022	0.025	0.003

Source Author's Calculations.

Table 3.6 Continued.

Social Insurance Benefit					
Personal Rate					
1987	0.089	-0.953	0.065	0.078	0.013
1994	0.084	-0.945	0.061	0.073	0.012
2000	0.080	-0.957	0.059	0.071	0.011
Dependent Rate					
1987	0.015	-0.936	0.011	0.014	0.003
1994	0.011	-0.913	0.008	0.010	0.002
2000	0.004	-0.816	0.002	0.003	0.001

Source Author's Calculations.

Figure 3.1. Hierarchy of Tax-Benefit System

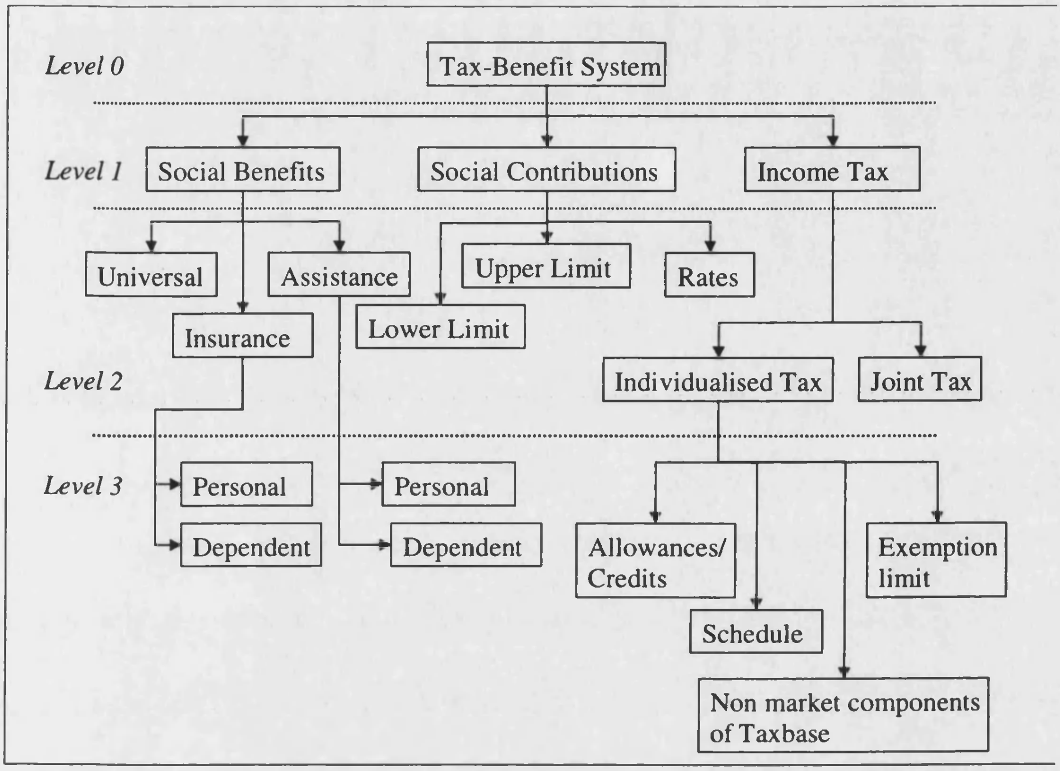
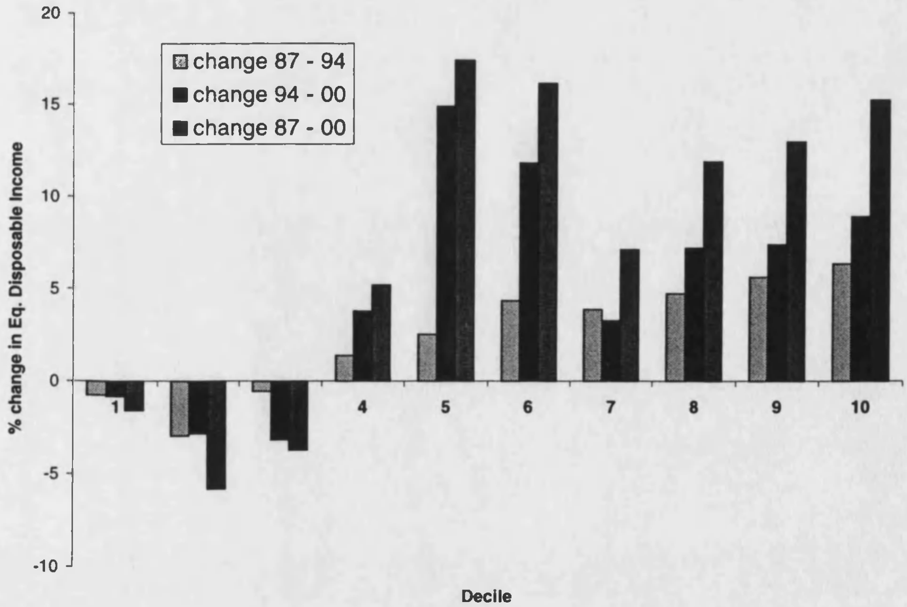


Figure 3.2. Percentage change in Equivalised Disposable Income in Ireland 1987-2000 by equivalised household disposable income decile.



Source Author's Calculations.

Chapter 4. Dynamic Microsimulation: A Methodological Survey

4.1. Introduction

In order to carry out micro level analyses of economic behaviour and of the influence of public policy over time such as examining the redistributive impact of the tax-benefit system over the life-course, it is necessary to utilise a long panel data set. In general such data sets are not available, either because the analysis relates to the future as in the case of pension forecasts or because collected data sets do not cover sufficiently long time horizons. Instead therefore, analysts use dynamic microsimulation models to synthetically generate a hypothetical panel. In this chapter we discuss some of the methodological issues related to the construction of a dynamic microsimulation model, surveying current practice in the field across the world.

There have been a number of surveys of microsimulation models (Merz, 1991; Mot, 1992; Sutherland, 1995 and Klevmarken, 1996). None have focused solely on dynamic models. This survey article concentrates only on dynamic models, drawing on a wide-ranging literature search.

What is a Dynamic Microsimulation Model?

A microsimulation model is a model which uses simulation techniques and which takes micro level units as the basic units of analysis when investigating the effects of social and economic policies. The method was developed initially by Guy Orcutt (1957, 1961) in the USA in the 1960's but its use has only become widespread in the last 15 years as computing power increased and datasets became available. Microsimulation models have taken firms as the micro unit of analysis (Eliasson, 1986), however most have carried out analysis at the level of individuals or households (See Mot, 1992).

Microsimulation models seek not only to explain the mean E(Y/X) of endogenous model generated variables Y, such as disposable income, as macro-economic models do, but also their distribution, given exogenous variables X (for example, pre-tax incomes, and personal socio-economic characteristics), and institutional policy variables P (for example tax rates and means for social assistance etc.). The joint distribution of the exogenous variable Y and the endogenous variables X conditional on the policy variables P can be described as follows:

$$f_{XY}(Y, X / P) = f_{Y/X}(Y / X, P_1) \cdot f_X(X / P_2) \qquad (1)$$

where $f_{Y/X}(Y / X, P_1)$ is essentially the microsimulation describing how the exogenous X specify the distribution of Y and $f_X(X / P_2)$ the distribution of exogenously specified input variables, given institutional characteristics P_2.

Dynamic microsimulation modelling is a technique whereby agents change their characteristics as a result of endogenous factors within the model. $f_X(X / P_2)$ is one example of a dynamic process, where the set of variables X are made endogenous in response to institutional characteristics P_2. Examples include models where labour supply responds to changes in government policy. Another form of dynamic process is where a dynamic model projects a sample over time, modelling life course events such as demographic changes like marriage and birth, educational attainment or labour market movements. In this case, the dynamics relate to the fact that characteristics in time (t), Y_t depend on characteristics in time (t-j) Y_{t-j} and exogenous characteristics X This model gives estimates of both time dependent cross-sections and estimates of mobility over time.

The chapter is divided into sections as follows. Section 2 describes some of the principle uses of dynamic microsimulation models. Section 3 assesses some of the advantages and disadvantages of the methodology. Section 4 discusses the model components. Section 5 contains the bulk of the chapter and discusses methodological issues related to dynamic modelling such as static versus dynamic ageing, behavioural versus statistical simulation, discrete versus continuous time, open versus closed models, steady state versus forecasted projections, cohort versus population models and validation. Section 6 concludes.

4.2. Uses of Dynamic Microsimulation Models

In this section, we describe some of the main existing and potential uses of dynamic microsimulation models. We limit our focus to models that project populations inter-temporally. Table 1 summarises the principal uses of the different dynamic microsimulation models, which can be classified into a number of headings:

- Projections
- Evaluations of public policy
- Designing policy reform

- Studies of inter-temporal processes and behaviour
- Investigating Inequality and Redistribution

Dynamic microsimulation models project samples of the population forward in time. If a full cross-section of the population is projected, then one can for example, examine future income distributions under different economic and demographic scenarios. DYNASIM2 (Wertheimer et al, 1986), MOSART (Fredriksen, 1998), the SfB3 population model (Galler and Wagner, 1986), DYNAMITE (Ando et al., 2000) and DESTINIE (Bonnet and Mahieu, 2000) have been used for these purposes. These models typically utilise macro-models or forecasts to align their own forecasts. However occasionally the opposite has occurred where dynamic microsimulation models have been used as input into macro models as in the case of MOSART (Andreassen and Solli , 2000), DYNASIM2 and the DARMSTADT models.

In a similar way in which static microsimulation models evaluate current public policy using samples of the current population, these projected cross-sections can then be used to evaluate the future performance of various governmental long-term programs such as pensions, health and long-term care and educational financing. The governmental models such as DYNCAN (Morrison, 2000), PENSIM (Curry, 1996), the Sfb3 models (Galler and Wagner, 1986), MOSART (Andreassen et al., 1996) and SESIM (Ericson, and Hussenius, 1999) have been extensively used for this purpose.

In addition, the existence of baseline projections also allows one to design new public policy by simulating the effect of potential reforms. Models such as PRISM (Kennell and Sheils, 1990), the Belgian dynamic model (Joyeaux et al., 1996), SfB3 population model (Galler and Wagner, 1986), LIFEMOD (Falkingham and Johnson, 1995) and DEMOGEN (Wolfson, 1988) have been used to look at pension reform. A number of models such as DYNAMOD, the SfB3 cohort model (Hain and Hellberger, 1986) and LIFEMOD (Harding, 1993) have been used to examine changes to education finance, allowing for education costs to be paid for over the lifetime. Fölster (1997) used a model to examine reforms to social insurance utilising personal savings accounts.

As inter-temporal models, they can be used to study inter-temporal processes and behavioural issues. For example, CORSIM (Keister, 2000), DYNAMOD (Baekgaard, 1998), and MIDAS (Stroombergen et al., 1995) have been used to look at wealth accumulation. FAMSIM (Lutz, 1997) is used to study demographic behaviour of women, while MICROHUS (Klevmarken and Olovsson, 1996) examined the impact of tax-benefit system on labour market mobility. Another type of inter-temporal analysis is to model the transitions into and out of poverty and social exclusion. Models that simulate these processes can be sued to design policy to combat these problems. For example, DYNASIM was used to study the effect of teenage child-bearing.

Single cohort models have been used to investigate life-course redistribution in tax-benefit systems and the degree of redistribution between life-rich and poor versus redistribution over one's life-course in a number of countries such as Australia, Ireland, Italy and the UK. (See Harding (1993); Baldini (1997) and Falkingham and Hills (1995)). Models that simulate the life histories of multiple cohorts have looked at inter-generational transfers and equity issues. For example NEDYMAS and CORSIM studied the redistributive impact of the social security system on different cohorts in the Netherlands and the USA respectively (Nelissen, 1994 and Caldwell et al., 1998). LifePaths and DESTINIE have been used to study intergenerational transfers in Canada and France respectively (Rowe and Wolfson, (2000), Bonnet and Mahieu, (2000)).

Other uses have been carried out in the spheres of health and spatial mobility. LIFEMOD was used to examine health status over the life-course and implications for health care financing in the UK (Propper, 1995), while CORSIM has been used to look at dental health in the US population (Brown et al., 1992). The SVERIGE models spatial mobility to the nearest 100m^2 in Sweden (Vencatasawmy et al., 1999), while LifePaths modelling framework in Canada has been used to examine time use issues (Wolfson and Rowe, 1998b).

4.2. Dynamic Microsimulation: Advantages and Disadvantages

Advantages

Policy makers are very interested in inter-temporal and adjustment issues, which only dynamic models can examine. Here we address some of the advantages and disadvantages of the approach. Burtless (1996), Nelissen (1994), Harding (1993), Orcutt et al. (1980), Arrow (1980), and Orcutt and Glazer (1980) outline some of the principle advantages of dynamic microsimulation. These include the use of a micro unit of analysis, use of nationally representative data and the ability the ability to examine micro consequences of macro phenomena.

The micro unit of analysis is the primary advantage of microsimulation. The method is intuitively appealing because it simulates on individuals at the level on which they make decisions. Modelling at the micro level enables complicated individual decisions such as when to work and have children etc to be modelled. Modelling at the micro level can enable some of the complex processes and interactions between policy instruments to be disentangled. Simulating at the lowest level also gives one the flexibility of altering the assumptions of the micro processes quite easily. Micro-level output also allows one to consider more detailed analyses than more aggregated methods such as cell based and macro-econometric models. While all microsimulation models have the advantage of utilising micro units, dynamic inter-temporal models have the advantage that they can examine inter-temporal issues and simulate policy that requires historical information such as the simulation of pensions. Also dynamic models can be used to look at future behavioural adjustments of the population to a policy reform and at the effect of different economic, social and demographic scenarios.

Using micro data allows for the widest range of heterogeneity in the population to be captured in the model. Representative agent models cannot explain the diversity of behaviour in an economy. Simulating the effect of a tax/transfer policy change on example families may not address or highlight the more counter-intuitive outcomes of a policy. These typical families are simply statistical averages and make up only a very small fraction of the population, whereas in reality household income, size, type and life-course trajectories vary a great deal.

Using microsimulation, the economic analysis can take place at the micro level, incorporating decisions that are made at the micro level. Modelling at the micro level allows macro phenomena to be studied without the aggregation bias produced from the study at the macro level. For example, a macro model that tracks aggregate changes of an economy, will however mask many of transitions going on at the micro level and because it simulates only averages, it ignores distributional consequences. Dynamic microsimulation models can simulate the effect of changing structural patterns of society, such as the effects of changing age, employment and family structures at the individual level.

Another important advantage is that dynamic models can be used to pool together data from different sources. For example, dynamic microsimulation methods, have been used to impute associated expenditures into income surveys (See Baldini et al., 2001).

Dynamic models also allow one to pool together different econometric models such as labour supply marriage and fertility models in one modelling framework.

Disadvantages

We now address some of the difficulties associated with microsimulation modelling (dynamic modelling in particular). Nelissen (1994), Hoshka (1986), Klevmarken (1980) and *Panel on Retirement Income Modeling (PRIM)* (1997) present some of these difficulties, including, insufficient knowledge and weak economic behavioural components, large data requirements, large cost and effort and difficult to validate.

Dynamic microsimulation models if they are to project the characteristics of a population over time, require the simulation of very many micro-processes. These include demographic, educational, labour market and income processes. A fully dynamic model would be able to jointly model how each process interacts with each other. Burtless (1996) questions whether the knowledge of micro-behaviour is sufficient to be able to reliably simulate population dynamics. The PRIM (1997) highlights a number of knowledge gaps of individual and family behaviour such as shortcomings in the life-cycle model of savings and consumption and in models of the determinants and consequences of marital changes. Also we generally do not understand very well the dynamics of labour supply and retirement behaviour. Another issue is that current knowledge about micro processes may only be valid for today and in the past. It does not necessarily follow that these relationships will apply in the future.

Another criticism due to PRIM (1997) is that dynamic microsimulation models only incorporate economic behaviour in a limited way. Typically they are not sufficiently flexible to incorporate more detailed behavioural modules because of their limited ability to include feedback loops, or link to other models such as overlapping generations models.

Microsimulation models incorporate behaviour in a less comprehensive manner, than say overlapping generations models (OGM) which have production sectors and models of sectoral interactions. However OGM's lack the detail of microsimulation models and so are less able to simulate the detail of tax-benefit systems. Recently, an attempt has been made to link OGM's with DMM's, but this task is non-trivial, requiring linkages between highly complex DMM models and quite stylised OGM's (See Andreassen and Solli, 2000 for a discussion).

Data necessary to estimate behavioural processes used by dynamic microsimulation models is often at present quite limited. For example in most European countries only 4 waves of the *European Community Household Panel* are available. Only the USA with its *Panel Survey of Income Dynamics*, Germany with the *German Socio-Economic Panel* and countries such as the Nordic countries where access to register information is available have panel datasets which span 10 years. Short panel datasets will be less able to disentangle the impact of age, cohort and period effects.[52] However, panel surveys are continuing so that in the near future, panel surveys, which exist for 10 years or more will soon exist for many developed countries. A number of Scandinavian countries have developed models which have been based on very rich, extensive and detailed register information such as the MOSART model in Norway and SESIM in Sweden. However access in most countries to administrative records is typically quite limited even within government.

Dynamic models require much greater resources to build, maintain and use than static models, having much greater data and modelling requirements. They are also much slower to use and produce output. They are therefore more suited to long term scientific research than immediate policy reactions.

Although popular in the late 1970's/early 1980's, when large programs were financed in the USA and Germany, development fell back in the mid-late eighties. After this period, only less ambitious projects such as the HARDING and PENSIM models were created. Caldwell (1996), attributes a number of reasons for this development cycle. He attributes the fact that initially perceived benefits outweighed the very high costs at the time of development. However even though the costs of development declined over the 1980´s, as computing power and data availability increased, resulting benefits from these models did not match what was expected. It is unsurprising given the data and computing resources available at the time that results were less useful than policy makers would have liked.

[52] The *Age Effect* relates to changes that occur as they age. For example in the case of earnings, an individual's average income tends to rise over time until retirement. The *Cohort Effect* is the effect specific to those who were born around the same time, so for example earlier cohorts will have lower education levels and lower earnings. The P*eriod Effect* relates to the conditions of those who lived through a certain period of time. For example, individuals can expect higher real wage increases in times of economic growth and lower increases during times of recession. We can see the effect of the interaction of the different effects in the estimation of age earnings relationships using cross-section data. Typically this which exhibits an inverted U shape. This is because of the interaction of cohort and age effects. As later cohorts will tend to have higher wages throughout their lifetime than earlier cohorts, when examined in a cross-section at one point in time, it will appear that earnings fall at higher ages.

Even today, dynamic models pose very large demands on the latest computing technology. As late as 1997, the *Panel on Retirement Income Modeling*, in the USA was advocating that the construction of a new generation dynamic retirement model should be delayed until data, micro-economic knowledge and computing technology had improved. Much work is being done to close these gaps. Improved data and econometric knowledge has resulted in extensive research programs into improving knowledge of micro-behaviour in the fields of labour supply, retirement decisions and fertility etc.

However at present, generally available computing power is insufficient to create an idealised dynamic microsimulation model that contains a large sample size, detailed micro-behaviour, behavioural feedback loops, linkages to other models and the ability to have multiple runs to estimate the confidence intervals through the use of multiple runs.

Given these limitations it might be argued that one should wait until these deficiencies are corrected before embarking on such an ambitious project as creating a microsimulation model. However, as Burtless (1996) points out *microsimulation provides an organising framework*. In other words, the existence of a microsimulation model, forces model developers to think about the interactions between behavioural processes rather than focusing purely on specific issues micro-econometricians specifically do. In this way they help to identify knowledge and data gaps and help to create an agenda for filling them. Also, although not perfect, dynamic microsimulation models are starting to be able to provide cost-effective answers to policy, economic and social policy questions. This is witnessed by the rapid expansion in activity in the late 1990's where new models have been financed in Australia, Canada, France, Ireland, Italy, Sweden, in the United Kingdom and in the USA.

4.3.Model Components: Data, Processes and Policy Instruments

The potential uses of a dynamic microsimulation model are limited by a number of factors including (a) the initial base dataset, (b) the types of processes simulated and (c) the types of policy instruments incorporated in the model.

Data

There are a number of different types of base data that a dynamic model can use. Table 2 describes the types of dataset used by different dynamic microsimulation models, detailing the data source and sample size.

Firstly initial databases can be divided into single and multiple cohorts. Single cohort models limit an analysis to investigations relevant to a single cohort such as the life-course redistribution. Multi-cohort models allow one to compare the position of people of different ages.

Sample size is another issue. The larger the sample size, the more one can consider smaller groups. Sample sizes are more important for inter-temporal analysis because the number of dimensions increases. This is because similar individuals in a cross-section, may in fact be very different due to a different paths to reach that state. Sample size also has an impact on run time of the model. The larger the sample size the longer the run speed, resulting in a trade-off. Faster computer power will however reduce the impact of this trade-off.

Base data can also be divided into historical and current data. A number of models (CORSIM, DYNAMOD and DYNACAN) start with historic data such as census files from the 1960's. The reason for this is that in order to simulate pensions, one needs information about work-histories. These models therefore start their simulation at a point in the past building up a sufficiently long work-history to the present day. Some models such as MOSART or PENSIM have base data sets that include work histories, so the early start date is not necessary, while other models such as the DESTINIE model simulates both forwards as other models do, but also backwards to create a work histories.

Data can also be divided into Administrative, Census, Survey Sample and Synthetic data. Administrative data often contains the most accurate data as more effort is placed in data collection. As the data often is collected for the whole population, sample sizes are often much larger than in survey samples. However administrative data typically only collect information necessary for administrative purposes for which they are collected. So for example, income tax data in a country that uses individual taxation will not contain information about an individual's spouse. For this reason countries that use administrative data often supplement information contained in administration data with extra survey data as in the case that used by the SESIM and MICROHUS models in Sweden. Often however administrative data is not available and so other data have to be used. Models such as CORSIM, DYNACAN and DYNAMOD use census data. While census data has better coverage than household surveys, they often have less information and so often have to be supplemented with imputed information from other sources. Household surveys although typically having small sample sizes have extensive information. A drawback is that they suffer from differential non-response and so have to use non-response weights. The use of weights in a dynamic model adds complexity in many areas and can result in individuals have different weights at different points of their lives. One solution made by the DYNAMITE and ANAC models is to replicate households according to their non-response weights, so that each household then has the same weight. The last type of base dataset in this classification are synthetic datasets. These are used when either a longitudinal model is used as in the case of DEMOGEN, HARDING, LIFEMOD and BALDINI, or where no data exists as in the case of the NEDYMAS model, where a synthetic initial sample representative of the Dutch population in 1947 was generated.

Behavioural Processes

Dynamic microsimulation models simulate processes that are relevant for the objectives of the model. For example a model such as the PENSIM model in the UK, which focuses on the income of pensioners, will simulate processes that are relevant to the determination of pensioner income such as income from capital, private and public pensions. Any process that is required as an input to one of these processes also needs to be simulated. So for example, work histories will have to be simulated to determine eligibility for pensions. As these processes themselves may depend upon other processes such as an individual's education, they will also have to be simulated.

Given the very different objectives of different model processes, it is difficult to compare behavioural processes used by models in a systematic way. In the O'Donoghue (forthcoming), we however describe, for each model, the principle processes used by each of the models and the input variables used by each of these processes. This section draws on some of the detail described there.

Models even with similar objectives vary extensively in the types of processes they include. For example focusing on the labour market, a model like HARDING simulates whether an individual works, if they work whether they are employed or self-employed and how much hours they work. If they don't work it simulates whether an individual seeks work. At the other extreme, because of budgetary constraints and a narrower focus, the MINT model simulates only the earnings per annum. However one must be cautious in comparing model processes in this way. Because of the amount of processes as well as data and resource limitations, models have often not adopted best international practice in the estimation of econometric models. Rarely do model builders subject their model estimates to detailed econometric tests of the validity of the assumptions made by the methods used. For example OLS models are often used in circumstances where one might expect biased results as in the case of estimating models with lagged dependent variables. Also, data limitations have often meant that some processes included in dynamic models have been estimated solely on cross-section data.

Policy Instruments

The policy instruments included in dynamic models are also quite varied. Policy instruments included in models include simple or comprehensive tax-benefit systems, educational financing systems, long-term, health and dental care provisioning and financing and private savings instruments such as pensions.

Often policy instruments have been included as optional add-ons that can be simulated once the behavioural processes have been simulated. However as discussed below, models with this structure do not allow for feedback from the policy simulators and the actual model processes and thus do not allow changes in retirement pensions to influence retirement age etc.

4.4.Methodological Issues

Static versus Dynamic Ageing

An alternative to dynamic ageing is static ageing. Instead of estimating econometric models to run simulations, static ageing takes macro-aggregates and then adjusts the underlying distribution to produce projections of the population distribution over time. It is an ageing procedure that takes a sample whose underlying characteristics X, are held constant, while the weights given to different parts of the sample is changed through the use of a dynamic reweighting mechanism to produce different weighted distributions corresponding to expected characteristics in the future.

Pudney (1992) finds that neither approach should be used in isolation. Dynamic ageing by focusing on the individual takes no account of processes at the level of the market such as labour demand and has impossible requirements in terms of data and modelling to jointly estimate all the required processes.

Static ageing has a number of theoretical objections. Klevmarken (1996) makes the point that whereas static ageing may avoid some of the problems of drift in the projected cross-section associated with dynamic ageing because of misspecification in dynamic equations, it cannot account for mobility between states. Also, he points out that from a statistical point of view it is inefficient not to use all available historical information to project into the future. A consequence of not modelling the mobility of individuals between points in time is that it reduces the type of analyses one can carry out using a microsimulation model. For example, it is not possible to carry out analyses that require life event histories such as the simulation of pensions.

Static ageing cannot be used where there are no individuals in the sample in a particular state. If there are a small number of cases of a particular household category, a very high weight may have to be applied, resulting in unstable predictions. Changing demographic and economic trends over time may mean that increasing weight is placed on population types with very few cases in the sample.

In order to dynamically-reweight, one needs forecasts of future weights. Macro models or other forecasting devices can be used for this. However, macro models may not forecast weights at the level of detail required. In an example used by Pudney (1992), weights consisted of a table of occupation $\times$ age $\times$ marital status $\times$ pension membership. It is necessary that this table of weights be produced for each simulation period. It is unlikely that any forecasting device can produce a jointly determined table of this level of detail and thus marginal distributions will have to be used.

Static ageing assumes that the characteristics within a weighted group do not change over time. Therefore, if large changes occurred in a variable that was not included in the macro weights, large errors might occur. For example a weighting scheme where weights were applied according to whether a family had children would over-estimate the number of children, if the fertility rate fell as a result of less large families rather than less families with children.

Static ageing procedures are relatively well suited to short to medium term forecasts, of approximately 3-5 years where it can be expected that large changes have not occurred in the underlying population. However over longer periods of time, it may be more difficult to use static ageing due to changing characteristics of the population.

Dynamic ageing will consistently estimate characteristics of the future income distribution, under ideal circumstances in which all transitions probabilities and state specific expectations can themselves be estimated consistently. This may be possible in a simple model with a small number of processes. However in a fully dynamic model of work and life histories, many more processes need to be jointly estimated. This is a formidable requirement given the available data. Therefore, it is necessary to assume that the marginal distributions of different processes are independent.

Projections over time at the micro-level are particularly susceptible to misspecification error as modelling at this level involves more detail than in macro models. In addition, our knowledge about micro-behaviour is not good enough to specify a fully dynamic model. Therefore, what is more commonly used is to combine dynamic ageing with an alignment (calibration) mechanism to keep aggregate outputs in line with predictions from macro models.

This procedure combines the best of both static and dynamic ageing. It allows for individual transitions to be simulated as well as ensuring that aggregate outputs track macro forecasts (See for example Chénard 2000a, 2000b).

Alignment faces a difficulty however if there is a behavioural response to a policy change. The existence of an alignment mechanism may constrain model outputs to always hit aggregate targets even if there has been an underlying behavioural or structural change. An example would be if education levels rose. One would expect this to reduce mortality rates and increase female labour force participation. If the alignment mechanism for each process did not incorporate the impact of educational achievement then an increase in the education level would have no effect on these aggregate.

One potential solution is to examine the average (pre-alignment) event value such as the average transition rate or average earnings in the baseline scenario with the average in the alternative scenario and increase alignment values by proportional difference. This is a method utilised in some dynamic models.

This however assumes that all processes are *unconstrained.* This may be the case for example with the mortality rate. One may expect that an exogenous increase in human capital will reduce total mortality rates and thus one can shift down in the alignment totals is appropriate.

However some processes face market or other institutional *constraints*, issues that are only partially simulated in the model. For our example in the labour market if education increased the labour force participation rate, if labour supply increases, then wages may fall and employment increase. This is similar to shifting the alignment probabilities. However one would have to shift earnings as well. However due to rigidities in the labour market, this may not necessarily happen. Labour Demand may be fixed, in which case we may just simply see that as more women supply labour, they simply replace people in the labour market who are less "employable". This is similar to not shifting alignment at all. In cases where there are market interactions such as this, it may be useful to incorporate a model of the market that would inform the response of alignment totals to economic and demographic changes.

Behavioural versus Probabilistic models

The next consideration is whether a model will be a behavioural or probabilistic model. Behavioural models are grounded in economic theory, in the sense that changes to institutional or market characteristics result in a change in the behaviour of agents within the model. A probabilistic model on the other hand attempts to reproduce observed distributional characteristics in sample surveys without necessarily a theoretical underpinning. Depending on how they are constructed, they may or may not be able to dynamically respond to external market and institutional characteristics.

Klevmarken (1996) categorises three types of behavioural adjustments in a dynamic microsimulation model: imputation of missing data, updating of simulation population and behavioural adjustments to policy changes. We shall not deal with the first here (See Klevmarken 1983) concentrating only on the latter two.

Updating of the simulation population also known as probabilistic modelling is a process used to age a sample. This method refers to the functions used to simulate mortality, fertility, family formation, labour market transitions etc. They are not necessarily grounded in microeconomic theory, but based on a probability-based method and do not depend on the policy parameters in the model. In practice many transitions are based on only a small number of factors such as age and sex. Methods that can be used include markov processes and survival functions discussed in later sections. Equation (2) gives an example of a probabilistic dynamic model. If we stick with the labour force participation example given above, the marginal distribution of Y_1 after tax labour income, $f_{Y_1/Y_2,X_1}$, depends on the marginal distribution of hours worked f_{Y_2/X_2}. In this model hours worked does not depend on the tax system and therefore fits our example of a probabilistic model.

$$f_{YX}(Y,X/P) = f_{Y_1/Y_2,X_1}(Y_1/Y_2,X_1,P)\cdot f_{Y_2/X_2}(Y_2/X_2)\cdot f_X(X) \qquad (2)$$

It might however be expected that changing economic and social policies would have an impact on behaviour. Klevmarken's third approach relates to models of this kind. In a behavioural model, where individual behaviour changes as a result of changing policies, the policy parameters must have a direct or indirect impact on the model. An example includes models of labour supply that respond to changes in the tax-benefit system. This is not normally the case in the probabilistic method. Equation (3) expands equation (2) and introduces a new decomposition of Y into Y_1, the targets of the simulation, endogenous variables which impact on Y_1: Y_2 which do not depend on policy parameters and Y_3 which are. In our example, Y_3 might still be hours worked, but now takes the form of a Hausman (1981) type labour supply model which depends on the net wage.

$$f_{YX}(Y,X/P) = f_{Y_1/Y_2,Y_3,X_1}(Y_1/Y_2,Y_3,X_1,P_{11}) \cdot f_{Y_2/X_2}(Y_2/X_2) \cdot \\ f_{Y_3/X_2}(Y_3/X_3,P_{13}) \cdot f_X(X) \tag{3}$$

A requirement of behavioural models is of the stability of the parameters. The parameters of the behavioural model must not change as a result of a policy change. A problem with behavioural models is how to cope with individual heterogeneity. For example a reduction in taxes may increase the labour supply of a low-income worker, but reduce the labour supply of a high-income worker. A potential way around this problem is to make the behavioural response, state dependent.

$$f_{YX}(Y,X/P) = f_{Y_1/Y_2,Y_3,X_1}(Y_1/Y_2,Y_3,X_1,P_{11}) \cdot f_{Y_2/X_2}(Y_2/X_2) \cdot \\ f_{Y_3/X_3}(Y_3/X_3,P_{13},P_0,Y_0,Y_{30}) \cdot f_X(X) \tag{4}$$

The behavioural part of equation (~~6~~ 4) accounts for state dependence by making the marginal distribution of the behavioural variable Y_3 dependent on not only the policy but also the type of policy system P_0, the original states, Y_3 and Y_{30}.

Klevmarken (1997) outlined three criteria for choosing what types of behavioural equations should be included in a microsimulation model.

- They should be relevant for the objectives of the model.
- There should be major behavioural adjustments to the policy changes the model is built to analyse.
- Behaviour that influences the fiscal balance should be included.

Examples of behavioural responses that fit these requirements include labour supply, the retirement decision, the effect of income and price changes on consumption, fertility and marital decisions and the take-up of social benefits.

Very few dynamic inter-temporal models have incorporated behavioural response in their design. The only examples known to the author (See table 3) are the MICROHUS, PRISM, and SESIM models that incorporate labour supply behavioural responses to the tax-benefit system and the DYNAMITE and ANAC models whose retirement decisions depend on the social security system. Why then have behavioural modules not been included in MSM's more often? Incorporating behavioural responses into microsimulation models has been found to be very difficult. Estimates of the value of the relevant elasticities have varied a great deal in econometric studies to measure them (Citro and Hanushek, 1991; Killingsworth and Heckman, 1986). Pudney and Sutherland (1996) have found that predictions based on behavioural models have very wide confidence intervals. Also, the addition of feedback loops from tax-benefit algorithms can substantially increase the time of simulation. For these reasons, builders of microsimulation models have often opted not to include behavioural responses in their models.

Competing Risks: Discrete versus Continuous time

At any point in time a variety of mutually exclusive transitions are possible for individuals in a dynamic model. Different outcomes may be regarded as different events competing with each other in order to be observed. For example a single woman can get married or have a child at a point in time. Whichever event comes first will influence the other. In this case, the probability of having a child is much higher if the woman is married. This is the notion of competing risks. Galler, (1995) discusses some of the issues relating to the modelling of simultaneous risks in dynamic microsimulation models.

Ageing modules in dynamic models are often constructed using annual transition probability matrices. Individuals are passed through a collection of transition matrices in each time period of the simulation (usually a year) to determine their simulated life paths. This method assumes that life events are independent of each other, while in reality they can be interdependent as in the example given above. Therefore, the order in which the transition matrices are applied is very important. In the example given above, if marriage is determined first, the potential fertility rate changes quite a lot. Likewise, a pre-marital pregnancy will increase the probability of getting married. Galler (1995) discussed a number of options in this situation including the procedure of random ordering used by the DARMSTADT (Heike et al., 1987) and Hungarian models (Csicsman et al., 1987). In these models the order in which processes take place varies randomly.

There are a number of other problems with this type of approach. Firstly transitions are assumed to take place at a single point in each time period and the duration of the event must last at least one time period (typically a year, but can be of shorter duration). For example if the time period is a year, then this approach rules out transitions in and out of unemployment over the course of the year. This is unrealistic, as many people will have unemployment transitions for periods of less than one year as in the case of seasonal workers. Therefore, the discrete time transitions simulate net transitions (See Galler, 1997) at discrete points in time, ignoring the transition path taken to reach the end state.

Recent dynamic models such as DYNAMOD in Australia and the demographic microsimulation model SOCSIM (Hammel, 1990) have begun to use survival analysis techniques to model life event transitions. Rather than simulating annual transition probabilities, survival functions model the length of time an individual will face in this current state. In Antcliff (1993), this method is discussed. Once a referencing event has occurred such as marriage, an individual is passed through each survival function that given their current state their eligible for. For example once an individual gets married, they are then eligible for divorce! The event given their current state with the nearest event time is selected. This process then repeats itself until death.

The use of survival functions in microsimulation models poses a lot of possibilities but however also a lot of problems. One of the assumptions of using hazard function continuous time models is that the probability of two events occurring at one point in time is zero (See Galler, 1997). This however is unrealistic in a dynamic model. For example when one simulates an individual to enter work, one must also decide whether they become an employee of self-employed and how many hours they work per week. Thus a number of processes need to be determined simultaneously. Galler argues that it is preferable to regard these types of simultaneous events as a single composite event. However in this case it is not possible as someone in work can become self-employed from a state of employment or vary their hours etc.

Another problem relating to the use of continuous time models is that incorporating explanatory variables, which vary continuously over time, results in very complex econometric models which are difficult to solve (Galler, 1997). In a dynamic model with continuous time, then labour market states, durations in these states and the resulting labour market incomes will vary continuously and are desirable to have as explanatory variables for other processes. One solution is to hold these explanatory variables constant for finite periods so that they can be considered within the model as discrete time explanatory variables. Galler argues that this results in a transformation of the problem into a discrete time problem. Also if flow variables are held constant during these intervals, then problems will occur if the state which is kept can actually be changed during the interval using the hazard function.

Galler also points out that macro-aggregates, which are typically discrete time variables, can be accommodated with ease as explanatory variables in a continuous model. He argues that in many respects the incorporation of macro variables is easier in the continuous time framework. This is because if the time period of the micro process is less than that of the macro process in a discrete time framework, then some interpolation may be necessary. However, another use of macro aggregates is in the alignment of aggregates from the model. Here one again has the problem of combining the continuous time predicted variables into discrete periods to make them compatible with macro-aggregates. One has to try to force the number of transitions within the discrete interval to match the aggregate totals. Given that the continuous time process are rerun every time a dependent variable is changed it becomes very difficult to identify the transitions that occur within the interval. Only when the actual interval has been reached is the number of transitions known. At this point, it is possible to restrict the number of transitions if the predicted number is higher than the macro aggregate. It may however be more difficult to maintain the same distribution of durations. The more difficult problem occurs if the predicted number of transitions that occur during the interval is lower than the macro aggregate. In this case it is not-obvious how to generate a higher number of transitions.

Another issue that is related to the alignment question is the interdependence of transitions for members of the same household (or in fact other unit such as the firm or industry). Each individual's behaviour may be dependent upon the behaviour of the other person in the unit. For example, it is known that the decision (or opportunity) of one spouse to work has been found to be related to the behaviour of the other spouse. In a continuous time model, when the explanatory variables of one spouse change, the dynamic processes have to resimulated. In addition, the dynamic processes of the second spouse need to be, which in turn may cause the first spouse's behaviour to change. This will significantly add to processing time. Furthermore, one has the problem that units such as this are non-constant, due to births, deaths and separations. This however is not greater a problem than the fact that units of analysis are wider than the individual and just require further iterations. Multi-individual units of analysis also pose problems for discrete time processes, as simultaneous interdependent transitions are difficult to model. They are however quite common place now in family models of labour supply, using multinomial logit models (See van Soest, 1995). A solution that is often used to this problem in dynamic microsimulation models is to simulate the transition of one spouse first and base the other spouse's behaviour on the behaviour of the first. Another is to base the behaviour of one spouse on the characteristics of the other spouse in the previous time period. While both approaches are less desirable than jointly estimating transitions, data constraints often limit the use of joint estimation. With regard to the second solution, the shorter the time between transition periods the better. It does however add to the time needed for simulation.

In general dynamic models have employed discrete time. Some however have incorporated a mixture of discrete and continuous models such as DYNAMSIM, DYNAMOD, LifePaths, MICROSHUS, MINT and PENSIM (See Table 3).

Open versus Closed Models

A decision dynamic microsimulation model builders have to consider is whether the model should be open, closed or a mixture of the two. A model is defined as closed if, except in the case of newly born children and new migrants, the model only uses a fixed set of individuals. Thus if an individual is selected to be married, their spouse is selected from within the existing population of the model. An open model on the other hand would start with a base population and if spouses are required, new individuals are generated. This has the advantage that simulations for individuals (and their immediate families) can be run independently of other individuals. It thus allows the model to be run in parallel on different computer processors, allowing overall run times to be reduced. This is the method used by the *DEMOGEN*, *LifePaths*, *Melbourne*, *MINT* and *Sfb3 cohort* models (See Table 3). However sometimes it is necessary to interact (in a modelling sense) with individuals outside ones immediate family. This is particularly true of the alignment process. Although possible, it is a non-trivial task to align a varying population with macro-aggregates as the weights would necessarily have to be dynamically reweighted constantly. In any case if this is done, most of the benefits of running the model in parallel will be lost. As a result most dynamic models in use, utilise a closed model method. Despite this, most have to incorporate a degree of *openness*. This is because of migration. While emigration is easy to do,[53] immigration requires the generation of new individuals. However this is less of a problem for alignment purposes than a fully open model, as macro-aggregates are based on a partially open population in any case.

Steady State versus Forecasted Projections

Another decision to be made is whether the model should be run in a steady state world or whether the model should try to incorporate forecasted projections. In a steady state world, because of the uncertainty surrounding such matters as marriage and fertility rates and economic growth rates, it is assumed that the world remains the same for each member of the sample's lives. For example, it is assumed that demographic, labour force, income and other characteristics of the population and all government policies existing in the base year remain the same for the entire modelled period. A model that attempts to track trends in the real world, will allow these characteristics to change during the simulation. The decision depends on the purpose of the model.

A number of models (e.g. LIFEMOD, HARDING, SfB3 and DEMOGEN) are simulated in a steady state world. One criticism of this method however, is that they represent no actual cohorts and that tax-benefit systems do not remain the same over an entire lifetime.. Nevertheless, steady state models also have a role as varying behaviour and systems over time can complicate the causes of various effects. Utilising a steady state approach, by focusing on just one system with unchanging behaviour patterns, allows one to look at the actual forces within a particular tax-benefit system, for example which drive particular results such as the extent of lifetime redistribution results without considering potential compensating interactions.

Allowing the model to be state dependent allows one to examine different environments and behavioural patterns to be examined. For example, a steady state model would not be effective in examining the impact of changing demographic or labour market

---

[53] This is unless one wants to track an individual living overseas, who accumulates pension entitlements which are transferable to their original country and then goes home to claim pension rights there. For countries like Ireland and Portugal with a lot of mobility within the European Union, it my be necessary to consider this issue in a public pensions dynamic model.

patterns, or changes in the wider economy. For these purposes, models need to incorporate information about actual changes in behaviour or to take into account projected changes. Some of the major modelling projects such as CORSIM and DYNACAN are simulated in non-steady state worlds. Doing this however comes with a cost as much more parameters need to be specified in the model and may require the use of many more datasets. As a significant component of designing a dynamic model is this estimation process, it can result in a much more expensive model to build.

While cohort models often take a steady state assumption, it is not necessarily the case (See van de Ven's (1998) Melbourne model).

Classifying Models: Cohort versus Population Models

Harding (1993) and others have categorised inter-temporal dynamic models into two types: cohort/longitudinal models that model a single cohort over their lifetime and population/cross-section models that model a population cross-section over a period of time. Some models in addition only focus on adults ignoring children and thus although the may contain a cross-section of the population, it is not representative of the whole age spectrum.

From a model design viewpoint, the distinction between cohort and population model is less significant than the use the model is put to. The distinction in the literature had more to do with computing power and data constraints until recent times rather than any major methodological differences. Cohort models were typically used because the computing costs to simulate whole lifetimes for cross-sections with sufficient sample sizes to be able to examine specific cohorts were too high. Both types of model can be simulated in the same modelling environment. A cohort model is simply a model that ages a sample of unrelated individuals aged zero, while a population model ages a sample of individuals of different ages, some of whom are related. Both samples are then passed through ageing procedures, to produce life event histories over the modelled period.

It is logical to model both types in the same computing platform. The potentially larger size of the cohort modelled in dynamic cohort models, allows one to look at life time income patterns for smaller population groups such as recipients of disability benefits or lone parents. Some cross-section models such as MOSART combine the advantages of both types of models because of access to a very large dataset. Access to administrative datasets that contain detailed labour market and life event histories for 1% of the population allows one to run the model over the lifetime of particular cohorts while comparing their position with other cohorts.

Population models, should perhaps be classified under two headings:

- Multi-purpose Models
- Special Purpose Models

Large cross-section models which were usually built with large teams with access to large and complex datasets. They usually simulate a wide variety of economic and demographic processes and can therefore be used for many different applications. These are forecasting models and usually incorporate alignment systems in order to keep the model in line with external forecasts or are in fact linked to macro-models. Models of this type are DYNASIM I and II, CORSIM in the USA, the SfB3 model in Germany, the Canadian Pensions Program DYNACAN, the MOSART model in Norway and the DYNAMOD model in Australia.

Another group of cross-section models are models built for specific purposes, mainly forecasting pension costs and other maintenance costs of the elderly. As forecasting models they also usually contain external weights to keep the simulations *on track*. Models of this type include PENSIM in the UK, the Belgian Pensions model and the French pensions model. More advanced is the US Pensions and Retirement Income Simulation Model (PRISM) which simulate a much wider variety of characteristics.

Validation

not in refs

One of the major perceived problems of dynamic models is the fact that insufficient effort has been placed on validation matters. PRIM (1997) argues that projection models of all types including dynamic microsimulation models should have a number of validation goals.

- Firstly they should provide accurate estimates of policy outcomes,
- Secondly provide estimates of the uncertainty associated with projections and
- Thirdly incorporate the most up to date information about underlying behaviour.

PRIM (1997) advocate that one should use *ex-post* analyses of previous periods to assess the reliability of the model. It is for this reason that a number of the major microsimulation projects have taken historic datasets as the starting population base for their simulations. For example the CORSIM model takes as its base a sub-sample of the 1971 US Census, while the DYNACAN model takes as its base a sample of the 1970 Canadian Census. By running the model forward to the present they can compare the model forecasts to what actually happened See for example (Morrison, 2000; Caldwell and Morrison, 2000). However invariably these models incorporate historical information such as macro-aggregates in the model. As this information would not have been known to forecasters, this may produce better forecasts than would have otherwise been the case. PRIM (1997) therefore argue that a more effective validation would be to take aggregates which would have been available at the time rather than the more accurate historical information.

Within these validation approaches, there are alternative types of validation. One method is to compare directly generated forecasts with what happened in reality. This is for example comparing forecasted labour participation rates with actual rates. Another method described in Caldwell (1996) uses an indirect approach, known as a multiple module approach. An example he cites is the case of validating the numbers of married persons with health insurance, when the directly simulated processes are marriage and medical insurance membership. Sources of error may result from errors in either or both direct processes or because of misspecified interactions. Some types of dynamic model however, may have no comparable source of validation. For example models which solely look at a single cohort living in a steady state will have nothing with which to validate as the model does not attempt to mimic real, life, but merely a stylised version of it. Alternatively, countries which have developed their micro-data resources only recently may not have alternative sources of data with which to validate, although this problem will become progressively less of a problem with time.

Clearly given the length of projections and the level of detail simulated by dynamic microsimulation models one must emphasise the level of uncertainty about results. Measuring this uncertainty in the form of confidence intervals has not been carried out to any great extent.[54] One of the reasons for this is because policy makers typically are interested in only point estimates and not the level of confidence, which in any case is

[54] Pudney and Sutherland (1996 and 1994) did however consider the confidence intervals associated with sampling error and of behavioural response estimates.

often misunderstood. There are exceptions to this in other fields as for example the provision of inflation forecasts, which now typically come with error bounds. Another reason is that the cost and time taken to do this is also often very large. However given the length of forecasts used in for example public pension forecasts, the need for estimates of the level of confidence is apparent.

PRIM (1997) describe 4 sources of variability, sampling variability in the input database, in other components such as regressions and alignment totals, errors in the base database and misspecification errors. Sample reuse methods as described by Cohen (1991) can be used to estimate sources of sample variability. Although it may be difficult to put the resulting uncertainty into a probabilistic context, it is quite a useful method for assessing the sensitivity of results to for example different specifications of behavioural equations. It is also an effective method for assessing the size of the error which results from the use of monte carlo processes within the dynamic model itself.[55]

Because of computing constraints, one faces a trade-off between the complexity of the model used and the number of iterations one can use to estimate the sensitivity of the model. Some models such as the LifePaths model in Statistics Canada have been developed to be able to be run in parallel and with access to large institutional computing facilities have been able to measure this kind of variation. However even with the access to these resources, a number of simplifications have been necessary.

4.5. Conclusions

This chapter reports some of main issues involved in constructing such a dynamic microsimulation model and describes some of the choices made by different models world wide. The main issues discussed in this chapter include the decision whether the model should simulate a multi-cohort representation of the population or to just focus on a single cohort. Other decisions include whether the model should be run in continuous time or in discrete time intervals, whether the model should be open or closed, whether alignment should be used, whether the model should be run in a steady state and whether the model should incorporate behavioural response to policy changes or to simply simulate a statistical representation of the population. This issues were

[55] By this we mean that for every dynamic process, there is a model which predicts say an average probability that a transition will occur and in addition a random number which decides whether for that individual the transition will occur.

considered in the light of available practice amongst model builders around the world, drawing on a detailed literature survey of the main models in O'Donoghue (2001).

Although many countries possess models, there is a concentration of models in the USA, Germany, Sweden, the UK and Australia. Most models are categorised as open cross-section models utilising discrete time. The use of alignment depends on the function of the model. Likewise most models attempts to replicate period effects and thus are not run in the steady state. Cohort models are typically run in a steady state world, with van de Ven (1998) being an exception. Likewise alignment is more common for population models, simulating an entire cross-section.

A comparison of models using broad headings as we have done underestimates the degree of variability of different types of model in terms of the actual behaviour simulated. The complexity modelled very much depends on the primary objective of the model. Thus large-scale models such as CORSIM, DYNAMOD and DYNACAN etc. have very large sets of detailed behaviour, while some models have been designed for limited purposes as in the case of Creedy (1997).

Tables and Figures

Table 4.1. Uses of Dynamic Microsimulation Models

Model	Country	Uses
DYNAMOD I and II	Australia	Potential areas such as superannuation, age pensions and education, long-term issues in labour market, health, aged care housing policy, broad long-term distributional issues within the population and across generations, asset accumulation retirement incomes, future characteristics of the population or the projected impact of policy changes.
HARDING	Australia	Analysis of lifetime tax-transfer analysis, for analysis of policy concerning the Higher Education Contribution Scheme redistributive impact of government health outlays over the lifetime.
Melbourne Cohort Model	Australia	Analysis of income inequality in a lifetime context
FAMSIM	Austria	Demographic behaviour of young women
Pensions Model	Belgium	Analyse and forecast the medium term impact of a change in the pension regulations
DYNACAN	Canada	Models Canada Pension Plan its impact on the Canadian population
LifePaths	Canada	Health care treatments, student loans, time-use, public pensions and generational accounts
DEMOGEN	Canada	Distributional and financial impact of proposals to include homemakers in the Canadian pension plan
DESTINIE	France	Public Pensions and Intergenerational Transfers
Sfb3	Germany	Analyses of pension reforms, the effect of shortening worker hours, distributional effects of education transfers, inter-pers redistribution in the state pension system.
Dynamic Model	Ireland	Inter-temporal issues relating to the degree of redistribution in the Tax-Benefit System
DYNAMITE	Italy	Examine household level microeconomic questions and the impact of macroeconomic and institutional changes on distribution of resources
ANAC	Italy	Examine the effect of demographic changes on the Italian saving rate and the reform of the pension system in Italy
Italian Cohort Model	Italy	Analyse lifetime income distribution issues
Japanese Cohort Model	Japan	Look at the impact on household savings of changes in the demographic structure
NEDYMAS	Netherlands	Intergenerational equity and pension reform, the redistributive impact of social security schemes on lifetime labour inco Demographic projections, Annual versus lifetime income redistribution by social security, Lifetime income redistribution by old-age state pension, Lifetime income distribution and the unit of analysis, modelling of institutional households, Annuali and lifetime income redistribution, Vertical and horizontal lifetime redistribution, Annual versus lifetime income redistribu by social security. Mortality differences related to socioeconomic status and the progressivity of old-age pensions and he insurance, Pension Reform.
MIDAS	New Zealand	Wealth accumulation and distribution
MOSART	Norway	Modelling the future cost of pensions, carrying out micro level projections of population, education, labour supply and pu pensions and incorporating overlapping-generations modelling in a dynamic microsimulation framework.
MICROHUS	Sweden	Study the Dynamic effects of changes in the tax-benefit system on the income distribution
SESIM	Sweden	Modelling budget estimates of student grants and loans,. analyses of other inter-temporal policy issues such as labour sup savings decisions and pensions
SVERIGE	Sweden	Human ecodynamics (the impact of human cultural and economic systems on the environment)
Swedish Cohort Model	Sweden	Examining the replacement of social insurance by personal savings accounts and the distribution of lifetime marginal effec

		tax rates
LIFEMOD	UK	Modelling the lifetime impact of a welfare state
Long Term Care Model	UK	Modelling Long Term Care Reform Options
PENSIM	UK	The treatment of pensioners by the social security system, the regulations and coverage of private pension schemes and performance of pension funds investment portfolios, projected demographic movements and movements in aggregate varia such as unemployment and interest rates.
CORSIM	USA	Changes occurring in kinship networks, wealth accumulation, patterns of intergenerational mobility and whether individual paths depend on aggregate conditions in society, the progressivity and the life course of the current Social Security syster well as potential reforms, Household Wealth accumulation, Socioeconomic Mobility, Health status, Interstate Migration, T and Income Allocation, and International Collaborations
DYNASIM I & II	USA	Forecasts of the population to 2030 employing different assumptions about demographic and economic scenarios, An anal of the cost of teenage childbearing to the public sector under alternative policy scenarios and linking with a macro model
MINT	USA	Forecasts of the distribution of income of the 1931-1960 birth cohort in retirement
PENSIM/2	USA	Analyses lifetime coverage and adequacy issues related to employer-sponsored pension plans in the USA.
PRISM	USA	Evaluation of Public and Private Pensions

Sources: Antcliff et al., (1996), Harding (1993), Van de Ven (1998), Lutz (1997), Joyeaux et al. (1996), Morrison (1998), Osberg and Lethbridge (1996), Rowe and Wolfson (2000), Wolfson (1988), Bonnet, C. and R. Mahieu, (2000), INSEE, (1999), Galler and Wagner, 1986 and Hain Hellberger, 1986, O'Donoghue (2001), Ando et al. (2000), Ando and Nicoletti Altimari (1999), Baldini (1997), Ando (1996), Nelissen (1996), Stroombergen, Rose and Miller (1995), Fredriksen (1998), Klevmarken and Olovsson (1996), Ericson and Hussenius (1999), Pylkkänen (2000), Vencatasawmy et al. (1999), Winder and Zhou (1999), Fölster (1997), Pudney (1992), Hancock, Mallender and Pudney (1992), Falkingham J. and C. Lessof, (1991),Hancock (2000), Toder et al. (1999), Panis and Lillard (1999), Holmer et al. (2001), Citro and Hanushek (1991b), Citro and Hanushek (1991b), Caldwell et al. (2000).

Table 4.2. Base Data Sets of Dynamic Microsimulation Models

Model	Country	Base Data	Sample Size
DYNAMOD I and II	Australia	1% sample of the 1986 Census	150000 individuals
HARDING	Australia	Synthetic Cohort Aged 0	4000 individuals
Melbourne Cohort Model	Australia	Synthetic Sample of 20 year olds in 1970	50000 Males and families
FAMSIM	Austria	1995-96 Family and Fertility Survey (Austria)	4500 women
Pensions Model	Belgium	Synthetic Cross-section based on Survey Data	
DYNACAN	Canada	1971 Census Public Use File (1% sample)	212000 individuals
LifePaths	Canada	Synthetic Cross-section	Varies
DEMOGEN	Canada	Synthetic Cohort Aged 0	1000-5000 individuals
DESTINIE	France	1991 Financial Assets Survey	37000 individuals
Sfb3 Population/Cohort	Germany	1969 Integrated Micro Data File (Pop.), Synthetic Cohort Aged 0 (Cohort)	69000 hh/ 7300 ind.
Dynamic Model	Ireland	1994 Living in Ireland Survey (Pop.), Synthetic Cohort Aged 0 (Cohort)	4500 hh/variable ind.
DYNAMITE	Italy	1993 of Household Income and Wealth	67000 households
ANAC	Italy	1993 of Household Income and Wealth	67000 households
Italian Cohort Model	Italy	Synthetic Cohort Aged 0	4000 individuals
Japanese Cohort Model	Japan	Synthetic Multiple Cohorts (single representative of each cohort type)	4000 individuals
NEDYMAS	Netherlands	Synthetic Cross-section based on 1947 Census	10000 individuals
MIDAS	New Zealand	Synthetic Cross-section based on 1991 Census	10000 individuals
MOSART	Norway	1989 administrative data (1% Sample)	40000 individuals
MICROHUS	Sweden	1984 HUS income distribution database	
SESIM	Sweden	1992 HINK survey	30000 individuals
SVERIGE	Sweden	1% Sample drawn from administrative data in 1985-1995	9 million ind.
Swedish Cohort Model	Sweden	Synthetic Cohort Aged 20	1000 individuals
LIFEMOD	UK	Synthetic Cohort Aged 0	4000 individuals
Long Term Care Model	UK	1993-1996 Family Expenditure Surveys	1770 individuals
PENSIM	UK	1988 Retirement Survey, 1986 Social Change and Economic Life Initiative Survey and 1988 Family Expenditure Survey	5000 benefit units
CORSIM	USA	1960 Census (0.1% sample)	180000 individuals
DYNASIM I & II	USA	1973 Current Population Survey (CPS) matched to Social Security Administration (SSA) data	
MINT	USA	1990-93 Survey of Income and Program Participation, matched to SSA data	85000 individuals
PENSIM/2	USA	Synthetic Cohort Aged 0	
PRISM	USA	March 1978, March and May 1979 CPS matched. to SSA data	28,000 adults

Sources: See Table 1.

Table 4.3. Dynamic Model Principle Features

Name	Country	Base Pop.	Time (C/D)	Open/ Closed	Alignment	Steady State	Behaviour
DYNAMOD I/ II	Australia	Cross	C/D	C	Y	N	N
HARDING	Australia	Cohort	D	C	N	Y	N
Melbourne Model	Australia	Cohort	D	O		N	N
FAMSIM	Austria	Cross	D	C	N	N	N
Belgian Pension Model	Belgium	Cross	D	C		N	N
DEMOGEN	Canada	Cohort	D	O	N	Y	N
DYNACAN	Canada	Cross	D	C	Y	N	N
LifePaths	Canada	Cross	C	O		N	N
DESTINIE	France	Cross	D	C	Y	N	N
SfB3 Cohort	Germany	Cohort	D	O	N	N	N
SfB3 Population	Germany	Cross	D	C	Y	N	N
Irish DMM	Ireland	Both	D	C	Y	Y/N	Y
DYNAMITE	Italy	Cross	D	C	Y	N	N
ANAC	Italy	Cross	D	C	Y	N	N
Italian DMM	Italy	Cohort	D	C	N	Y	N
Japanese Model	Japan	Cohort	D	C	Y	N	Y
NEDYMAS	Netherlands	Cross	D	C	Y	N	Y
MIDAS	NZ	Cross	D	C		N	N
MOSART	Norway	Cross	D	C	Y	N	N
MICROHUS	Sweden	Cross	C	C	N	N	Y
SESIM	Sweden	Cross	D	C	N	N	Y
SVERIGE	Sweden	Cross	D	C	Y	N	N
Swedish Cohort Model	Sweden	Cohort	D	C	N	Y	N
LIFEMOD	UK	Cohort	D	C	N	Y	N
Long term care	UK	Cross	D	C	Y	Y	N
PENSIM	UK	Cross	C	C	Y	N	N
CORSIM	USA	Cross	D	C	Y	N	N
DYNASIM I/II	USA	Cross	C/D	C	Y	N	N
MINT	USA	Cross	C/D	O	Y	N	N
PENSIM/2	USA	Cohort	C	O	N	Y	N
PRISM	USA	Cross	D	C	Y	N	Y

Sources: See Table 1

Chapter 5. A Dynamic Microsimulation Model for Ireland

(A Study of a Flexible Dynamic Modelling Computing Framework)

5.1. Introduction

The objective of this chapter is to describe a general method for constructing a dynamic microsimulation model. The computing framework that is described is the basis for the dynamic microsimulation model used in this thesis.

Microsimulation models, which take micro household datasets and simulate government policy have been used for about a decade in Ireland starting with the construction of the SWITCH model at the Economic and Social Research Institute in Dublin (Callan et al., 1996). Work has focused on examining the impact of potential and actual policy reforms on a cross-section of the population (Callan et al., 1995), a comparison of Irish policy with that of European neighbours (O'Donoghue and Utili, 2000), examining policies to reduce pollution (O'Donoghue, 1997) amongst others. These studies have employed a static methodology, which means that policies and reforms are examined on a cross-section at one point in time and with no behavioural response. More recently there has been a desire to explore the dynamics of policy reform. For example work has been done on modelling labour supply in Ireland (Callan and Van Soest, 1996).

The objective of the computing framework described here is to incorporate the time dimension into policy analysis. Using models based on cross-section data simply allows one to look at the effect of policy at one point in time. Using cross-sectional data one is limited in the simulation of policy instruments that depend on inter-temporal factors such as pensions. A dynamic microsimulation life cycle model allows one to examine policy over time; for example life course redistribution, forecasts of cross-sectional redistribution and the simulation of pensions. In chapter 4, a number of decisions were described that need to be made in constructing a dynamic microsimulation model. In this chapter, we describe the decisions made and why. We also describe an innovative computing framework used to create the model.

5.2. Objectives

The construction of a dynamic model is an enormous task, both in terms of grasping the types and forms of behaviour that take place over a lifetime and the effort in programming 1000's of lines of code.

Despite dynamic microsimulation modelling (DMM) as a science having existed since the 1970's (see Orcutt et al.), the field has progressed only slightly. Part of the reason has been the huge resources necessary. When DMM's were first developed, they were in fact advances in Computer Science as well as being advances in Social Science methodology. Likewise in many countries, data limitations have prevented the development.

However in recent years, both difficulties have been overcome as computers have increased in speed and thus allowing for very powerful models to be constructed on PC's. The establishment of household panel datasets in many countries, for example the European Community Household Panel Survey, the British Household Panel Survey and the German Socio-Economic Panel has removed the barrier to the estimation of dynamic behavioural processes.

However despite these advances, the spread of the DMM technology has been quite slow. A large potential reason is the apparent benefit to cost ratio. Many institutions when faced with the large cost of developing a dynamic model felt the money better spent on other techniques.

One significant contributor to the cost of development is the cost in actually producing the computing environment of the model. Because the computing necessary to produce a computing framework is so complicated, computing development has often taken precedence over developing better behavioural equations. It is therefore important to focus on ways of reducing the cost of building this initial framework. Clearly the most obvious way is to use reusable code. There were some efforts in the 1970's to write actual microsimulation computer software packages. However because of the complexity of the system to be simulated, users are likely to demand much greater access to the actual program code than software packages allow. A more successful method of reusable code has been the use of the CORSIM model as a template for the construction of models in Canada, Sweden and the US Social Security Administration.

This model is designed to achieve a similar purpose, aiming to be able to be used for different research purposes of the author in the future.

In constructing this dynamic model, the author had a number of constraints not necessarily experienced by other builders of dynamic microsimulation models. Dynamic models are typically constructed by governmental institutions (MOSART, SESIM, DYNACAN) or by major research grants (SVERIGE, DYNASIM), although a number of models have been constructed as part of PhDs (Harding, Baldini). Not being funded by a major research grant or by a government institution this model falls into the latter category. As a result, the model has necessarily to be less ambitious at the outset. A number of examples where limitations were imposed on the construction of the model include use of a small dataset (just under 2000), simplified behavioural equations and focusing solely on a single cohort. However despite these shortcomings, it is hoped that with improved data and funding availability that the model can be improved in the future. Therefore the objective of the model is to construct a program which although relatively basic initially is not constrained from adapted for future uses. Future potential improvements of the model include:

- Inter - cohort redistribution of the tax-benefit system.
- Demographic Ageing and the Income Distribution
- Comparisons of welfare state life course redistribution across countries
- Improve behavioural equations
- Improve data
- Savings processes
- Life-course labour supply
- Medium Term Forecasts
- Add graphical front end

It is not possible to foresee the problems involved in developments in these areas in advance. However in order not to allow current limitations to inhibit future developments of the program, careful thought is necessary in the design of a flexible modelling framework. There are a number of features that would be desirable in such a model to be able to meet these objectives in the future.

- In order to be able to deal with new datasets with ease, using different sets of variables should not be a problem.
- It should be easy to incorporate new behavioural information in the model.
- Need to be able to run on a Personal Computer using standard "inexpensive" software.
- It should be straightforward to make changes to the model even if the model has not been used for a period of time. This implies transparency in the operation of the model and also flexibility in the way in which behaviour can be incorporated in the model.
- These points also imply that the model should be robust to changes desired.
- Speed at the present is not considered a priority as it is expected that computing time will decrease with the availability of cheaper and faster computers.
- The objective of this model is to allow the user to focus more on the estimation of behavioural equations rather than computing issues.
- The model should also allow feedback effects of policy reforms to be examined.

A dynamic microsimulation model is essentially a model that takes individuals and simulates the probabilities of various events occurring at various points in time.[56] Figure 1 describes the main operations of the ageing component of dynamic microsimulation model. Here the operation of one particular ageing module at one point in time is examined. In the model itself this process would occur on a number of occasions as all the individuals in the database would pass through many ageing modules at each point in time.

Data for each person are firstly taken from the database and transformed into the model data-structure, which is described in more detail below. The individual is then passed through each ageing module in turn. The ageing modules to be used are specified as part of a parameter list, which allows the order and the types of the transition processes to be

[56] Dynamic events may of course occur at the same point in time as other events

varied. Input parameters for each ageing module are stored in Microsoft EXCEL spreadsheets (XL). Output from each ageing module is stored in alignment storage matrices in memory. If the ageing module is a transition between states, then the output will be a probability, otherwise if the ageing module is a transition between continuous amounts like for example incomes, the output is a real variable. When all individuals have been passed through the particular ageing module, alignment occurs. This ensures that aggregates from the micro model match macro aggregates. Finally if a variable for any individual changes then this change is registered in the database[57]. The rest of the chapter will describe in more detail the operations of each of the components described here.

5.3.Model Features

Data and Model Data Structure

In this section we describe how data is handled in the model. We describe the database used, how data is stored within the model and how it is transferred between database and model. Turning first to data storage, we adopt a relational database (Microsoft Access '97) due to organisation and memory handling advantages.

Figure 2 describes the data-structure used by this modelling framework. Structurally the data is stored in a hierarchy of object types such as person, household, firm etc.[58] Each of these object types themselves consists of a number of objects such as the actual incidence of a person or household. Events such as births, tenure status or even identification number then occur to objects.

We exploit the hierarchical nature of relational databases making data storage event driven. Storing model output as consecutive cross-sections would result in severe inefficiencies, as each variable would be stored for each output period, so for example the gender would be stored for each point in time. Making data storage event driven, new data is stored only when a new event occurs and thus the data changes. Gender is therefore only stored at birth. One can make significant savings in memory as a result. Each individual variable however requires more information than in the case of the

[57] Note by the term database, we refer to both the physical relational database, Microsoft Access 97 and the virtual database we create in memory.

[58] In cross-sectional data structures, persons are considered at a sub-level to households. However because persons can be members of a number of different households over time, this relationship breaks down. In

cross-section data structure. For each event it is necessary to know what event occurred, when it occurred, who the event occurred to and the value of the event.[59]

The initial database depends on the purpose of the simulation. In the literature, models have been classified as either cohort or population models. However, as chapter 4 points out, this distinction is now largely redundant due to advances in computing power. From a computing perspective, a cohort can simply be seen as a an initial sample of unrelated individuals aged 0, while the population contains a sample of individuals of different ages, some of whom are related. As a result, a decision about this does not have to be made about this, as the computing framework has been developed to handle both types of analysis. Running the model as a dynamic population model requires that the initial cross-section is stored in the required manner, while running the model as a dynamic cohort model requires the model to first generate an initial cohort.

There are a number of ways in which data can be stored within the model itself during the simulation. If the model were open as in the case of the DEMOGEN or LifePaths models in Canada where new spouses are generated synthetically when needed, then all of each individual's transitions could be simulated independently of other individuals. Thus each individual could be read from the database, simulate their life course and store in the database one at a time. This framework however uses a closed methodology where individual behaviour can be dependent on the characteristics and behaviour of other members of the sample. Utilising a closed model means that except for new births or immigrants, no new individuals are generated. Marriages for example link individuals already in the database. This method is more straightforward to interpret as it mirrors the actual population. The model is not individual based as many operations in the model depend on other individuals such as the marriage market, processes which depend on spousal information and alignment routines (see below for a description). A side effect of this is that it is necessary to store all individuals in memory during the simulation. The virtual database stored in memory during the operation of the program mimics the structure of the Relational Database.

Once the data has been read from the database into memory, the model runs through each household in turn simulating the life course events desired. Firstly however the

---

the data-structure persons are considered one set of objects and households another, where the ID's of the member individuals of a household are events that can occur to households.

59 Another means of reduce storage space is to store variables as integers rather than as real numbers. Therefore when storing output, variables are first multiplied by 100 and then truncated.

data is read into household data structures. Typically variables which are components of the household data structure are declared in long lists within a dynamic model. They may be initialised elsewhere and have other operations carried out in other parts of the program. As the model is so large and complicated, it may be difficult to keep track of all the places in the model which need to be altered when a new variable is included. Therefore, in order to keep the model flexible and yet maintain the robustness, it is desirable that the number of alterations necessary is kept to a minimum. As a result instead of declaring variables within the model, we declare the list of variables to be used separately in a parameter sheet. The model then creates space for the variable, initialises the data and carries out all necessary transformations and operations automatically and therefore is entirely flexible with regard to the set of variables used within the model. Thus if the user wishes to introduce a new instrument with an output variable such as health status, then the user simply needs to introduce the variable into the parameter sheet and the model will do the necessary steps, without having to recode the model. Another advantage of the flexible declaration of variables described is that because variables are stored in vectors, new composite variables can be produced easily.

Another important advantage of the hierarchical method of data storage is the ease in which duration information can be accessed. As the date and value of each event is stored it is possible to determine such information as duration, duration in the last 12 months, date an event first occurred, date an event ended, and so on. Information of this kind is frequently required be tax-benefit systems. Additionally it is easy to access previous values of an event such as previous earnings etc.

Modularisation

The use of modularisation is an important technique that helps achieve the objectives of flexibility, transparency and robustness that the modelling framework requires. Modularisation means that components within the model are designed to be as autonomous as possible. Modules are the components where calculations take place, each with its own parameters, variable definitions and self contained structure with fixed inputs and outputs. The result is a set of independent components that do not interact with each other directly, allowing the model to operate as a collection of independent building blocks. Because each process module is entirely self contained, each can be run independently, left out or new modules included. Constructing a program in this way allows for the model to be easily expanded to deal with new behavioural equations or functions. Also because it allows the user to focus on individual components one at a time, without interaction with the rest of the program, the model becomes more robust.

Parameterisation

In order that modules and other components of the model framework can be changed with ease, it is necessary to store model parameters externally. Where possible no parameters are hard coded within the model. Figure 3 details the set of parameters used by the modelling framework. The sets of parameters, representing the *flow of control* in the model, are hierarchical.

At the top level we have the "Process Spine", that consists of a list of the number and order in which processes occur in the simulation. This feature exploits the modularisation, where because each process is seen as a separate building block, the number, type and order of processes can vary. The process spine contains the list of modules to be run in the dynamic model, so that by varying the order of the modules and varying the content of the list, one can vary the types of processes that can be run in the model.

Each process or module has a corresponding parameter sheet in the parameter file "Processes". These parameter files tell the model the output variables of each process, what type of process (described in the next section), whether a process needs to be aligned and the actual process parameters themselves such as the transition rates, regression equation and policy rules etc.

If a particular process is to be aligned, then the model framework will look for an appropriate parameter sheet containing alignment parameters. These are contained in the "Alignment" parameter file.

All variables used in the model are declared in the "Dyvardesc" or variable description file. This file contains information on whether a variable is

- to be outputted at the end of a simulation,
- an income variable,
- a categorical variables (if so how many categories),
- is to be updated during the simulation (to account for inflation)

In order for the model to use a variable, it needs either to be read in from external data or generated in some way. The process modules described above describe ways in which variables can be generated either through statistical models or models describing public policy rules. Sometimes however variables are generated as a simple transformation from other existing variables. For example an age variable can be generated as the duration since birth. The Transformation parameter file describes a set of transformations such as this.

5.4. Process Modules

This section describes the main process types that can be used by the model framework. This refers to the collection of operations that are simulated on individuals during a lifetime. These include demographic processes such as birth, marriage, having children and death, education, labour market processes such as employment and unemployment, the simulation of incomes and interactions with the tax-benefit system.

In order to aid flexibility, we classify processes under a number of headings. In this way, instead of programming each module separately, we only need to program the module type once. In order to run a module, we then only need a module name (which is included in the process spine), a module type to determine what program to run and a set of parameters which is fixed for every process type. At present there are 4 module types:

- transition matrices, in the form of a log linear model
- regressions, both with continuous and limited dependent variable
- marriage market
- tax-benefit system[60]

The first component of a parameter file contains details about what conditions need to hold for the process to be run. At each point in time, each individual is passed through the module. If the conditions hold, then the module calculations are carried out and the output passed to the alignment component of the module. The output for each individual is stored until all individuals have passed through the module. The alignment component then ensures that the aggregates correspond with external control totals.

Transition Matrices

One of the most important processes in a dynamic model is the transition between different discrete states. Transition Matrices are often used to perform these operations. They specify the probability for an individual of particular circumstances to move from state A to state B. In this framework, transition matrices can be stored as log-linear models (See Dobson, 1990). In this way transition rates are decomposed into average and relative transition rates. In this way extra-relative transition rates can be added with ease. For example, if a mortality rate on average fell by 0.1% every 10 years, then a relative probability time dependent parameter Of 0.999 could be added. Similarly it also allows the model builder to combine information from different sources. So for example we combine actual age-gender specific mortality rates for 1991 taken from life-tables and use relative mortality rates taken from (Nolan, 1990) that incorporate socio-economic relative mortality rates.

Regressions

The second type of transition process used are those based upon standard regression models. At present, this type of module allows four types of dependent variable

- standard continuous dependent variable
- log dependent variable, allowing for use of the log normal distribution.
- logit discrete choice dependent variable
- probit discrete choice dependent variable

Any variable in the model can be used as a dependent variable and any variable can be used as an explanatory variable. The error term can also vary. The default error term takes a normal distribution with independent disturbances. The model also allows for the error term to be decomposed into individual specific (u_n) random effects and general error components (v_{nt}) (See Pudney 1992). This allows some degree of heterogeneity to be assigned specifically to individuals. So for example in determining earnings, the individual specific error may represent some difference in innate ability, while the general error term represents random variation over time. Breaking up the variation in this manner will tend to reduce within lifetime variation and prevent to some degree the existence of very unusual life paths.

---

[60] The tax-benefit system is in fact a collection of modules.

In this model, transitions occur at discrete time intervals because of the weakness of the data and because of the desire to be able to align the data.[61] As Galler points out some statistical difficulties relating to the use of discrete time models, it is desirable to use short term discrete time periods such as a month. However running monthly transitions requires significant computing power. Therefore annual transitions are used. However, the framework is sufficiently flexible to simulate monthly transitions if the computing power is available.

Marriage Market

If an individual is selected to marry then, a process is needed to determine which spouse they will take. The process used here is to take the characteristics of the individual chosen to marry and the characteristics of each possible spouse and determine the likelihood of a match. Similar to the method used in other models such as the CORSIM model, this is done using a logit model that estimates the probability of marriage between pairs of individuals. The parameter file therefore is identical to that used in the regression process type. The module itself forms a matrix of the characteristics of the n men and n women selected to marry. Estimates a probability for each pair and assigns a match to the couples with the highest probability of marrying. Chapter 6 describes this process in more detail.

Policy Processes

The fourth process type is the core analytical component, the simulation of the tax-benefit system. The Irish tax-benefit system that is simulated is described in more detail in chapter 2. Here we describe how it is implemented in the program. Again, to re-emphasise the desire to reuse code wherever possible and to avoid duplication, the dynamic framework is flexible enough to link with other specialist programs such as tax-benefit models. Tax-benefit routines from the model EUROMOD can be seamlessly accessed by this model and thus can be used as module components of the dynamic model. Immervoll and O'Donoghue, (2001) describe the EUROMOD tax-benefit framework in detail. A high degree of modularisation is used, which allows the entire tax-benefit system to be built up from building blocks of calculation modules.

Tax-benefit systems are defined as being composed of policy types, composed of policies, which are in turn composed of modules. For example, we define income taxes,

---

[61] Chapter 4 describes some of the advantages and disadvantages of continuous time versus discrete time.

social benefits and social insurance contributions (SIC) as separate policy types. Policy types are programmed in the same manner and contain the same set of modules as each other. So for example, in our example here Unemployment Assistance (UNA), Unemployment Benefits (UNB), Old Age Contributory Pensions (OCP) and Survivor Contributory Pensions (SCP) all use the same code; they simply differ by the parameters specified. Each policy type has the same set of modules. These are the real building blocks of the tax benefit system, where the calculations take place. In our example we consider Eligibility, Equivalence Scale and Means Tests as some of the core modules within a social benefit policy.

Behavioural Response

A desirable feature often ignored in dynamic microsimulation models is the ability to include feedback loops so that behaviour can respond to changes in public policy. This is a criticism made by PRIM (1997), is that dynamic models are insufficiently flexible to incorporate the demands of behavioural response. While we do not attempt to model in detail, changes to behaviour as a result of policy change in this model, the software framework has been designed to be able to incorporate feedback loops. The degree of modularisation that exists in the framework allows any number or order of modules to be run and for modules to be able to be run a number of times. Thus for example in order to have labour supply depend on tax-benefit policy, the tax-benefit system will need to be run once as an input into the labour supply module and again once labour supply has been determined, taxes and benefits need to be calculated again on the resulting behavioural decision. Currently the model uses the tax-benefit system as an input into decisions to work, decisions to seek part-time employment versus full-time employment and to become self-employed. The tax-benefit system therefore needs to be run 5 times to examine the impact of the system on the choice faced by an individual. When there are more that 1 adult in the household, because behaviour of spouses can depend on each other, the tax-benefit system needs to be simulated 17 times (4 decisions for each, plus one run on the basis of resulting behaviour). As a result incorporating behavioural response can be computationally expensive. Utilising the behavioural component doubles the length of a simulation. As a result other behaviour such as retirement decisions, consumption and benefit take-up have been ignored for the time being. However the important thing is that the framework is sufficiently flexible should the user require and the computing power becomes available.

5.5. Transformations

Often variables depend indirectly on other transition processes and thus are not directly simulated, but change in response to changes in other variables. Examples include age that depends on the date of birth, widowhood, which depends on the death of a spouse and so on. Likewise if an individual moves from year 6 in education to year 7, years of education increase by 1. This component has also been parameterised. In this model when an indirect variable like this is required, a calculation is carried out to derive the variable from previously simulated variables. This procedure too has been parameterised. The parameterisation first declares the variable to be transformed, Var[k]. A transformation occurs if a condition is true. The function can compare any two variables of any two individuals in a household, using the operators ≥, ≤, >, < or =. Two types of transformation are allowed. Type 1 sets Var[k] equal to a value A. For example if a spouse dies then the marital status of the other spouse becomes widowed. In type 2 Var[k] is set equal to a value a particular variable of a specified person in the household.

5.6. Alignment

The section describes the alignment function contained in the model framework. The objective of alignment is to ensure that output aggregates match external control totals. The reason this is done is that micro behaviour (both social and economic) is extremely complex and micro-theory being limited, cannot predict accurately all the variability of the system (in this case the life paths of individuals). In addition, a household model only makes forecast about a small part of the economy and largely ignores interactions with the rest of the world economy. Also, data taken from relatively short periods of time may not fully reflect the dynamics within the household sector over time. As a result dynamic micro-models may not be able forecast aggregate characteristics of the population well. Alignment is therefore used to achieve this.

In the discrete choice models, the output for each individual is a probability. In order to use these models for predictive purposes, a decision rule is necessary. In other words, what forecasted probability or higher will produce an event. In order to predict a state with a logit (or probit model), one draws a random number uniformly distributed number u_i. When $u_i < logit^{-1}(\alpha + \beta X_i)$ (or $u_i < probit^{-1}(\alpha + \beta X_i)$), then a state is predicted to occur.

Another use of alignment is in correcting for predictive failures of econometric models. For example when using discrete choice models such as logit or probit models, often, the predictive power is poor. Duncan and Weeks, (2000) highlight that *"even in functionally well-specified models, the predictive performance is poor, particularly where some states are relatively densely or sparsely represented in the data".*[62] Thus the further the probability of an event occurring is from 0.5, the less effective these decision rules are at producing the desired result. As a result models may under or over predict the number of events. So for example if 5% of individuals of individuals should have the event, then the logit model may not necessarily produce 5% of events. Alignment will however constrain the event to occur to 5% of individuals. This is effectively a calibration mechanism and will produce the correct proportion of events. Care must be however taken in its use as it may disguise errors in the model specification.

The types of control totals that would be used to align to include:

- The aggregate proportion/number in a state.
- The aggregate proportion/number moving between states.
- The average event value.
- The distribution of values.
- The average growth rate in the value of an event.

A simple analogy about the relationship between alignment and the process modules is that the process modules such as logit models produce a ranking variable, while the alignment mechanism selects the number of transitions. Table 1 highlights an example of age-gender-occupation specific mortality rates. In our econometric model we may have an equation of the probability of dying as described below, that depends on age, gender and whether an individual is disabled or not. Assuming that disabled people have a higher mortality rate, then given the same age and gender and distribution, as expressed by the stochastic component ε_i, the mortality distribution for disabled people will be higher.

---

[62] The reason for this according to Greene (1997) is that "the maximum likelihood estimator is not chosen to maximise a fitting criterion based on prediction of y, as it is in the classical regression (which maximises R^2). It is chosen to maximise the joint density of the observed dependent variable.

$$\begin{aligned} logistic(p_i) = \quad & \alpha + \beta_1 \times Disabled_i + \beta_2 \times Age_i + \\ & \beta_3 \times Gender_i + \beta_4 \times Disabled_i \times Age_i + \varepsilon_i \end{aligned} \tag{3}$$

The deterministic component of the model will result in those with a higher risk, having a better chance of the event occurring, while the stochastic part will ensure that there is some variability (so that not only those with high risk are selected). This model therefore produces the risk of dying.

In order to select the number of people that die, we use the alignment probabilities. Firstly individuals are grouped into the appropriate age and gender groups. As everyone in the relevant group will have the same age, gender and occupation, they only differ by the deterministic component for disabled people $\beta_1 \times Disabled_i + \beta_4 \times Disabled_i \times Age_i$ and the stochastic component ε_i. The object then is to select to die, the people in the group with the highest probabilities of dying. As β_1 is positive, proportionally more disabled will die than non-disabled. As a result we see that the output of the model equation is used to rank the individuals to whom the event occurs, but to leave the decision to the alignment process.

Macro Alignment.

There are a number of levels at which alignment can occur. At the lowest level, alignment refers to the decision rule used in a logit/probit or some other discrete choice model. At the next level, described above in our mortality example, which is called the meso-level, concerns the idea that the aggregates for particular groups (in this case gender, age and occupation) should match the external totals. Meso-level alignment and the use of alignment as a decision rule can however be combined into one stage.

Sometimes the desired targets are narrower than the alignment targets we use. An example is in our mortality alignment example. Here we align mortality by age, gender and occupation. We include occupation in the alignment because the occupational structure is very important for other characteristics in the model. However if say one of the core targets in the model is to achieve the mortality distribution supplied by external sources such as official population projections, which may only be by age and gender, then our meso-alignment may produce different aggregates. This will happen if our underlying occupation distribution is different to the one implicit in the official forecasts. It may therefore be desirable to adjust the results again to achieve these targets. This process is known as macro alignment. In the application of the framework used in this thesis, an example of meso alignment is the simulation of transitions between employment states. Macro alignment is then used to constrain total employment rates.

Behavioural Change.

Handling behavioural interactions in the model resulting from alternative scenarios is therefore another issue one needs to consider when deciding on an alignment strategy.

One potential solution is to examine the average (pre-alignment) event value such as the average transition rate or average earnings in the baseline scenario with the average in the alternative scenario. One potential method is increase alignment values by proportional difference. This is a method utilised in some dynamic models.

This however assumes that all processes are *unconstrained.* This may be the case for example with the mortality rate. One may expect that an exogenous increase in human capital will reduce total mortality rates and thus one can shift down in the alignment totals is appropriate.

As described in chapter 4, some processes face market or other institutional *constraints,* issues that are only partially simulated in the model. An example is in the labour market such as the case where there is a behavioural change in labour participation in response to a tax change. If labour supply increases, then wages would fall and employment increase. This is similar to shifting the alignment probabilities. However one would have to shift earnings as well. However due to rigidities in the labour market, this may not necessarily happen. Labour Demand may be fixed, in which case we may just simply see that as more women supply labour, they simply replace people in the labour market who are less "employable". This is similar to not shifting alignment at all. In cases where there are market interactions such as this, it may be useful to incorporate a model of the market that would inform the response of alignment totals to economic and demographic totals.

Implementation

So far in this framework alignment has only been implemented for the rates of transitions for logit models. In this section we describe a practical method for ranking individuals for alignment. We take as our reference point a logistic model:

$$p_i = logit^{-1}(\alpha + \beta X_i + \varepsilon_i) \qquad (4)$$

Utilising the model $logistic(p^*_i) = \alpha + \beta X_i$ will result in those with the highest risk always being selected for the event. So for example in our example given above, the disabled, all other things being equal would be selected to have to die. In reality those with the highest risk will on average be selected more than those with lower risk, rather than simply selected those with the highest risk. As a result some variability needs to be introduced.

Models based on the CORSIM framework such as the DYNACAN model (See Chénard, 2000) utilise a method of incorporating variability that shall be discussed here. Firstly, predicted probability is produced using our econometric model: $p^*_i = logit^{-1}(\alpha + \beta X_i)$. Next, a random number u_i, is drawn taken from a uniform distribution, is subtracted from the predicted probability, p^*_i, to produce a ranking variable, $r_i = p^*_i - u_i$. This value is then used to rank individuals so that the top x% of values are selected. Mathematically, we can define this ranking variable as follows:

$$r_i = logit^{-1}(\alpha + \beta X_i) - u_i = \frac{\exp(\alpha + \beta X_i)}{1 + \exp(\alpha + \beta X_i)} - u_i \qquad (5)$$

A concern about this method is that the range of possible ranking values is not the same for each point. In other words, because the random number $u_i \in [0,1]$ is subtracted from the deterministically predicted, p^*_i, then the ranking value takes the range $r_i \in [-1,1]$. However the ranking value for each individual will only take a possible range $r_i \in [u_i - 1, u_i]$. So for example if p^*_i is small say = 0.1, the range of possible ranking values is [-0.9, 0.1]. At the other extreme if p^*_i is large say = 0.9, then the range of possible ranking values is [-0.1, 0.9]. Thus because there is only a small over lap for these extreme points, even if a very low random variable is selected, then an individual with a small p^*_i will have a very low chance of being selected.

Ideally the range of possible ranking values should be the same, so that for each individual, $r_i \in [a,b]$, with individuals with a low p^*_i being clustered towards the bottom and those with a high p^*_i being clustered towards the top.

We now consider an alternative method. This method takes a predicted logistic variable: $logit(p_i) = \alpha + \beta X_i$. Next, a random number is drawn taken from the logistic distribution ε_i. This is added to the prediction of the $logit(p_i) = \alpha + \beta X_i$ to produce $logit(p_i) + \varepsilon_i$. The resulting inverse logit, $p_i = logit^{-1}(\alpha + \beta X_i + \varepsilon_i)$ is then used to rank individuals and similarly the top x% of households are selected. The ranking variable can therefore be described as follows:

$$r_i = logit^{-1}(\alpha + \beta X_i + \varepsilon_i) = \frac{\exp(\alpha + \beta X_i + \varepsilon_i)}{1 + \exp(\alpha + \beta X_i + \varepsilon_i)} \tag{6}$$

Utilising the uniform random number, u_i, to produce the logistic random number,

$$\varepsilon_i = -logit(u_i) = -\ln(u_i / (1 - u_i)) \text{ or } u_i = \frac{\exp(-\varepsilon_i)}{1 + \exp(-\varepsilon_i)}. \tag{7}$$

As a result,

$$\begin{aligned} &logit^{-1}(\alpha + \beta X_i) - u_i = \frac{\exp(\alpha + \beta X_i)}{1 + \exp(\alpha + \beta X_i)} - \frac{\exp(-\varepsilon_i)}{1 + \exp(-\varepsilon_i)} \neq \\ &\frac{\exp(\alpha + \beta X_i + \varepsilon_i)}{1 + \exp(\alpha + \beta X_i + \varepsilon_i)} = logit^{-1}(\alpha + \beta X_i + \varepsilon_i) \end{aligned} \tag{8}$$

The rank produced by the two methods is not the same. The second method will be more likely to select cases at extreme points than the first, while first method will select more points with central values of p^*_i.

5.7. Conclusions

To conclude we discuss some of the Methodological innovations of this Computing Framework.

- Cohort and Cross-section in one Framework. Although not discussed in detail in the chapter, the model allows both cohort and cross-section type dynamic models to be used in the same framework.

- Parameterisation: parameterisation has been used extensively throughout the model. This aids flexibility as code does not need to be reprogrammed when parameters change. This in turn improves the durability of the model as it allows new parameters to be included when better information becomes available.

- Defining the data structure outside the model improves the transparency and the robustness of the model. When adding new variables to the model, alterations need only to be made in one place, in a parameter file. It therefore reduces the possibility of error and makes the model easier to change.

- Modularisation: All modules work independently of others which means that new modules can be added without affecting the integrity of the model. It therefore adds to the robustness of the model. Also, by allowing the user to focus on small sections of code at time, improves the transparency of the model.

- Generalisation of main features of the dynamic model: The code which runs transitions, alignment and transformations can all be reused under different names and different parameter files.

These building blocks can be classified into four types. Taking these as templates, one can declare a new module in the parameterisation of an existing type and simply change the parameters in order to produce a new process module. Also because the number order and type of module is parameterised, the model can handle any number of modules of each type and in any order without any need for extra programming. This is perhaps the most important feature of the model as it allows the model to be used for a wide variety of purposes. It thus allows for ease of expansion as improved data and micro-behaviour become available. Allow this not an attempt at writing a microsimulation programming language, it should allow for a variety of different applications to be constructed without the need for extensive recoding. In addition it may be possible to use this framework as a template for other dynamic models because the model itself is entirely independent of data and behavioural equations to be used.

- Finally in order to avoid robustness problems due to modules being incorrectly specified, the model contains a debug device which ensures that all inputs required by a module are actually available (i.e. have either been generated in the model or read from the database) before each module can be run.

Tables and Figures

Figure 5.1. Description of a Dynamic Module

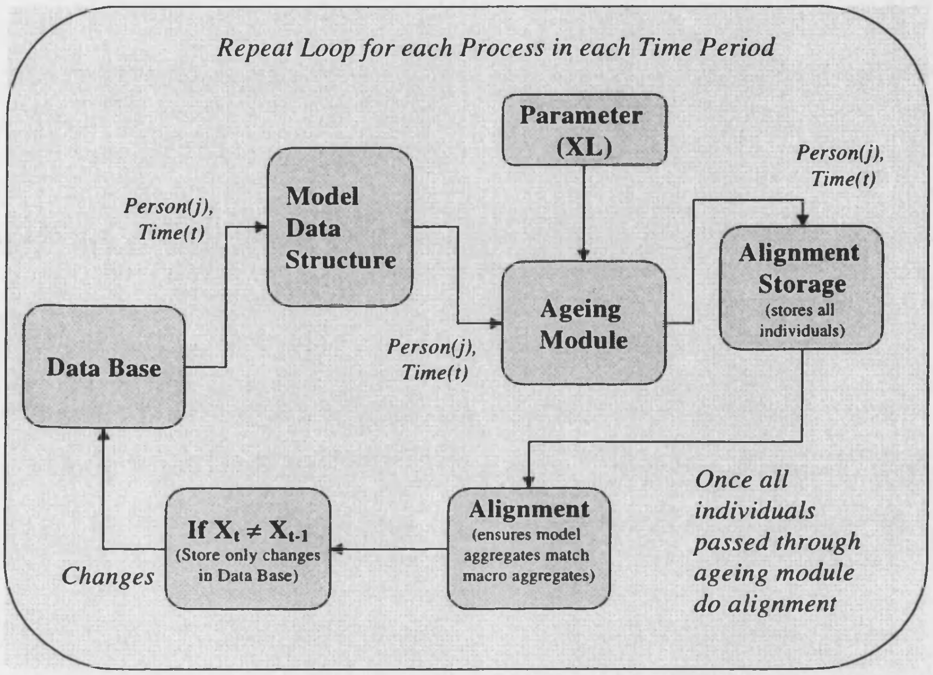


Figure 5.2. Model Data Structure

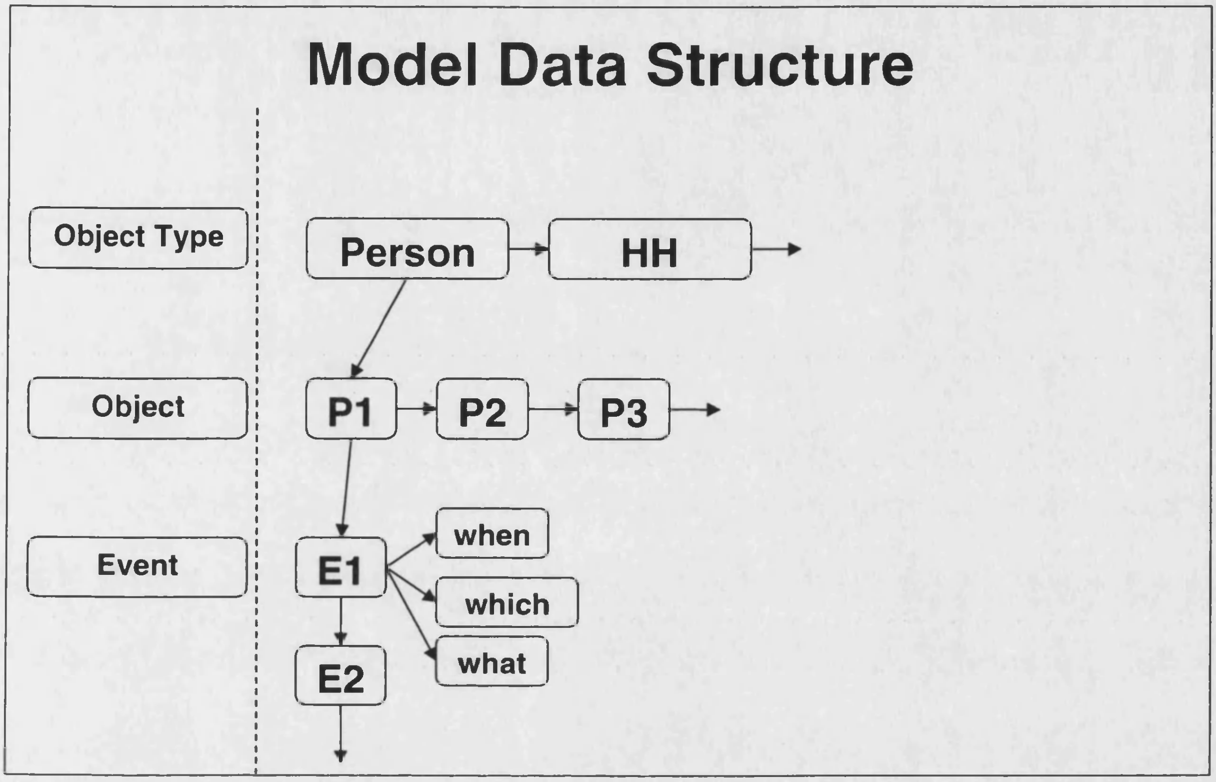


Figure 5.3. Parameter Sheet Hierarchy

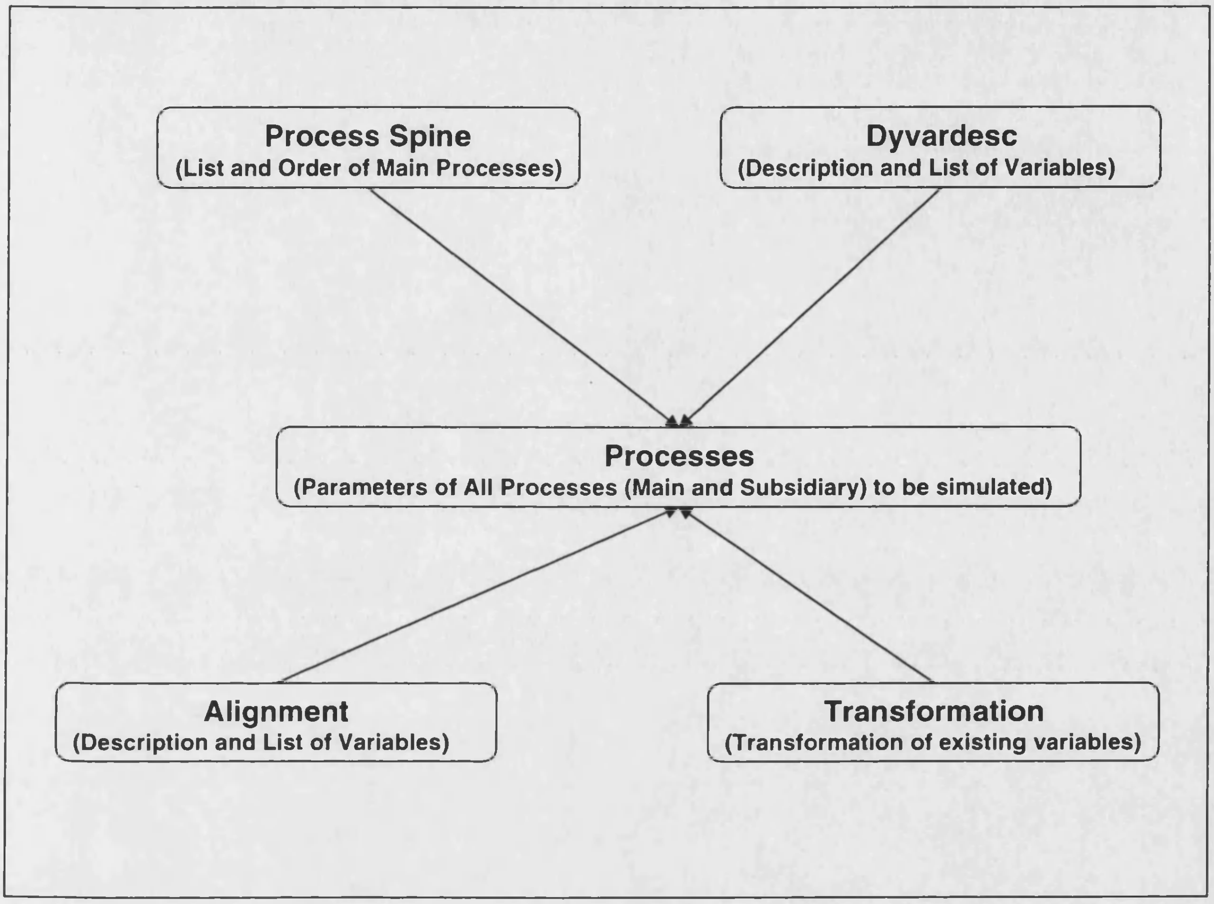


Figure 5.4. Distributions of Probit Participation Equation Probability for High and Low Education

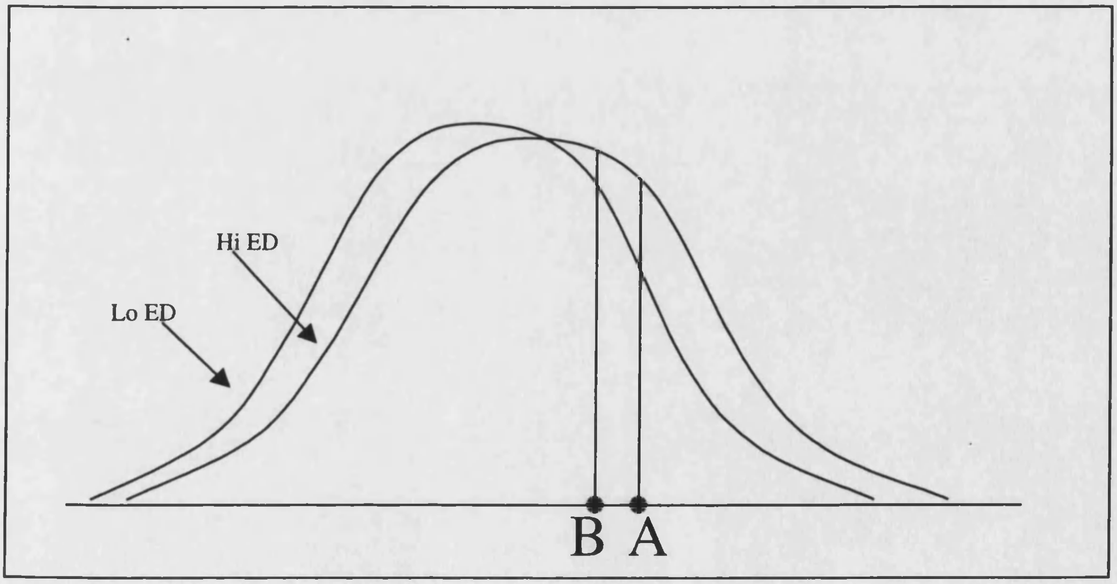


Figure 5.5. Aligning Averages (Correct Distribution)

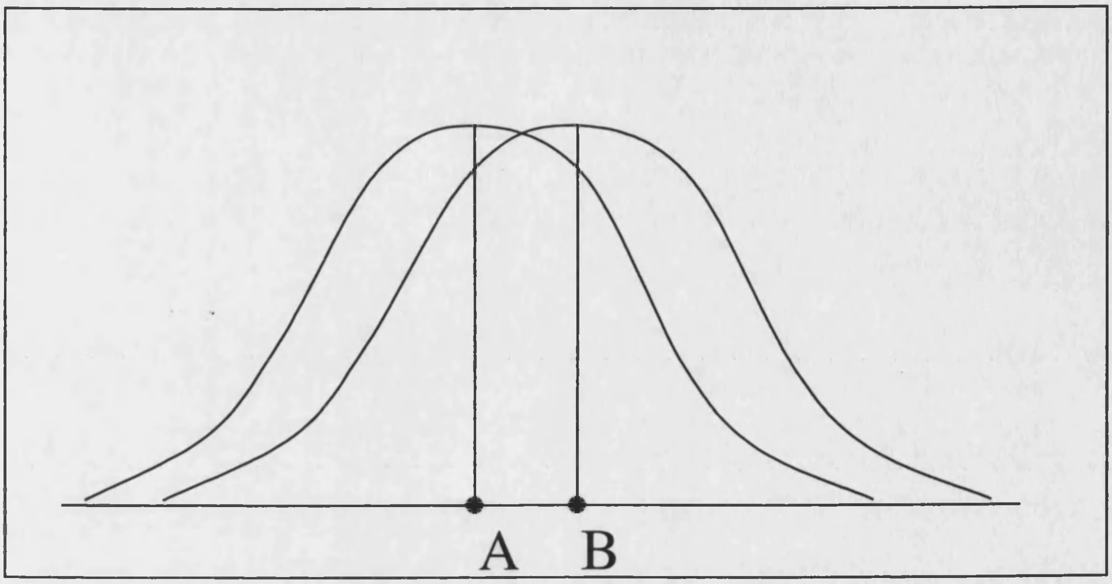


Figure 5.6. Aligning Distributions (Correct Means)

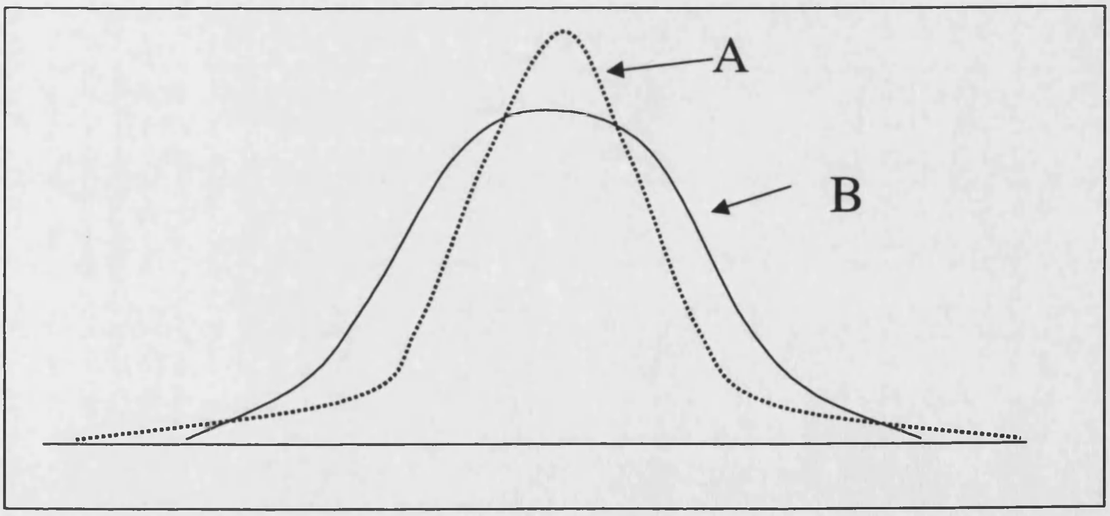


Table 5.1. Mortality Rates for Males and Females by Age and Occupation

Age	Male	Female
Occupation = 1		
20	.001	.001
21	.001	.001
. . .		
65	.09	.075
66	.095	.078
. . .		
Occupation = 2		
20	.0015	.0014
. . .		

Chapter 6. Modelling Demographic and Education Behaviour

6.1. Introduction

This chapter describes some of the characteristics of micro-level behavioural processes of individuals in Ireland. In this chapter, processes are broken up into demographic and education behaviour. Chapter 7 describes how labour market behaviour and capital income is modelled. The processes are dynamic in the sense that the processes are endogenous within the model and also can vary over time. They form the components of an ageing model within a new dynamic microsimulation model for Ireland. In addition to behavioural equations, alignment processes are described, which allow transitions within the dynamic model to match macro-level aggregates.

Estimation of dynamic processes in Ireland is quite strongly constrained by data limitations. Few micro-data sets are available for Ireland before the 1970's and since then household surveys have typically been collected in seven-year intervals. Ireland has been a country that has experienced massive economic and social transformations over the last three decades of the twentieth century. During this period the country has moved from a poor agricultural country, with traditional family structures to the *celtic tiger* with the highest growth rates in Europe, an economy where although agriculture is still important has been superseded by high technology and financial service industries. Family structures have changed enormously with falling birth rates, early marriage rates and the legalisation of divorce. From being a country with high emigration rates, it has become a country of net immigration. Education attainment rates have climbed from being relatively low by European standards, to a situation where the education participation rates are above average. Because of the data gaps it is quite difficult to disentangle these processes and to design models which explain these trends. Perhaps there is no single underlying model for particular processes and maybe what we have witnessed is a changed paradigm due to the opening up of the economy to outside influences. This is not the place to examine such trends. Instead we shall focus in this chapter on the micro-behaviour of individuals in Ireland in the mid-1990's, independent of wider trends.

Summary

As the purpose of this chapter and the next is to describe the behavioural processes included in a new dynamic microsimulation model for Ireland, we are in particular interested in dynamic relationships between these processes. Figure 1 outlines the broad relationship between these processes. Starting at birth individuals have a number of characteristics which strongly influence future life events, including gender, parental education level and family occupation group or social class. As we shall show below, parental education level, together with one's own education level (also influenced by background variables such as parental occupational group) are important determinants of ones career occupational group. As this variable is an important driving force for many lifetime outcomes such as mortality, marriage, earnings and , parental education level and occupational group though their influence on their children's education level are thus important influences on intergenerational mobility. These demographic processes then have strong influences on the labour market processes that in turn influence the level of income from savings.[63]

This chapter attempts to describe in more detail the actual processes both from a cross-sectional and inter-temporal point of view. Section 2 describes the main data source used, section 3 the principle demographic process and section 4 educational attainment.

6.2.Data

The primary source of data used in the model is 1994 *Living in Ireland Survey,* collected by the Economic and Social Research Institute as the Irish leg of the European Community household panel survey. In some cases especially for education and demographic processes, official statistics are used to specify the processes.

The Living in Ireland Survey is a cross-section survey of the Irish households and is described in Callan et al. (1996). It collects information on incomes, labour market status and demographic information, with 4048 responding households and a response rate of 57.1%. Although the income collected in the ECHP is primarily annual income from 1993, additional data was collected in the LII, so that current income from 1994 can be used. Therefore the data has current information for 1994 for both incomes and labour market characteristics as well as recall data for 1993. In addition to previous

[63] In this model we do not simulate wealth accumulation and thus do not take into consideration issues such as bequests or portfolio decisions.

states, the data collects information on the duration in the current labour market state. It also collects life time duration information for employment, unemployment, illness, education, retirement and not participating. The sample has been reweighted using the Census of Agriculture (to account for an under-representation of small farmers) and the Labour Force Survey. The sampling frame for both surveys is the electoral register.

Summary Statistics for men and women are described in table 1, for sample members aged over 16. Averaging over all people, men have higher incomes than women. Although women have slightly higher education levels, men are twice as likely to be in work. This is particularly noticeable for self-employment (especially agricultural self-employment), where men are over 6 times more likely to be self-employed. Employment status is recorded for each month of 1993 and 1994. In the employment status variables used in this chapter, we take the employment status during the month of interview and for the month 12 months previously. We notice that the proportion of the adult population in work rose over the period 1993-1994, with the proportion of males in work increasing from 0.55 to 0.59 and women from 0.27 to 0.31. Proportionally this is a larger increase for women. This highlights a particular drawback of the short panel surveys; period effects may influence the data. So as we see here there are higher exit probabilities from out-of work than entry probabilities as the labour market increased in size. The period 1993-1994 was at the start of the Irish economic boom. However the numbers in employment have risen quite a lot more in subsequent years. Women despite having a lower probability of being in work are more likely to work part-time, while men are more likely to be in management positions or work in the public sector. Women are more likely to have white collar jobs, and men blue collar jobs. Men are also more likely to be unemployed, although this is likely to be as a result of the structure of the benefits system, where only one spouse claims unemployment assistance. As a result of the factors discussed so far, using the lifetime duration information, men are more likely to have worked for more years and have been unemployed for longer. Women despite having longer life spans are likely to have shorter periods spent in retirement. This is likely to be compensated by the variable years in home duties.

6.3. Demographic Behaviour

In this section, the main demographic transitions used in the model will be detailed. The demographic decisions modelled consist of mortality, fertility, marital status(marriage, remarriage, cohabitation and separation) and disability. Although not modelled there are short descriptions of migration and leaving home decisions.

Mortality

In this section we consider mortality. As Figure 2 demonstrates, life expectancy has risen gradually since the independence of the country in the 1920's. Gains for women have surpassed that for men. The biggest improvements occurred just after the Second World War due to an increased interest in public health provision, immunisation and maternity services. The biggest health service related impact was due to post-natal care as the infant mortality rates dropped significantly during this period from 6.5% of births in 1946 to 4.6% in 1951, falling to 0.7% by the 1980's. In recent times most of the improvement in life-expectancy has been a result of improved living conditions and medical care for the elderly. Looking internationally, there seems to have been a converging trend in mortality rates over time. Table 2 which outlines life expectancies at birth in different countries shows that from very different starting positions, life expectancy has converged to a very similar level across countries. Nevertheless life-expectancies in Ireland in 1992 were still low by international standards, especially in the case of women.

As life-expectancy ~~fell~~ rose over time, where have the improvements occurred? One possibility is that there is a phenomenon known as orthogonalisation, which means that except for the oldest age groups, one sees a fall in the age specific mortality rate and with the maximum lifetime duration not moving much. The other possibility is that the shape of mortality rates remains constant with an increasing maximum lifetime duration. Figure 3 demonstrates that in Ireland, the former phenomenon has been the driving force in the falling average mortality rate. We notice that between 1921 and 1992, especially for women, mortality rates fell for younger age groups, with the very oldest age groups having an increased mortality rate. Thus age at death has become less variable and more concentrated amongst older ages.

Besides, age and sex, research has shown that mortality is related to a number of different socio-economic factors such as income, occupation and education level etc.[64] Kitagawa and Hauser (1973) looked at the relationship between mortality and education in the USA in 1960 and found that those with lower years of schooling had higher mortality rates. This relationship was found to be more pronounced amongst women than amongst men. In the UK Townsend and Davidson (1982), found that mortality rates for both men and women and for different age groups were higher for lower socio-economic groups. They found that this trend had worsened over time. Also men tended to have greater differential mortality than women.

In Ireland, Nolan (1989) has carried out some research on the socio-economic impact on mortality using data collected in the death certificate. Age specific mortality rates broken down by socio-economic group have been outlined in table 3. Nolan found that low skilled workers had higher mortality rates and that professionals, managers, farmers and salaried employees had lower mortality rates. A number of factors which may contribute towards this differential mortality include occupational hazards, poverty (both directly and indirectly), lifestyle and health care. O'Shea (1999) found that within a falling mortality rate, for men with observed occupations, mortality differentials narrowed between 1981 and 1991. However the mortality rates for those with unknown occupation (approx. 7% of population) increased substantially. On the whole however between group variation in mortality fell over this period.

One however must be cautious about results of these exercises because measurement of occupational related mortality differentials are faced with data problems. In both Nolan's and O'Shea's papers children were ignored because of the low numbers of cases and because of the high numbers of parental occupations classified as unknown[65]. Retired people are also not included as often the deceased's last job is classified rather their principle occupation during their lifetime. Retired people may therefore be categorised in the wrong group or not at all. Women were also left out because in many cases their husband's occupation is a better indicator of social class of a family. Also death certificate data is however not totally reliable as often the person who fills out the form may not know precisely what occupation the deceased had.

In our model of mortality, we use the 1990-1992 life-tables as the basis for our age differential mortality. Differential mortality is based on socio-economic group for those aged sixteen or over. For those aged over 65, we assume that the differential mortality rate of the 60-65 age group is maintained. For women, although the UK results quoted above indicate a slightly lower variability in mortality rates between occupational

---

[64] See also Goldblatt (1990), Townsend et al. (1988), Illsley (1986) and Wilkinson (1986)

[65] The Dept. of Health (1984) however have looked at mortality amongst children and socio-economic group.

groups, in the absence of data, we assume the same relative differential as men in Ireland. This age-occupational group differentiation can be applied to trends and forecasts in average mortality rates to produce differential mortality rates for different years.

Fertility

Traditionally Ireland has been characterised by quite a high fertility rate by European standards. In 1960, the total fertility rate (TFR), a measure of the average number of children per women in Ireland was about 4 compared with a European Average of less than 3. In the last number of decades, like in most other countries, the birth rate has fallen. Ireland has been no exception, as witnessed by Figure 4, the crude birth rate over the century. This decline was clearly evident from 1980-1995. Birth rates are now close to European averages, thus this 15 year period witnessed a huge transformation in fertility behaviour. The trend in the end of the nineties however was reversed as the number of women of child-bearing age increased and as families who had delayed having children during the earlier recession started to have children and thus the birth rate increased.

In designing a model of fertility, there are a number of characteristics we would like to include. Firstly despite rising number of births outside marriage, fertility is still highly related to marital status. Age is also an important determinant. Table 4, describes the age specific fertility rates for married and unmarried women. For married women the peak fertility occurs in the 25-29 age group and for unmarried women in the 20-24 age group. Other demographic factors that influence fertility include the number of previous children, duration since last birth and the duration of marriage. Unfortunately detailed information is not available for Ireland to incorporate all these characteristics. Although the number of births is reported by age and duration of marriage, the corresponding population totals of women with these characteristics are not available. However by carrying out an iterative simulation procedure, it was possible to find relative fertility rates which would produce the distribution of births by parity using the age specific fertility rates reported in table 4. In order to approximately hit the control targets it would be necessary for married women without children to have 0.55 of the average age specific fertility rate and other married women to have twice the rate. Pregnancies are more likely to result in male children, with just over half of all children being born as boys.

Becker (1960) argued that the fertility decision should be viewed as an economic one, where the costs of having a child include foregone earnings due to caring for the child. Di Tommaso et al. (2000) in summarising the literature highlight that fertility and labour participation are lifetime utility maximising processes and as a result should be estimated jointly. Empirically, census reports in the USA have shown that families with higher incomes have less children. Also, higher social groups and those with higher education levels have been found to have less children. Klevmarken and Olovsson (1996) found that in Sweden the wage rate had a negative effect on fertility and that women who have long periods in schooling typically postpone having children, but then have a second child shortly later. Di Tommaso et al. found in an endogenous model of labour supply and fertility, that the participation and fertility decisions were negatively correlated, so that those with children were less likely to work. Hannan and Ó'Riain (1993) found that poorly educated women with poorly educated parents had high chances of having children at a young age.

In Ireland, there exist some limited life event history data in the *Living in Ireland Survey*, however the sample size is small to look at fertility issues in detail. Also another problem related to using cross-sectional survey information is disentangling the period effects. Due to the rapid fall in fertility in recent times, most births in the survey will have occurred during periods of higher fertility. For this reason I have chosen to rely chiefly on recent administrative statistics, using the survey only for supplementary information on the variation of fertility by education level. Table 5 describes the relative probability of having children by education level. We notice that women with lower education levels are less likely to have children. For married women, this feature is less strong. These results confirm the findings of Hannan and Ó'Riain. Instead however, it is the number of children rather than actually having children which is important. Here we see that more educated married women are in general less likely to have more than two children than less educated women.

Family Formation and Dissolution

There are a number of processes under the heading of family formation and dissolution. These include marriage, divorce and separation, cohabitation and dehabitation, remarriage and widowhood.

Marriage rates in Ireland have tended to be low. Table 6 describes this trend. Starting from a very low base, marriage gradually rose from a low of 4.8 marriages per 1000 in the 1920's to a high of 7.5 in 1973. Since then marriage rates have fallen. Part of the reason for this low marriage rate has been on average very late marriage ages. For example, the average age for males at marriage in the 1920's was 35 and 29 for women. As in other European countries, although at a later state, this rate has fallen over the decades, before rising again during the 1980's and 1990's. Nevertheless the average rate of marriage is higher than average, still remaining about 2 years higher than the average in England (Coleman, 1992).

Like the other demographic phenomena, modelling marriage in Ireland is beset by data problems. Published information exist for age and gender specific marital status as outlined in table 7. Marriage rates for both men and women are bell-shaped with concentrations around the modal age group 25-30. For women however, higher marriage rates tend to be skewed towards lower age groups as a result of the lower average age. Economic and social factors also play a role in marriage rates. Economic pressures were some of the main reasons for the previously mentioned low marital rates in Ireland. Kennedy (1989) argued that the trend in Irish marriage rates have tended to follow economic circumstances, that marriage rates increased during the 1960's and 1970's during the economic expansion of the period and fell back again during the recession of the 1980's. Meenan (1970) noted that the possession of land in rural areas strongly influenced the chances of marriage. Lack of land resulted in a situation whereby people either did not marry or migrated. Walsh (1970) in a study of inter-county marriage rates in Ireland found that marriage rates were positively related to the income per head of the county and to labour force participation rates of single women in that county. Hannan and Ó'Riain (1993) found that those with lower occupational position and lower education levels were more likely to marry. Coming from larger families also was found to influence early marriage.

Marital status by occupational group are published in Ireland. Table 8 describes the situation in 1991. Those in lower socio-economic groups and from farming background were more likely to marry early, with non-manual workers and professionals in general more likely marry later. The 1994 *Living in Ireland* Survey contains information in duration of marriage and some duration variables. However, it is difficult to match labour market data to this marital information. As cross-section data, period effects also influence it. To get round these problems, we look at a sample of those who married in the 4 years before the survey was undertaken. Comparing the population who got married with population available for marriage, it was found that those in work were more likely to get married (See Table 9).

The second component of a marriage model is the matching spouses. In other words, given the population of those available for marriage, what personal characteristics result in men and women selecting each other for marriage? These issues have been the subject of research in many different disciplines from psychology to sociology to genetics to economics. Becker (1973 and 1974) argues that people marry to increase their utility and that there is a competitive process between members of the same sex to find a partner; the marriage market. In designing an empirical model of the marriage market, one is again limited by the availability of data. Very many of the personal characteristics which relate to the utility of actually marrying are not available in nationally representative datasets.

Official statistics produce information about mating characteristics only on the basis of age and occupational group. In our model we use information contained in the *Living in Ireland* Survey to estimate a model of this marriage market. Using the survey, we can observe a number of characteristics of individuals who marry each other. As mentioned above, because the survey is a cross-sectional survey, we have the problem of period effects. Age effects are captured by cross-section data. Cohort effects are less important because of the narrow range of ages over which marriage takes place. If the data-set was large enough, then we could look at those who married in the data year. This would give us access to the wide variety of information contained in the survey. Unfortunately, the sample size is too small for this purpose. Instead we take individuals who married in the period 1990-1994. This group is likely to avoid problems associated with period effects and supply a sufficient sample size for our purposes. Unfortunately looking at this group reduces the characteristics known when they married and thus cuts down on the level of complexity which can be included in the model.

The main characteristics of this model are that we take the group of people married in 1990-1994 as our population of people who wish to marry. All other people, married and unmarried are assumed to be not participating in the marriage market. Examining characteristics of actual partners versus their choice of other partners from the marriage market, we can observe preferences of people in their selection of mates. From a practical point of view, the first step to select from the sample the set of individuals who married during the period in question (448 people, 224 couples). Our objective is to examine why individuals selected their spouse rather than the other potential 223 partners. We therefore have 224 × 224 matrix of information, where the diagonal is an example of a successful match and the off diagonal values unsuccessful matches. A logit model is a suitable device for modelling a bivariate process like this. A number of variables are available concerning the characteristics of particular spouses. These include employment status at marriage, education status at marriage and parental background variables. Another observable characteristic is their earning ability. Although this is only available for 1994, it can be used as a proxy for ability. Table 10 details the estimated coefficients of our marriage market. The first component looks at difference in age at marriage and the square of this variable. The combination of the two variables produces a preference curve as outlined in table 7, where the maximum preference occurs when the male is about 2 years older than the female. The difference in the number of years of education achieved is a proxy for many characteristics, including personal affinity and similarity of background. The coefficient is significantly negative indicating that people prefer partners with similar characteristics. Education difference and differences in the educational attainment of parents were not found to be significant determinants. Inclusion of the male's education level was found to be positively significant. Thus the higher education level of the male, the greater the preference for marriage. The next category of variables relates to the labour market position of the partners. In this case, an out of work person is more likely to have an out of work person as a spouse. This may not necessarily be their preference, but may be more to do with competitive component of the marriage market. Meanwhile, in-work persons are more likely to select an in work person as a spouse. Also given the age preference, females have higher preferences for males with higher employment histories. Lastly, we look at the squared difference in current market incomes, 0-4 years after marriage. The coefficient is significantly negative indicating that the greater the difference in income, the less likely are two people to marry. Utilising Becker's theory although individuals may prefer to marry to increase their utility and thus marry people with higher incomes, this is counterbalanced by the competitive nature of the market and thus people will end up marrying individuals with similar income capabilities.

The other family formation and dissolution phenomena are widowhood, remarriage, separation and cohabitation. Before 1997, there was no divorce in Ireland. The first, widowhood is an indirect component of the dynamic model, depending on the mortality rate of spouses. The remaining categories however have very limited information available. The only data available is on the stock of people with these marital statuses rather than flows necessary for our dynamic model. We therefore impute a series of plausible flows which could produce the stock information contained in the data. As we have discovered for other demographic characteristics, the use of cross-section information results in period effects. Marriage dissolution has been very uncommon for older generations and thus the numbers in the data who are separated is very low. Likewise remarriage rates were low. We therefore make educated guesses for the older age groups. In the case of cohabitation rates, very little study has taken place in Ireland. In order to construct the flows, we assume that cohabitation lasts 5 years and that half of the cohabitees marry. Table 11 describes the results for women. We assume that female rates drive the three phenomena. Although the rates of cohabitation increase with age, the numbers actually fall because the denominator falls faster.

Migration

Emigration in the past has been one of the defining components of population change in Ireland, resulting in large populations of people with Irish antescendents around the world, and a resulting fall in the population of the island in 1960 to half what it was before the *Irish Famine* in the 1840's. However migration is not constant being typically related to economic circumstance in Ireland, but also importantly in Britain, the principle destination in recent times of Irish migration. The most recent period of high emigration was in the late 1980's during a period of economic recession. However despite the poor economic state in the early 1990´s this trend slowed down substantially as a result of large numbers returning to Ireland during the UK´s economic slowdown. Because of the high variability in the migration rate Irish population projections have tended to be very poor. As recently as 1996, the Central Statistics Office forecasted net emigration net per annum during the period 1996-2006. However these figures were very far out. Punch and Finneran (1999) in examining more recent trends found that rather than net emigration, there has been significant net immigration for the period 1995-1998. As a result of this variability, we assume a constant migration rate of zero in this model.

Leaving Home and forming a new Household

Leaving home decisions are important as they determine the requirement of additional housing and have impacts on the way individuals are treated within the benefit system. Simulating leaving home decisions requires panel data recording this transition and the specification of a statistical model. In the absence of such data, we have chosen not to model this decision. Instead we assume that people leave home on completion of full-time education. This has implications for modelling Unemployment Assistance for individuals who might be living with their parents. UA also depends on the net income of the claimants parents if living at home. This is however a relatively minor aspect of the tax/benefit system. Other implications of this assumption are however more significant; the treatment of state housing expenditures, whether through subsidised state housing, rent assistance or help with mortgage through the tax system. However again as we do not consider housing costs, this problem can be postponed for now.

Location Mobility

Location is another important issue determining lifestyle choices and income. For example, in the 1987 ESRI survey earnings were 45 per cent higher in the Dublin, the Capital City and its suburbs than the rest of the country. Unemployment Rates are also different as will labour force statuses. Hannan and O'Riain (1993) carried out some work on migration patterns between 1982 and 1987 using the School Leavers Cohort Study. Migration tended to be higher amongst those with higher education levels and amongst those from more remote regions. However the study occurred during a period of widespread emigration; Over 20 per cent of respondents, regardless of original area emigrated in the 5 years after school. In addition about 15 per cent of respondents in the 5 years after school migrated within Ireland, mainly to Dublin. However there is little other information about internal migration patterns within the country. In the absence of panel data outlining movements within regions, we are faced with a number of choices. (1) Assume no regional dimension, (2) assume an initial regional pattern with no subsequent movement or (3) Attempt to model transitions using very limited data. For now choice 1 is assumed.

Disability

An individual's disability status affects a number of other processes in a dynamic model and therefore needs to be modelled implicitly in the model. Disability is likely to lead to longer periods outside the labour market and as a result lead to lower human capital levels and thus lower wages. Also disability status is required to receive certain disability benefits and are also likely to result in higher state health expenditures. In some cases the fact that someone is classified as disabled does not mean that they are incapable of work. During recent years in many European countries, the numbers in receipt of disability benefits rose dramatically (See Blondal and Pearson, 1995). This is despite no diminishing in the qualifications needed for these benefits. As one can rule out an increase in illness levels across the population, this would tend to indicate that increased numbers of disabled actually indicates a discouraged worker effect. Ideally therefore one should attempt to model the economic incentives of becoming disabled. Relevant variables may include local labour market conditions and the cost of being disabled (the loss of income). Another relevant incentive is the decision to declare oneself as disabled to the authorities rather than claim unemployment benefits. This will depend on the relative level of benefits and the strictness of work tests employed by the unemployment benefits authority. In addition in a similar way to the numbers declaring themselves as unemployed, chronic illness is likely to be under-reported in data for spouses of people who are either working or receiving benefit as in real life it has no impact on their income position. Klevmarken and Olovsson (1996) found that the marginal income loss due to sickness loss of short-term illness was negatively related to the duration of sickness. However given the small sample size available in this study, the lack of a panel element and the low numbers of disabled in the data, we ignore economic incentives.

A number of sources are used to produce a disability status variable. Firstly, we include those who have declared themselves ill in the employment status variable and secondly we can identify those who are receiving disability benefits in the data. Disability status can be divided into long term and short term on the basis of the length of time in current status and on the basis of the type of benefit received. Although information is contained in the data, for disability status in both the current month and 12 months previously, not enough transitions occur due to the small sample size to adequately simulate disability transitions in detail. We therefore utilise the cross-section information contained in the dataset. We can use the longitudinal information to look at aggregate recovery rates, which we find to be 5.4% per annum and transitions between short term and long-term disability 3.7%. For other transitions into states of disability, we generate a transition matrix which takes account of recovery rates to generate the cross-sectional distribution of disabled by education status and age. These transitions are described in table 12.

6.4. Educational Attainment

We now discuss behaviour that relates to educational attainment. The model of educational attainment at present does not take into consideration any economic incentives of staying in education. As wages are likely to be higher for those who chose to stay on education longer, individuals must weigh up the future benefits of staying in education against the cost of not earning during this period. Other factors that may influence this decision include the condition of the labour market at the time. During periods of high unemployment, individuals may prefer to undertake further education than be unemployed. Klevmarken and Olovsson (1996) found however for Sweden that labour market conditions were not an important determinant. Recent studies for Ireland indicate however a degree of qualification inflation which would tend to indicate that this hypothesis is true (See Hannan et al, 1998). Again however, a model of this sophistication is beyond the scope of this study. Instead the model of educational attainment is a purely a probabilistic model, which models the probability of continuing through the education system on the basis of recent trends.

For each year of education, the probability of repeating, continuing, dropping out or returning is simulated. Entry to third level education has been modelled as has the successful completion. Different categories of third level education are modelled, including university and regional technical college, full-time and part-time and degree subject.

Only the public education system is modelled as the private system currently plays only an insignificant role. The Irish educational system is divided into three levels, primary, secondary and tertiary. There is currently no state provision for pre-school. Education is compulsory for children between the years of 5 and 15.

Primary Level

Primary school is sub-divided into two types of schooling, the infant cycle which comprises the first two or three years, followed by the six grades of primary cycle proper. Table 14 outlines the probability of a child of a particular age starting school. We notice that very few children start at age 3, with 55% of 4 year olds who have not already started school starting at age 4 and with the remainder starting at 5. As most children progress through school year by year, until the end of lower secondary education, we only focus on the proportion who repeat each year, reported in Table 15, with about 2% of children repeating each year.

Secondary Level

Second level schooling consists of 3 years of compulsory education and 2 or 3 years of post compulsory education. As there is no data on repeating years, each student is assumed to continue until the end of third year that corresponds with the end of compulsory schooling. The student then has three choices. They can leave school, go on to Leaving Certificate (LC1), take an applied course (SC1), a vocational course (VPT1) or take a transition year. Table 16 describes the transition probabilities for Males and Females moving from lower secondary (Junior 3) to Upper Secondary. For males, more than half go straight into Leaving Certificate studies, with over a quarter taking a transition year and 6.5% taking other courses and about 7% leaving school. As no data exists, we assume that most transition year students continue directly into Leaving Certificate 1 with a 7% drop-out rate, the same as from Lower Secondary to Upper Secondary. A greater proportion of females (35%) go into the transition year. Less drop out at this stage however.

Hannan and O'Riain (1993) examined the relationship between family background and the likelihood of continuing to post-compulsory education. They found that father's occupational class and mother's education level were very significant contributory factors to educational attainment. Coming from a farming background was also an important determinant. Although we do not consider the division between different types of schooling here, they found that students in vocational schooling whether through selection or allocation tended to drop out earlier. Examining the micro-data available to us in the *Living in Ireland Survey*, we found a similar relationship, with the children of higher educated parents being much more likely to continue past post-compulsory education (See table 16). As one of the primary determinants of future life chances, incorporating socio-economic factors in the staying on decision has the potential to use education as a vehicle for modelling intergenerational mobility. From a policy perspective it also lends support to the argument to target more resources at those from less educated backgrounds to try to break these cycles.

Virtually all students who start the Leaving Certificate cycle continue onto the second year. Lower proportions continue onto the second year of the vocational and applied courses. Those who finish their leaving certificate (LC2) have the option of going on to third level repeating their leaving certificate or going into the labour market or other non labour market statuses such as non-working lone parent or disabled etc. About 15%

repeat the exam, while 11% of males and 30% of females undertake further second level vocational courses.

Third Level

There are two levels of third level simulated here, regional technical colleges and university. The data available for the university sector is better, with detailed data on numbers entering by socio-economic group (SEG), age and subject undertaken and also numbers completing their degrees. University sector transitions shall be considered first. Data are published on the numbers entering university for the first time as full-time undergraduates by age, sex and SEG. By assuming a constant age distribution of new entrants by socio-economic group, a table of new entrants by age by sex by SEG can be constructed. The equivalent numbers of people in the population as a whole are known, so that the conditional probabilities can found of attending University as a full-time undergraduate given age, sex and occupational background can be found. Table 18 details the probability of entering University for those who have finished their leaving certificate, and for those who have not already entered University. We assume due to data constraints that individuals do not take two undergraduate degrees. Once a student enters University, the subject undertaken is decided upon by using the distribution of students entering as full-time undergraduates for the first time. Data are published on probability of being awarded a degree at the end a course by subject. Only those who actually graduate from their degree can be considered for moving on to post-graduate.

Tables and Figures

Table 6.1. Summary Statistics

Variable	Male	Female
Number of Observations	5190	5141
Employment Income	578.71	251.86
Investment Income	8.36	2.97
Irregular Income	0.05	0.05
Maintanence Income	2.35	12.79
Maternity Income	0.00	0.97
Other Income	8.43	3.47
Pension Controbutions	20.14	6.12
Property Income Income	6.56	2.24
Private Pension	18.55	6.66
Private Transfers	1.07	0.53
Self-Employment Income	180.02	13.74
Primary Educated	0.11	0.11
Lower Secondary Educated	0.34	0.31
Upper Secondary Educated	0.23	0.31
University Educated	0.13	0.11
Years in Education	11.02	11.20
Retired	0.15	0.06
In work	0.59	0.31
In work, last period	0.55	0.27
Non-agricultural self-employed	0.08	0.02
Non-agricultural self-employed, last period	0.07	0.02
Farmer	0.07	0.003
Farmer, last period	0.07	0.003
Employee	0.44	0.29
Employee, last period	0.41	0.25
Early Retirement	0.04	0.01

Long Term Disabled	0.04	0.03
Short Term Disabled	0.01	0.01
Works Part-time	0.02	0.05
Unemployed	0.17	0.06
Manager	0.17	0.07
Average Hours	16.78	9.11 ?
Agricultural Worker	0.11	0.01
Higher Professional	0.07	0.09
Lower Professionals	0.06	0.06
Employers & Managers	0.09	0.03
Salaried Employees	0.05	0.16
Non-manual wage earners white collar	0.07	0.19
Skilled manual workers	0.14	0.03
Semi-skilled manual workers	0.11	0.10
Unskilled manual workers	0.16	0.13
Unknown Occupation	0.14	0.21
Member of a privat pension scheme	0.28	0.12
Public sector worker	0.85	0.91 ?
Has Property Income	0.02	0.01
Has Investment Income	0.21	0.13
Father primary educated	0.79	0.79
Father lower secondary educated	0.10	0.10
Father upper seconddary educated	0.058	0.057
Father other tertiary educated	0.021	0.018
Father university (undergraduate) educated	0.021	0.023
Father university (postgraduate) educated	0.016	0.017
Number of children	1.18	1.33
Years worked	21.41	10.82
Years Unemployed	1.95	0.91
Years Ill	1.00	0.80
Years Home Duties	0.51	14.96

Years Retired	1.69	0.96

Source: *Living in Ireland Survey*, 1994.

Table 6.2. Life Expectancy at Birth 1950-1992

Country	1950	1992	1950	1992
	Women		Men	
France	69.7	81.4	63.9	73.2
Germany	68.3	79.1	64.4	72.6
Ireland	67.1	77.9	64.5	72.3
Italy	67.9	80.3	64.3	73.6
Japan	60.8	81.7	57.5	79.9
Spain	64.3	80.5	59.8	73.3
Switzerland	71.3	81.3	66.9	74.5
UK	71.3	81.3	66.9	74.5

Source: Kessler, (1995), CSO (1995).

Table 6.3. Age specific death rates by socio-economic groups for men age 15-65, 1991.

Age	15	20	25	35	45	55	All
Farmers	0.42	1.25	1.81	1.41	5.65	14.82	5.96
Farm Labourers	2.11	1.20	1.26	3.09	4.57	15.17	4.92
Higher Professional	0.00	0.18	0.28	0.84	3.47	12.77	2.42
Lower Professionals	1.50	1.52	0.46	1.39	5.30	13.95	2.42
Employers & Managers	2.41	0.62	0.49	1.25	4.50	11.65	3.15
Salaried Employees	1.23	0.92	0.58	1.50	3.57	15.18	3.29
Non-manual wage earners white collar	0.86	1.07	1.07	2.39	7.78	20.23	3.99
non-manual wage earners other	1.74	1.76	1.19	2.03	6.18	20.13	5.06
skilled manual workers	0.77	1.05	0.69	1.87	6.21	18.70	3.35
Semi-skilled manual workers	1.72	1.61	1.08	3.01	7.19	22.10	4.89
Unskilled manual workers	2.26	1.81	1.50	3.42	10.69	31.59	8.05
Unknown	3.77	2.78	6.83	6.76	13.37	25.94	11.80
Total	1.26	1.33	1.08	2.14	6.62	18.91	4.91

Source: Nolan 1990.

Table 6.4. Age Specific Fertility Rates 1991

Age Group	Married	Unmarried
16– 19	0.00244	0.02126
20 – 24	0.041425	0.056791
25 – 29	0.129422	0.051133
30 – 34	0.11871	0.041902
35 – 39	0.058809	0.030258
40 – 44	0.01426	0.009464
45 –	0.001039	0.000119

Source: CSO Statistical Bulletin 1992.

Table 6.5. Relative Fertility Rates by Education Level (Ratio of Fertility Rate to Average Rate)

Education Level	3+ children, Married	1+ Children, Unmarried
None	6.937	3.887
Primary	8.682	3.704
Lower Secondary	4.497	0.874
Upper Secondary	0.272	2.119
Tertiary	0.524	0.206
Average	1.000	1.000

Source: Living in Ireland Survey, 1994.

Table 6.6. Marriage rate and age at marriage1921-1985

Year	Marriage Rate per 1000	Average Age at Marriage, Male	Average Age at Marriage, Female
1921-30	4.8	34.9	29.1
1931-40	4.9		
1941-50	5.6	33.1	28.0
1951-60	5.4	31.3	27.3
1961-70	6.0	29.2	26.0
1971-80	6.8	27.3	24.5
1985	5.2	27.5	25.4
1990	5.1	28.0	25.9

Source Kennedy (19889) and Author's Calculations from Register Information

Table 6.7. Age Specific Marriage Rate 1991.

Age	Female	Male
15	3.7	1.1
20	59.9	33.0
25	139.4	118.7
30	78.2	91.4
35	36.5	44.6
40	14.0	19.0
45	9.3	9.8
50	5.6	5.1
55	2.9	3.8

Source: CSO Statistical Bulletin, Vital Statistics.

Table 6.8. Relative Marriage Rates by Occupational Group

Age-group	15	20	25	30	35	40
Male						
Farmers	2.12	0.92	0.85	0.92	0.98	1.37
Other Agricultural	2.90	0.70	0.46	0.48	0.44	0.59
Higher Professional	0.00	0.84	1.24	1.65	1.84	1.57
Lower Professional	0.00	0.87	0.88	1.23	1.77	2.19
Employers and Managers	5.17	2.24	1.67	1.86	2.39	2.78
Salaried Employees	0.00	0.78	1.05	1.50	1.99	1.13
Inter. non-manual	1.40	0.89	1.05	0.97	1.14	1.13
Other non-manual	2.72	1.24	0.83	0.78	0.85	0.78
Skilled manual	2.62	1.79	1.61	1.56	1.36	1.49
Semi-skilled	1.94	0.97	0.60	0.52	0.48	0.45
Unskilled	1.94	0.97	0.60	0.52	0.48	0.45
Unknown	11.29	1.55	0.64	0.64	0.62	0.49
Female						
Farmers	0.02	0.34	0.66	0.06	0.24	1.00
Other Agricultural	0.52	0.53	0.24	0.09	0.21	0.00
Higher Professional	0.06	0.49	1.03	1.19	0.78	0.22
Lower Professional	0.33	0.92	1.25	4.55	1.43	0.88
Employers and Managers	0.10	0.89	1.02	1.35	0.81	1.15
Salaried Employees	0.00	0.54	0.93	0.74	2.04	1.97
Inter. Non-manual	1.16	1.07	1.07	3.49	1.04	0.96
Other non-manual	1.36	1.15	1.03	1.31	1.33	2.74
Skilled manual	0.29	1.21	1.44	0.21	0.94	1.04
Semi-skilled	1.05	1.11	0.76	0.48	0.50	0.84
Unskilled	1.05	1.11	0.76	0.48	0.50	0.84
Unknown	3.29	0.87	0.62	0.58	0.91	0.51

Source: CSO Statistical Bulletin.

Table 6.9. Employment Rate by Marital Status (Employment Rate in year of marriage as a proportion of Average Employment Rate for those eligible for marriage).

Age	Female	Male
Did Not Marry	0.929	0.967
Did Marry	1.227	1.091

Source: Authors Calculations

Table 6.10. Logit Model of Assortative Mating

Variable	Coefficient	Std. Dev.
Age Difference (Male – Female)	0.085	0.024
Age Difference^2	-0.019	0.003
Years in Education difference^2	-0.034	0.036
Years in Education (Male)	0.072	0.036
Female in Work	-2.133	0.520
Male in Work	-2.061	0.409
Both in Work	2.071	0.565
Years in Employment(Male)	0.038	0.020
Market Income difference^2/10000	-0.0012	0.0006
Constant	-3.443	0.363

Source: Author's Calculations based on *Living in Ireland Survey*, 1994..

Table 6.11. Separation Rate, Remarriage Rate and Cohabitation Rate

Age Group	Separation Rate	Remarriage Rate	Cohabitation Rate
15	0.47	1.68	1.39
20	0.71	0.42	3.86
25	0.66	0.66	6.34
30	0.45	0.71	12.03
35	0.22	0.46	10.34
40	0.04	0.21	5.28
45	0.04	0.21	8.40
50	0.04	0.11	8.47

Source: Author's Calculations based on *Living in Ireland Survey*, 1994..

Note: The denominator for separation rate is the number of people married, for the remarriage rate the number of people widowed and separated and for the cohabitation rate the number of single people.

Table 6.12. Proportion of Entering disability

	Male				Female			
Age Group	Primary	Lower Second.	Upper Second.	Tertiary	Primary	Lower Second.	Upper Second	Tertiary
Short Term								
25	0.003	0.003	0.010	0.010	0.009	0.009	0.006	0.006
30	0.008	0.008	0.000	0.000	0.018	0.018	0.020	0.020
35	0.008	0.008	0.000	0.000	0.046	0.046	0.012	0.012
40	0.017	0.017	0.000	0.000	0.025	0.025	0.006	0.006
45	0.003	0.003	0.000	0.000	0.008	0.008	0.017	0.017
50	0.020	0.020	0.000	0.000	0.005	0.005	0.000	0.000
55	0.013	0.013	0.013	0.013	0.009	0.009	0.021	0.021
60	0.036	0.036	0.017	0.017	0.007	0.007	0.000	0.000
Long Term								
20	0.002	0.002	0.000	0.000	0.014	0.002	0.001	0.001
25	0.002	0.002	0.000	0.000	0.014	0.002	0.001	0.001
30	0.002	0.002	0.000	0.000	0.000	0.001	0.000	0.001
35	0.002	0.002	0.000	0.000	0.000	0.001	0.000	0.001
40	0.008	0.001	0.007	0.001	0.000	0.001	0.000	0.001
45	0.008	0.001	0.007	0.001	0.000	0.001	0.000	0.001
50	0.018	0.021	0.005	0.001	0.001	0.001	0.001	0.000
55	0.018	0.021	0.005	0.001	0.001	0.001	0.001	0.000
60	0.018	0.021	0.005	0.001	0.001	0.001	0.001	0.000

Source: Author's Calculations based on *Living in Ireland Survey*, 1994..

Table 6.13. Proportion of Age Group starting Primary School

Age	Proportion
3	0.012
4	0.55
5	1

Source: Department of Education Statistical Report, 1994.

Table 6.14. Primary and Lower Secondary Repeat Proportions

Year Group	Boys	Girls
Infants 1	0	0
Infants 2	0.021	0.016
Class 1	0.022	0.018
Class 2	0.015	0.017
Class 3	0.015	0.015
Class 4	0.017	0.018
Class 5	0.024	0.018
Class 6	0	0
Junior 1 – Junior3	0	0

Source: Department of Education Statistical Report, 1994.

Table 6.15. Upper Secondary School Transitions

	Year t						
Year t-1	Transition	LC1	VPT1	SC1	VPT2	SC2	LC2
Male							
Junior 3	0.277	0.590	0.058	0.007	0.0	0.0	0.0
Transition	0.0	0.930	0.0	0.0	0.0	0.0	0.0
LC1	0.0	0.0	0.0	0.0	0.0	0.0	0.981
VPT1	0.0	0.0	0.0	0.0	0.784	0.0	0.0
SC1	0.0	0.0	0.0	0.0	0.0	0.784	0.0
VPT2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Female							
Junior 3	0.345	0.577	0.064	0.008	0.0	0.0	0.0
Transition	0.0	0.995	0.0	0.0	0.0	0.0	0.0
LC1	0.0	0.0	0.0	0.0	0.0	0.0	1.000
VPT1	0.0	0.0	0.0	0.0	0.862	0.0	0.0
SC1	0.0	0.0	0.0	0.0	0.0	0.862	0.0
VPT2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Department of Education Statistical Report, 1994.

Table 6.16. Relative likelihood of continuing beyond compulsory schooling by Father's education level

Father's Education Level	Male	Female
Not finished	0.805	0.886
Finished primary	0.805	0.886
Finished inter	1.277	1.175
Non-advanced secondary	1.390	1.305
Finished leaving	1.422	1.206
Finished Undergraduate	1.441	1.385
Finished Postgraduate	1.464	1.276

Source: Author's Calculations based on *Living in Ireland Survey*, 1994..

Table 6.17. Probability of Entering University if completed secondary school and not already started University/Technical College

Age	Male	Female
17	0.040	0.057
18	0.117	0.155
19	0.065	0.067
20	0.016	0.012
21	0.006	0.006
22	0.004	0.004
23	0.002	0.003
24	0.002	0.002
25-30	0.001	0.001
Technical College	0.152	0.241

Source: Higher Education Authority Statistics 1996

Table 6.18. Relative Likelihood of Entering University by Age and Parental Socio-Economic Group

	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Male														
Farmers	0.95	0.95	0.94	1.11	1.11	1.11	1.11	1.11	1.56	1.56	1.56	1.56	1.56	0.73
Ag. Workers	0.62	0.61	0.58	0.64	0.64	0.63	0.63	0.63	0.49	0.49	0.49	0.49	0.49	0.50
Higher prof.	4.33	5.04	15.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower prof.	2.52	2.70	3.47	4.62	4.91	5.02	5.09	5.14	3.73	3.73	3.73	3.73	3.73	4.75
Employers & managers	2.00	2.08	2.43	2.99	3.09	3.13	3.15	3.17	3.67	3.67	3.67	3.67	3.67	2.89
Salaried Employees	3.46	3.85	6.19	10.09	11.82	12.60	13.14	13.47	9.82	9.82	9.82	9.82	9.82	11.94
Inter. Non-manual	0.70	0.69	0.67	0.71	0.71	0.71	0.71	0.71	0.58	0.58	0.58	0.58	0.58	0.90
Other non-manual	0.37	0.36	0.33	0.33	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.33
Skilled manual	0.54	0.53	0.50	0.49	0.48	0.48	0.48	0.48	0.44	0.44	0.44	0.44	0.44	0.57
Semi-skilled manual	0.38	0.37	0.34	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.57
Unskilled Manual	0.13	0.13	0.11	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.20	0.19
Unknown	2.21	2.33	2.83	3.24	3.36	3.40	3.43	3.45	8.82	8.82	8.82	8.82	8.82	8.02
Female														
Farmers	1.28	1.30	1.37	1.68	1.69	1.70	1.70	1.71	8.73	8.73	8.73	8.73	8.73	1.64

Ag. Workers	0.85	0.84	0.81	0.96	0.96	0.96	0.96	0.96	1.21	1.21	1.21	1.21	1.21	0.99
Higher professional	3.90	4.73	15.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower professional	2.14	2.29	3.01	4.18	4.35	4.44	4.50	4.54	1.78	1.78	1.78	1.78	1.78	2.41
Employers & managers	1.90	2.02	2.48	3.30	3.39	3.44	3.47	3.49	4.85	4.85	4.85	4.85	4.85	3.99
Salaried Employees	3.18	3.67	7.18	15.31	18.41	20.69	22.28	23.55	35.93	35.93	35.93	35.93	35.93	32.15
Inter. non-manual	0.53	0.52	0.48	0.55	0.55	0.54	0.54	0.54	0.27	0.27	0.27	0.27	0.27	0.53
Other non-manual	0.29	0.28	0.25	0.28	0.28	0.28	0.28	0.28	0.33	0.33	0.33	0.33	0.33	0.33
Skilled manual	0.78	0.77	0.74	0.87	0.87	0.87	0.87	0.87	1.43	1.43	1.43	1.43	1.43	1.12
Semi-skilled manual	0.32	0.31	0.27	0.31	0.31	0.31	0.31	0.30	0.23	0.23	0.23	0.23	0.23	0.35
Unskilled Manual	0.13	0.13	0.11	0.12	0.12	0.12	0.12	0.12	0.20	0.20	0.20	0.20	0.20	0.13
Unknown	2.36	2.57	3.62	4.45	4.64	4.74	4.81	4.86	9.93	9.93	9.93	9.93	9.93	4.54

Source: Higher Education Authority Statistics 1996

Table 6.19. University Subject (Distribution, Length, Finish Probability and Post-graduate Study Proportion)

	Proportion taking subject	Length of Course	Probability of finishing degree	Probability of Doing Further Study on Completion of Undergraduate
Arts and Social Science	0.377	3	0.69	0.523
Science	0.163	3	0.75	0.659
Commerce	0.153	3	0.74	0.607
Law	0.023	3	1.00	0.67
Food	0.012	3	1.00	0.629
Engineering	0.201	4	0.84	0.556
Agriculture	0.019	4	0.99	0.7
Veterinary Science	0.008	4	0.96	0.743
Architecture	0.005	5	0.61	0.51
Medicine	0.039	6	0.85	0.743
Technical College	N/a	3[1]	0.8	0

Source: Department of Education Statistics and Patterns of First Destination of Graduates

Note: 1. 80% do 2 or more years, and 51% do 3 years.

Figure 6.1. Overview of Dynamic Processes

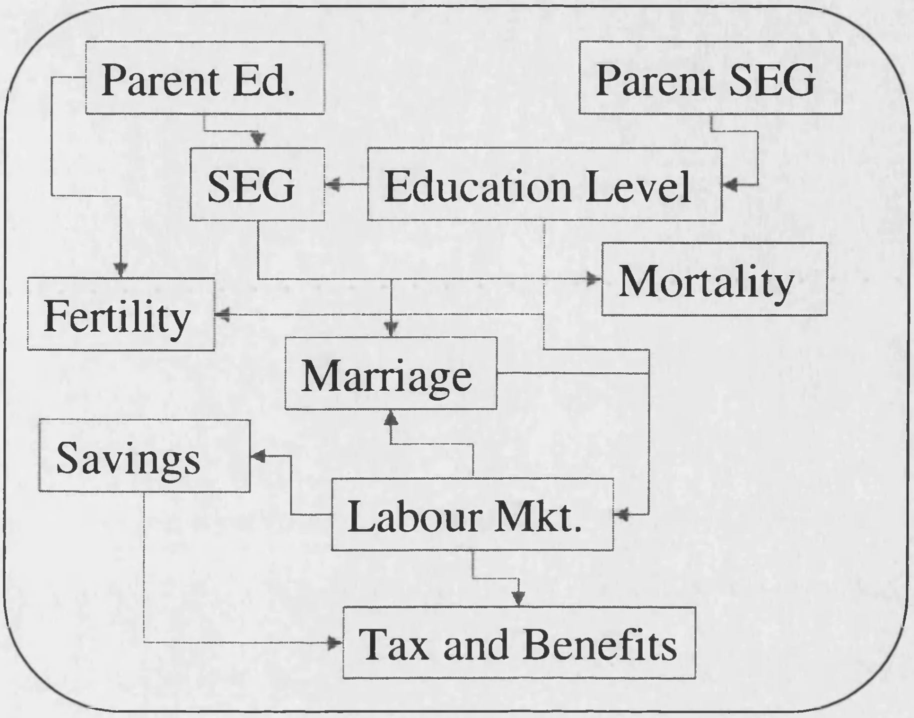
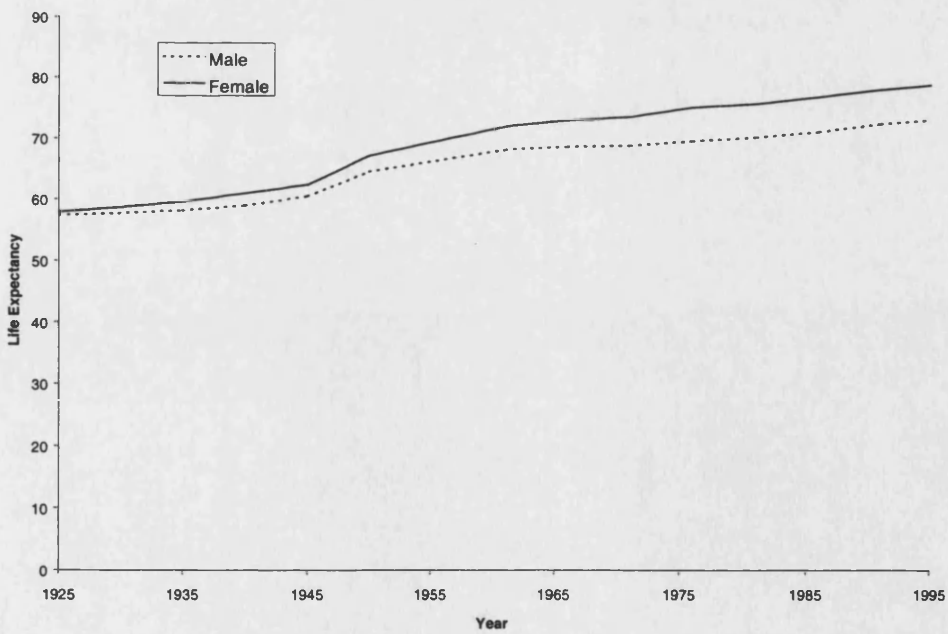
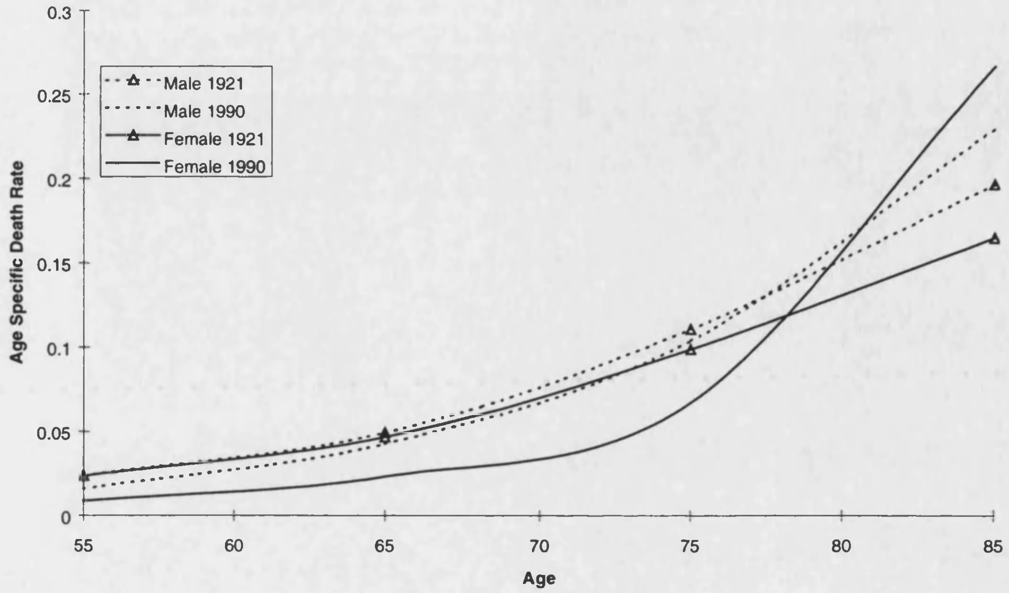


Figure 6.2. Life Expectancy 1925-1995



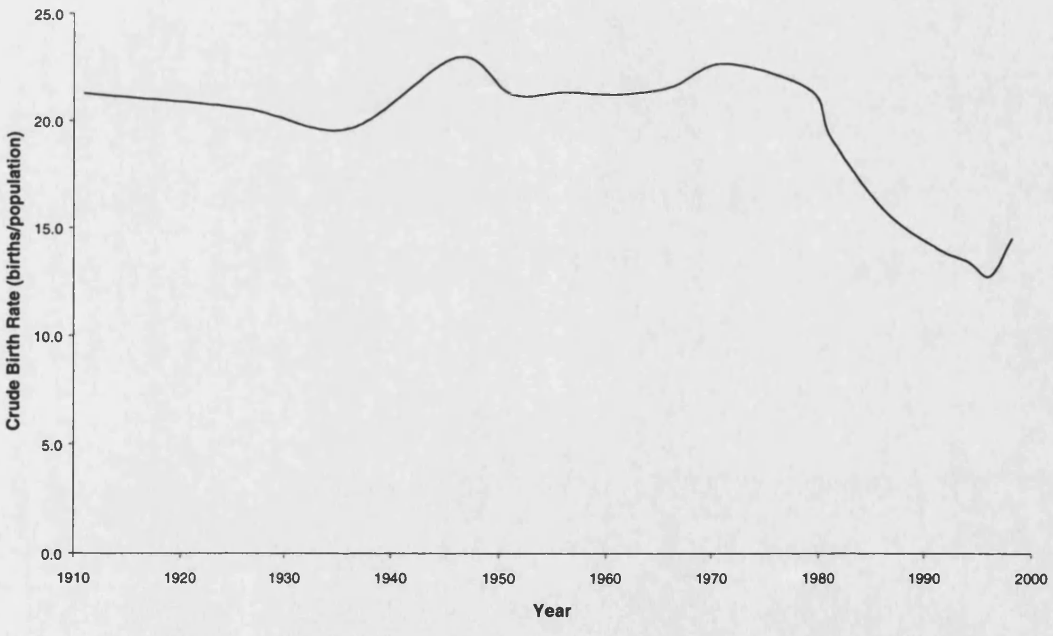
Source: CSO Statistical Bulletin Various Years

Figure 6.3. Age Specific Mortality Rates 1921 - 1990



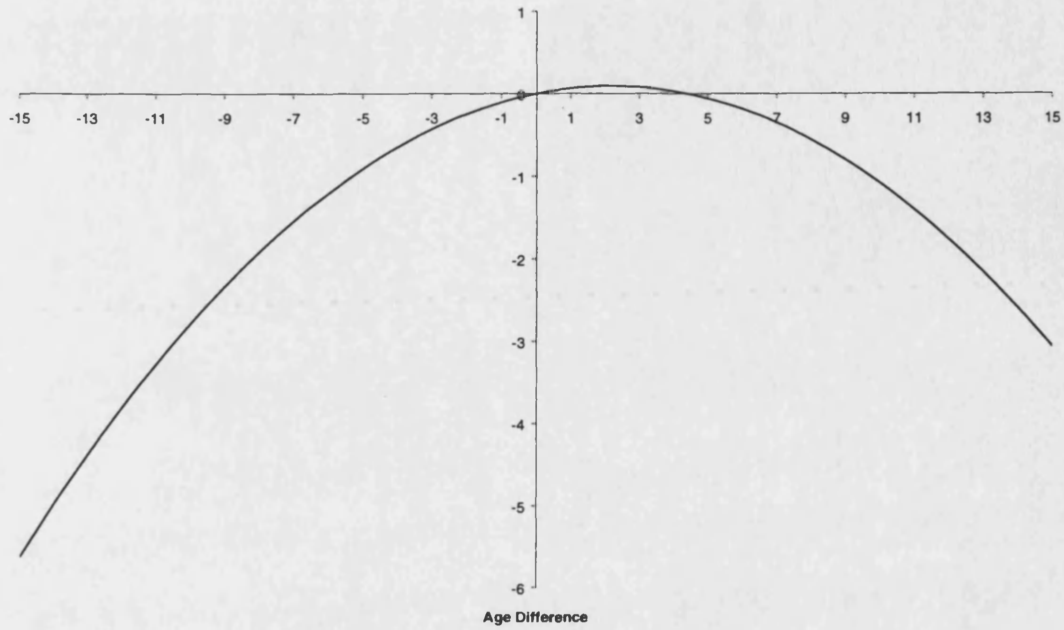
Source: CSO Statistical Bulletin Various Years

Figure 6.4. Crude Birth Rate (Number of Births per 1000 in Population 1911-1996)



Source: CSO Statistical Bulletin Various Years

Figure 6.5. Preference Curve for Age Difference at Marriage (Male – Female)



Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Chapter 7. Modelling Labour Market Behaviour and Capital Income

7.1. Introduction

This chapter describes some of the characteristics of micro-level behavioural processes relating to the simulation of labour market behaviour and capital income. Figure 1 describes the main labour market processes that are themselves hierarchical. We classify two broad states in the labour market, *working* and *not-working.* There are a number of reasons for non-participation. Firstly, we assume that those who are out of the labour market for "demographic" reasons such as disability or being in education are not eligible for work. For the remaining population (the heading "Other"), some will decide to retire. Those who do not retire can work or not. People not in work can choose to look for work or not to look for work. The latter group, because they do not seek work may not be eligible for social benefits. In-work categories are further split into part-time and full-time employment and agricultural and non-agricultural self-employment.

So far we have just considered cross-sectional dynamics, how processes influence each other at one point in time. Inter-temporal dynamics are also important. The duration in particular labour market states for example, influence the probability of remaining in that state and the probability of entering other states. Earnings are likely to be higher for those in long-term stable employment than for those who move in and out of employment frequently. This chapter attempts to describe in more detail the actual processes both from a cross-sectional and inter-temporal point of view. Section 2 describes labour market processes and section 3 income from savings.

7.2. Labour Market Processes

The labour market processes we are interested in are the transitions between in-work and out-of work, the sub-components of employment income, part-time work, self-employment, unemployment, retirement and non-participation and the incomes which result from participation.

Traditionally dynamic microsimulation models have estimated labour supply decisions by utilising transition matrices that model transitions between different states such as employment, unemployment and non-participation in the labour market. The numbers of hours worked are then simulated using statistical equations imputing an estimate of hours worked depending on characteristics such as age, education, gender, the presence of children, marital status and other socio-economic factors. However as Klevmarken (1997) points out that a *"Microsimulation Model has a relative advantage in computing...incentives from taxes and benefits"*. As some microsimulation models simulate detailed estimates of taxes and benefits, they have a strong advantage in simulating the behavioural response to changes in these policies in addition to changes in behaviour related to other socio-economic transitions. Although specifying a fully structural model of the labour market is beyond this study at the moment, and beyond the capacity of the data on which the estimation is based, it is intended to make some of the components of the model responsive to changes in the tax-benefit system.

This section is organised as follows. The principle transition driving the labour market is the decision (or opportunity) to work or not to work in a particular period. The decision to retire is described next. We assume that once someone retires, they have left the labour market for good, so therefore like education and disability, this labour market status means that individuals are ineligible to be considered for employment. As the decision to enter employment from education is different to that from other non-working states, this is modelled separately. Although most people in work are employees, self-employment is quite significant in Ireland, with over 25% of males in work being self-employed. As the treatment in the tax-benefit system is different for this group relative to employees, it is important to model this. Although part-time work is not very important in Ireland, nearly one fifth of female employees work part-time. This dynamic process is described next. The final two sections describe the models of earnings and general work characteristics such as occupation, sector and status.

Labour Market Participation: The Transition into/out of Work

The principle transitions that drive the labour market model are the decisions about whether an individual works or not. When we observe in the data, the existence of whether an individual is employed or not, we are observing the interaction between labour supply, the decision of an individual to participate in the labour market and labour demand, the labour requirements of employers. In our model, we assume, labour demand is exogenous and therefore focus instead on the employability ranking of individuals. By this we mean the likelihood, given a fixed labour demand that an individual will be employed. Thus if employers demand x% of the labour market, the top x% of individuals, ranked by their employability will be selected to work. This measure therefore combines the decision to actually participate in the first place and the desirability of the individual to employers or their ability to be entrepreneurs.

The literature describes a number of features such a model should have. From a labour supply point of view, individuals will decide to enter employment if their utility of working is higher than that of non-working. According to economic theory, individuals with higher average tax rates will choose to work more while those with higher marginal tax rates will choose to work less. As a result one produces a backward bending labour supply curve. In the presence of non-convex, non-linear budget constraints, it can be prohibitively difficult to estimate continuous labour supply models where continuous hours are the model outcome. In addition, in many countries because of institutional constraints, it is not possible to choose any number of hours of work. Typically, employees can choose only from a specific set of hours and thus distributions of hours worked per week will tend to be multi-modal rather than a continuous distribution of hours worked. As a result, recently, papers such as Van Soest et al. (1991) have estimated labour supply model with a discrete hour's choice set.

Because of the degree of income sharing within a household, the decision to enter the labour market is likely to depend to a certain extent on the decision of their spouse if they are married or cohabiting. Van Soest (1995) and Callan and Van Soest (1997) estimate labour supply models for the Netherlands and Ireland respectively, where the labour supply decision of both spouses is jointly determined.

We now focus on the dynamics of labour supply. There are a number of factors that drive movements between in work and out of work. For those in *steady* jobs, work patterns and conditions should have some time dependence. In other words, the number of hours worked and the wage rate should relate to previous years. However workers in more marginal employment are likely to have more movement between jobs. Marginal workers can be classified with longer unemployment spells, education levels and occupational groups.

The duration in work or out of work is also likely to be an important determinant on transitions. Those who have spent longer out of work are much more likely to remain out of work or become out of work, if already in work. The chances of working for someone who is already working is likely to be different quite different to someone looking for a job. Nickell (1979) outlines a number of reasons why a firm will prefer not to offer a job to an individual like this rather than offering the job at a workers marginal product. Reasons include, equity, custom, internal labour markets, union bargaining agreements, legal constraints, morale factors and difficulties in measuring individual productivity. Nickell (1979) also found a positive relationship between the replacement rate and the duration of unemployment in the UK. Narendranathan et al. (1985) found that generally the higher the income the lower the probability of leaving unemployment. This effect was strongest for younger people and for those with lower durations of unemployment. The effect lessened with age, while for those with unemployment durations of greater than six months the impact of out-of work income on exit from unemployment was not significant.

Because of the structure of the unemployment assistance system, spouses of unemployed workers are less likely to participate in the labour market. For example, Callan et al. (1998) found that between 1987 and 1994, despite a large increase in the participation rate for women, the participation rate of women married to unemployed men did not rise significantly. Doris (1998) found that in addition to the effect of the benefit system, selection characteristics are likely to play a role as well.

not in refs

The fixed costs associated with working, such as child care, transportation and job search can also create non-convexities in the budget set. As Hausman (1981) points out this can have important implications for the labour supply of women given that they usually have lower earnings, lower hours worked and more transitions out of the labour market than men.

A number of studies in Ireland have examined labour supply. Recently some studies have used the 1987 of *Survey on Income Distribution, Poverty and the Usage of State Services*. Dex et al. (1995) estimated a model of labour participation for married women in order to examine the influence on female participation rates of women married to unemployed men due to the benefits systems. They found that the presence of unemployment benefits created an negative incentive on the part of the woman to work. Own wage was found to have a positive influence on the participation decision. Unearned income unexpectedly was found to also have a positive effect. The presence of young children also had a strong negative effect on participation. Callan and van Soest (1996) developed a discrete choice model of family labour supply where not only participation is modelled, but also the numbers of hours worked per week. The labour supply model and the wage equation were estimated separately due to computational constraints. They also incorporated involuntary unemployment into the model. Callan et al. (1999) estimated a simpler model for use in a cross-country comparison, using a bivariate normal model of participation and full-time work given participation. The budget set was represented by household disposable income, the marginal effect per hour on disposable income of working part-time and the marginal effect per hour of working full-time. Like in the Dex et al. paper, the coefficients on unearned income and on the marginal effects were positive in the participation model. Thus the higher the wage, the greater the likelihood of participation, but also the higher the family income, the higher the participation rate.

In the model employed here, the (a) income and (b) substitution effect of income is taken into account through the use of (a) disposable income when working full-time (143 hours pm) and disposable income when working part-time (65 hours pm) and (b) household disposable income if the individual does not work. In order to do this, the tax-benefit system is calculated when the person is working 0, 65 and 173 hours per month. Household disposable is calculated by summing the market incomes, taxes and benefits of all individuals in the household. Net wages however are calculated by allocating family taxes and benefits between the adults in the household. Although it is desirable to jointly simulate the labour participation of men and women together, this is beyond the current study. Instead, the husband's decision is made first. He makes this decision on the basis that his wife will make the same decision in this period as she made in the previous period and receives the same wage. On the basis of the husband's decision the wife then makes her decision. Clearly this is a simplification of the fact that spouses are likely jointly decide their labour supply and therefore participation should be jointly estimated as in the case of Van Soest and Callan (1997). This is a potential direction of future development of the model. As an individual who is not in work in the data has no observed wage, we estimate a potential hourly wage for whole the sample (see below). In order to take dynamic information into account, we firstly estimate different labour supply equations for those who were in work in the previous period and those who were not in work. Lifetime durations in-work and out of work (unemployment, disability, home duties) are also used. As we do not know the cost of working, we include variables which classify the number of children aged 0-5, 6-18 in the household. The sample unfortunately is not big enough to look at lone parents

which

separately and we therefore cannot estimate the equations separately for this group. Lone parents are likely to have a different decision process as they face particular circumstances that will influence their decision to work.

The other component of the in-work model is the distinction between marginal workers with greater mobility and higher chances of unemployment. Duration information plays a part in this as do the inclusion of occupational status and education variables. In addition, in Ireland those out of work are very unlikely (7%) to ever have been members of pension schemes (Hughes and Whelan, 1996). As over 50% of workers are members of pension schemes, we can infer that individuals with jobs which have occupational pension schemes are more likely to be regular as opposed to marginal employment and thus are less likely to become unemployed. Another category that indicates regular employment is being a public sector worker, who has permanent contracts.[66] Rather than including these variables in the regression model, we include them in the alignment component of the model, thereby reducing the probability of individuals with these characteristics of becoming out of work. By this we mean that the employment chances of these individuals are driven by control totals.

Unobserved wage rates were replaced by predicted wages outlined below, without taking account of the error term. As the rho term in the Heckman selection model was not significant, we used OLS to estimate the wage equation. A tax-benefit model (see Immervoll and O'Donoghue, 2001) was used to estimate the resulting disposable incomes of individuals receiving these wage rates at 0, 18 and 40 hours per week, ? holding the rest of the household constant.

This model of labour supply was found however not to sufficiently model inter temporal mobility. Although predicted average years in work were reasonable, too many people spent a proportion of their career out of work. This is because of the fact that the panel data used to estimate inter-temporal labour supply covers only two years. It would be preferable to utilise data with more waves. Although, at present such data is not available to the author, it is hoped in the future to utilise other waves of the *European Community Household Panel* (presently 7 waves have been collected). Therefore we have to use cruder method to prevent too much mobility. To do this, we identify a group of people who do not spend any part of their working lives out of work. This model was

[66] An example of the permanence of these jobs is that public sector workers have a special category of social insurance contributions which does not cover workers for unemployment.

estimated by utilising duration data contained in the LII survey. We generated a binary variable for those who never spent any time out of work. We found that for men regardless of age, the proportion of those who worked their entire lifetime until retirement was reasonably constant when disaggregated by education level with about 80% of graduates and 50-55% never having a spell out of work. For women however the proportion of women who never had a spell out of work drops significantly as one moves from young women to older women. Much of the reason for this trend is that labour force participation rates for women have risen rapidly over time. As a result rather it is more appropriate to utilise rates for women under 35. Here we use a logit model based on education level, occupation, parental education and employment sector to estimate the probability of working an entire career. Alignment is based on aggregate rates decomposed by education level according to the rates for men aged 55+ and for women aged under 35.

Table 1 describes the logit model of the probability of an individual working in a year. Four equations are described, for males and females and whether they worked in the previous period or not. It would have been desirable to include a single parent equation, but the number of cases was too small. These models have been estimated on the set of individuals who did not work their entire career. Except for men who worked the previous year, the effect of unearned income was negative for all equation types, while the marginal income effect of working had a positive effect on the probability of working. In most cases the occupation status other than the base status of unknown are more likely to become or stay out of work. Likewise higher educational attainments result in higher in-work probabilities. However for men who were in work in the previous period, occupations and education statuses which indicate higher human capital stocks have negative coefficients. This is not because these groups are more likely to become out of work if already in-work. Rather these groups are likely to have higher disposable income if in work and thus confounding the coefficients of the human capital variables. Periods spent in work are likely to result in higher probabilities of staying/remaining in work, while periods spent out of work result in lower probabilities. Exceptions include the years of work for men who were out of work last year. This would seem to go against labour market theory. However if one examines these individuals one will see that men out of work of working age can be classified into two groups. The first group is in marginal employment and move in and out of work regularly. The second group will have worked for a long period as regular workers and then have left the labour market for good for reasons such as redundancy or early retirement or illness. These would seem to be the bigger group as the average years worked for those who were out of work last year and this year is higher than for those who were out of work last year and in work this year.

Turning to family influences, except for men in work in the previous period, the presence of children below school going age has a significantly negative impact on participation. Also being a female lone parent or married person reduces the probability. For those in work the previous period, the presence of an out of work spouse has a positive effect on working this period. The effect is mixed however for people out of work the previous period.

The equations described in table 1 are used to produce employability rankings. Labour demand is determined exogenously through the alignment mechanism. Table 2 describes the labour demand for individuals of different types. Labour demand is described by age, gender and previous employment status. Therefore 88.9 per cent of male third level graduates in their twenties who worked in the previous year will work in the current year. This increases to over 95 per cent for ages up to 60. While there is not much of an education differential for those who were in work in the previous year for men, it is much stronger for those who did not work in the previous year, where out of work University graduates are much more likely to find work than those with lower qualifications. The education differential is greater for women than for men. However the employment rates for women who worked in the previous year is not that much less than for males for all age groups. The employment rate for women who did not work is much lower. As a result once women leave the labour market, they are much less likely to return.

Retirement and Early Retirement

Labour force participation rates for men in the 50-65 age-band has fallen a great deal over the past decades. This has been a trend in many countries, as described by Tanner (1998) for the UK and Hurd (1990) for the USA. The literature attributes the decision to retire to various reasons. Unsurprisingly, those with the means to do so, in terms of personal wealth or access to other income streams such as benefits and occupational pensions, tend to retire earlier. Hurd (1990) describes a number of studies for the USA which found that those with occupational pensions were more likely to retire earlier. Available research however is not strong enough to explain the large drop in participation over the last number of decades. Tanner (1998) finds similar results for the UK, that although those with occupational pensions were more likely to retire, changes in the coverage of occupational pensions between the late 1980's and the mid-1990's did not have a corresponding effect on the retirement age. In terms of non-monetary factors, Tanner found that health status and unemployment were major determinants of retirement decisions. In Ireland, Whelan and Whelan (1988) also found that health and redundancy were important factors, especially for lower socio-economic groups.

A detailed analysis of retirement behaviour is beyond the scope of this analysis, so in this model, we use a relatively simple process. Examining the *Living in Ireland Survey,* we also find that occupational pension scheme membership results in a higher probability of early retirement, with 28% of people between 55 and 64 retired as compared with 10% of non scheme members. Examining transitions however must be done with caution as the numbers of transitions into retirement in the data, is very small in data. *A priori* there are a number of potential types of persons in Ireland who early retire. Firstly there are those who become disabled and give up work for good. In this model, they are classified in two separate categories, those with and without occupational pension rights. We assume that those who have pension rights will not return to employment. Nextly, there are those who are long term unemployed who give seeking work in middle age, opting instead for early retirement. The existence of a pre-retirement allowance means that those who are not pension members can retire early and receive an income. Of those in this category, 10% take early retirement. The last group we consider in this analysis are members of pension schemes who choose to retire neither on health or unemployment grounds. We find that 12.5% of men and 10.3% of women choose this option per annum. Clearly further work is necessary in this and it would be interesting to develop an econometric model of the decisions. It may however be necessary to wait until more waves of data are available to do this. Although, it is also possible to retire later than the retirement age at 66, we ignore this issue for the time being.

Transition from Education

Modelling transitions from third level education to other states is done separately to the rest of the population. Individuals moving from education should be treated separately from other types of out of work, as they are much more likely to enter the labour market. There are a number of sources of information on labour market transitions for education leaves. Breen, (1984) utilising the National Manpower Service *Survey of*

School Leavers for 1980-1982, found that school leavers with lower secondary education (At the time Intermediate or Group Certificates) were twice as likely to be unemployed or seeking their first job a year after finishing school as those with upper secondary education (Leaving Certificate), while those leaving without any qualifications were 3 times as likely. Breen (1991) examined a panel study of those who left school in 1982. This enabled him to examine the transition path of school leavers. Six months after leaving school, upper secondary school leavers (male /female) were 28/14 % more likely to be in work and 50/50% less likely to be unemployed than those without qualifications. Those with Upper Secondary were however more likely to do further training or state employment rather than become unemployed. However 5 years later, those with upper secondary levels of education were 46/86% more likely to be working than those without qualifications. The chances of being unemployed were 28/29% of those without qualifications. Higher educated women were also far less likely to move out of the labour force entirely than those without qualifications. By the 1995, the situation for school leavers without qualifications had worsened with over 60% unemployed as compared with 45% in the early 1980's. For those who leave University, there is an annual Higher Education Authority Survey of First Destinations of Graduates.

For the purposes of our analysis, we have the choice between using the analyses described above or using the *Living in Ireland* Survey. A number of studies cited are quite dated now, especially the panel component of the school leavers study described by the Breen (1991). However there are recent school leaver studies that can be used without the panel element. This is what will be used for the destination of those leaving secondary school. These results are described in table 3. For graduates, we use the HEA's *First Destination of Graduates* Survey, described in table 4 for those who left University in 1993. Employment rates varied from as low as 60% for food graduates to over 90% for Medicine, Veterinary and Architecture.[67] As the educational attainment model incorporates subject, the impact of subject choice on initial employment prospects will have an immediate labour market effect and thus improve the explanation of the variability. One problem with the model however is that social background is only used to determine who attends University and not what courses they take. This may therefore bias intergenerational mobility analyses. Table 5 describes the

[67] The low employment rate for food science graduates is masked by the fact that only a very small proportion of this students actually leave after undergraduate studies. The majority go onto postgraduate study.

probabilities of education leavers of becoming employed (versus self-employed) if they move into employment and unemployed versus inactive if not-working.

Employment versus Self-employment

Once an individual has decided to work they must then decide whether to become self-employed or become an employee. The literature is relatively scarce on this decision, remaining more in the realm of sociology. As presumably there is greater risk in becoming self-employed than being an employee, individuals will expect a risk premium to make this decision. On the other hand individuals who cannot get a job as an employee may be forced to become self-employed and thus may expect a lower wage premium. There are other factors involved as well. Taylor (1996) considers in addition to earnings, the degree of independence, labour demand and family background. He found that in a model of self-employment in the UK that as might be expected, individuals who were likely to earn more in self-employment than employment became self-employed. In addition, individuals whose parents were self-employed were more likely as were those with greater wealth, those who favoured independence and those who were less concerned about job security. Areas of high labour demand were also more likely to produce entrepreneurs. Harding (1993) meanwhile found that women in general were very unlikely to be self-employed in Australia. Having a spouse who was self-employed was however found to be significant factor.

We employ a model similar to that used to Taylor. However, we also take into consideration the tax-benefit system. Self-employed workers are treated differently to employees in a number of respects. Social Insurance Contributions rates are different as are resulting entitlements to benefits. It is questionable whether the potentially self-employed take the lower value of social insurance contributions (relative to employee and employer contributions) in their decision or whether they also factor in the resulting lower entitlement to contributory benefits. The self-employed are also more likely to be able to set more of their income off against taxes as Callan (1991) found when designing a static tax -benefit model for Ireland. Also, in Ireland, only employees are eligible for an in-work benefit known as the Family Income Supplement, while farmers on low incomes are eligible for unemployment assistance.

The first step in the process is to estimate hypothetical self-employment and employment monthly earnings. In the comparison we compare full-time employment with self-employment as we assume montonicity of preferences and thus if employment is preferred to self-employment and part-time employment is preferred to self-employment, part-time is preferred to self-employment. For everyone of working age, we simulate their resulting net employment (self-employment earnings), if they decided to be employed (self-employed). As a joint simulation of male and female decisions would result in large computing time costs, we assume instead that in making a decision as to whether to be self-employed in a particular period, the person only has information about what the other spouse did in the previous period.

Other variables that we consider are whether a person was in employment in the previous period. We however only do this if the person was in work during the previous period. As a result two models of employment/self-employment are estimated for men and women. In the first the sample used is all those who were in work in the previous period and in the second those who were out of work. In both cases we only focus on those who have decided to work in this period on the basis of the labour market participation model described above. Occupational categories, education levels and duration variables are also included.

In table 6, model estimates are described. The model is a logit model with, dependent variable, employment. The signs and relative sizes of net employment and self-employment income is as expected in the model where individual worked in the previous period. As a result individuals who have higher employment income net of taxes and benefits will be more likely to go into to self-employment. For those who were not in work in the previous period, the signs were the opposite of what was expected, however for men the coefficients were not significantly different from zero. We must however be cautious about the results for women moving into work as very few of this group become self-employed. Amongst the other variables, being employed in the previous period as well as occupational status of employer and manager had a strong impact on whether to continue to be self-employed. As in the labour participation model, the logit model here is used to rank individuals, the totals in employment versus self-employment are determined exogenously. Table 7 describes the totals used to determine aggregate transitions. Transitions are based on gender, age work status the previous period and if in work whether an individual was in self-employment (SE) or in employment (E). Persistence rates are quite high for those who remain in work. For those making a transition from out of work to in-work, men are more likely to enter self-employment than women.

Labour Supply: Part-time versus Full-time Work

In this model, we do not allow individuals to decide to vary their hours worked continuously. Instead as individuals are likely to only be able to select from a finite number of hours combinations, we model only a discrete choice. Because of the relatively small number of workers, working less than full-time wages, we only focus on two hours categories, part-time and full-time.

In this process we employ a similar model that used by the decision to work and the secondary decision to seek employment. In this case we employ a logit model based on the sample of those who have decided to be in employment. Although the decision to work part-time in reality is probably jointly determined with the decision to work in the first place, the decision to be an employee, we employee a set of individually specified models. The reason is partly to do with the fact that in Callan et al. (1999) the correlation of the error terms in a jointly estimated model was not significant and also partially because of the computational costs. Also the joint estimation of so many processes in a multinomial logit or probit model is unlikely to be supported by the available data.

Like the labour market participation model, we incorporate the marginal impact of part-time working versus not working and the marginal impact of full-time working over part-time working in terms of income after taxes and benefits. These results are reported in table 8. For both men and women the coefficients on these variables had the expected signs (positive for marginal net disposable income from part-time work and negative for disposable income if not working and the marginal effect of full-time work). For both men and women, being in employment during the previous period was negatively associated with working part-time. However those who worked for a longer number of years had higher probability of working part-time. Therefore in the short term part-time work may be due to being a way for unemployed people into work, while in the longer term, those with longer working careers are more likely to move to part-time work. This reinforced by the fact that unemployment and disability durations are positively related to the probability of working part-time. For men the presence of children is not significant, while for women the probability increases with the number of children. Also women, whose husbands are unemployed, are more likely to work part-time. Higher educated women are less likely to work part-time, but for men the opposite holds. However as very few men work part-time this effect is not that important. Table 9 details the aggregates transition rates.

Work Characteristics Occupation, Management, Sector

Occupation may have an impact on employment conditions that may in part influence options available. As many of the demand side aspects of our labour market module depend on occupation and industrial sector, it is an important aspect of the model. For example as outlined above, earnings vary a great deal across occupational group (See Callan and Harmon, 1997) and sector. Pension coverage also varies significantly by industrial sector (Hughes and Whelan, 1997) and occupational group (Keogh and Whelan, 1985 and Hughes and Nolan, 1996). Dex and Taylor (1995) define a number of ways of categorising employment mobility. These include mobility between jobs, employer's and occupations. Using the 1990/91 wave of the British Household Panel Survey, the authors examined the extent of employment mobility in the UK. Category of Job had the highest degree of mobility in the year with 21 per cent of the employed moving jobs at least once, while less than 15 per cent of employees changed employer. Finally occupational status had the highest degree of stability, with less than 9 per cent of employees changing occupation. Women were more likely to be more mobile in each category than men. Occupational change is more likely to occur at younger age groups, with fewer than 6 per cent of workers changing occupation each year in the over 35 age group. Younger people are also more likely to change jobs and employers. Cohabiting and single people also have higher mobility rates, which is likely to be confounded with the age relationship. Interestingly the presence of children does not seem to influence mobility rates. It is not an unreasonable assumption therefore to assume as Pudney (1992) did constant occupational status over time for each individual. Pudney varied the occupational structure through dynamic re-weighting. Other models such as CORSIM and HARDING do not incorporate occupational structures.

Breen and Whelan (1996) describe transition matrices of the mobility of men and women from occupational class of origin (parental occupational class) to entry class (occupation of first job) and the mobility between entry class and destination class. There are a number of difficulties in using this information however. Firstly, there is no information on women's transitions from entry to the labour market to final occupation. This is because of the difficulties in measuring this due to the very low participation rate of married women. Secondly, the classification used is slightly different to that used in this chapter. As a result, the route taken here is to model parental occupation using Census information. Occupational mobility between parental occupation, entry class and destination class is more difficult. This is because of the limitations imposed by having information only about two period data. With a large number of occupational categories (12 used here), and the low number of transitions as witnessed by the UK data, the cell sizes in a 12 × 12 transition matrix, except in the diagonal elements are likely to be very small and therefore not a good basis for modelling transitions. Instead we utilise a indirect method to model occupation group. As outlined above, parental background is used to partially determine educational attainment. This in turn as described by Breen and Whelan is a large determinant on the occupation undertaken by an individual. Therefore we employ data contained in the LII to chart the relationship between educational attainment, parental education level and occupation in 1994 .

Individuals who have management roles typically have higher earnings as outlined above. Table 10 details the model used here. For men, the probability of being a manager increases with experience, but at a declining rate. Simultaneously, the probability falls with age, resulting with the highest probability of becoming a manager in middle age. For women, the opposite largely applies, but the resulting effect is a similar age relationship rising to a peak and then falling. For men there is a strong education link, while for women, once other characteristics have been taken into consideration the link is insignificant. As expected, there is a strong occupation relationship, with the higher occupational groups being more likely to be managers. The declining value of human capital with periods out of work is highlighted by the negative relationship between periods of out of work and the probability of being a manager. Background especially for men is an important determinant, with higher parental education levels having a positive influence on the probability of becoming a manager. Table 11 describes the aggregate age distribution of managers by age group for men and women.

We use employment sector (private/public) as a determinant of regular employment. Determining a model of public employment is beyond the scope of this study, so we simply classify decisions to enter the public service by education level. We notice in table 12 that those at the extremes of education distribution for both men and women are more likely to become civil servants. This is a result of (a) the role public employment in reducing unemployment and thus providing jobs for poorly educated people and (b) the highly competitive nature of entrance to the more senior permanent pensionable jobs in the sector, which attract a disproportionate number of highly educated people.

Unemployment

The status of unemployment or in other words, the decision to seek work when out of work is an important component of our model. This is because of the use of the model to examine issues related to the tax-benefit system. Normally social benefits are only available to those of working age if they are seeking work or are otherwise excused from working due to illness or parenthood. This variable therefore is an important determinant.

It is realistic therefore that the decision to seek employment should depend on the decision of the other spouse in a couple. If both decide not to seek work if they are out of work, then they may not be eligible for benefits. To get around this, we include in the model the value of disposable income if they are unemployed and their spouse's market income and dummy variables of the spouse's decision not to participate or to seek employment. Lone parents can also be expected to be less likely to register as unemployed as they are entitled to benefits as a result of having children.

Three models are employed for men and women, one for those who were in employment in the previous period, one for those seeking work in the previous period and one for those out of work but not seeking work in the last period. Results are described in table 13. In most cases the coefficient on disposable income if unemployed is negative. Thus the higher the out of work income the less likely to seek work. For men the same is true for spouses original income, while for women the opposite is true. Thus the higher the spouses market income, the more likely they are to seek work. A number of factors explain this. Firstly higher education and income men are more likely to be in work and thus if not working more likely to seek work. This partially also related to the fact that they are likely to have had longer working durations and thus more likely to be eligible for social insurance benefits that do not depend on their spouses income. Table 14 describes the aggregate transition probabilities into and out of the state of unemployment. Probabilities are divided between whether an individual was in-work in the previous year or not. If an individual was out-of work the previous year, separate transition rates are given based on whether they were seeking work during the previous period or inactive.

Earnings

A number of different earnings variables are modelled, employment hourly earnings (table 15), employee income from secondary employment (table 16), non-agricultural self-employment earnings (table 17) and farm earnings (table 18). In each case standard human capital models are employed. There are however a number of possible other requirements. Firstly, as a dynamic model, it is desirable to include a dynamic component so that current earnings depend in some way on previous earnings. Because predicted earnings are to be used as part of the labour market participation, self-employment and part-time decisions, there may be selection bias. In other words the population who are in work may be different in some respects to the population out of work and as a result may have different earnings. Thirdly employee hours and wages should be jointly specified. Empirical studies in the USA have found that hours and wages should be jointly determined (Moffitt, 1986). The higher the number of hours the higher the wage rates all other things considered as over time more productive workers are more likely to get higher incomes.

Examining the first issue, dynamic earnings, ideally we should employ a structural wage equation for each earnings variable. Unfortunately however, at present the author only has access to cross-sectional earnings data. Therefore we can only explain cross-sectional variation. We therefore adopt a method adopted by Pudney (1992) who faced the same problem. A dynamic mode of earnings can be described as follows

$$y_{nt} = \beta x_{nt} + \varepsilon_{nt} \qquad \text{where } \varepsilon_{nt} = u_n + v_{nt},$$

a decomposition of individual and general error components. u_n describes an individual's unobserved characteristics not included in the model. One however might expect the error terms to be correlated over time, in other words, $\text{cov}(v_{nt}, v_{nt-s} | X_n) = \rho^s.\sigma_v^2$ (See Lilliard and Willis, 1978). However as in the case of Pudney, we cannot estimate the value of ρ, σ_v^2 or σ_u^2. We follow his approach and use estimates produced by Lillard and Willis (1978) from US panel data to produce the following estimates, $\rho = 0.40$ $\sigma_v^2 = 0.22$ and $\sigma_u^2 = 0.08$. However, rather than using the cross-sectional variability implicit in the US earnings data, we use Irish specific total variation, utilising the assumption of independence of the *u* and *v* terms to produce alternative values of σ_v^2 and σ_u^2.

Turning to the second issue, selection bias can incorporated into earnings equations through the use of the Heckman procedure of estimating the effect of selection bias through the use of a jointly estimated earnings and participation model. This method was tried for each earnings equation, but was found to be not significant; a similar finding to that of Callan et al. (1999). Rather than jointly estimate hours and wage rates, we deal with the relationship by incorporating as Harding (1993) does hours worked as an explanatory variable.

In each case, we employ a human capital approach. Results are described in tables 15-18. Earnings are examined in relation to the individuals human capital variables, including directly observable education variables and implicit measures of skill levels, measures of the durations in work and out of work. Recent literature has found that endogenising the process of schooling, increases the rate of return observed to higher levels of schooling. Although we do not endogenise schooling in this model, family background characteristics and period when education was undertaken are included in the model of educational attainment.

Occupation is also included as explanatory variables. Nickell (1982) describes a number of reasons why occupation can influence an individuals wage. Reasons include, the costly training necessary for high level occupations and also the entry restrictions which result from ability family connections, type of schooling and access to capital markets. Other occupational characteristics such as being employed in the public sector or having a management position. Intergenerational mobility is incorporated through the inclusion of father's education level as an explanatory variable.

As discussed earlier, it is important to distinguish between those in stable and those in marginal employment. Firms are liable to offer similar conditions year on year adjusted for productivity. This is especially the case for those with stable jobs. In other words wage rates and hours offered are likely to be related. Those in the less stable sector are likely to have lower wages. This is partially taken into consideration by incorporating experience and duration out of the labour market into the model. To incorporate these characteristics, we include a variable that accounts for pension membership and also whether an individual was in the labour market in the previous period. In addition to having lower wages, marginal workers are also likely to have more variable wages. Ideally again it would be useful to examine panel data to get estimates of the variability of ρ by age, by hours-worked etc. However instead we simply vary total variability by measures that are likely to be related to being in marginal employment, education occupation levels.

7.3. Capital Income

Under the heading of capital income, we include investment income, property income and private pension income. Although income from savings is relatively unimportant for the population as a whole, they are quite important for the elderly. We describe models for each type of income.

In describing a model of savings income one should have a life-cycle model of savings and consumption, together with the ensuing impact on wealth accumulation, through the portfolio choice. Income from savings as a result is a combination of capital gains, returns on investments in the form of rent, interest or dividends or the realisation of long-term savings instruments such as private/occupational pensions plans.

Although there is potential to produce a savings model through the use of expenditure data, the 1994 *Household Budget Survey*. This data is cross-sectional only. In this dataset, due to transitional factors those on low incomes are likely to spend much more than they receive in income. Thus for this income group there is substantial dissaving. However in the absence of both panel information and information on the extent of personal wealth, it is not possible to use this data to produce a dynamic savings model. Wealth information exists independently in the 1987 *Survey of Life-style and Usage of State Services*. Although the data is poor, it may be possible to statistically match this data with 1987 expenditure information, utilising common variables. Another problem relates to the general under-reporting of income relative expenditure in this data source; only in the top two deciles of gross income is there observed net saving. As a result, micro data is likely to under-report net savings. The approach we take here is to simulate private pension income deterministically on the basis of a stochastic model of pension membership and do as Harding (1993) did, estimate income equations for investment and property income.

Private Pensions

Some other models such as Harding (1993) treat the pension savings process as exogenous and simply assign pension income to pensioners on the basis of individual characteristics using an econometric equation. The second option is to simulate the accumulation process, whereby membership of a pension scheme is simulated and subsequently pension contributions and resulting benefits are simulated. This process has the advantage of being able to carry out experiments on pensions behaviour and its tax treatment. This latter approach is that taken by models which have studied pensions behaviour including CORSIM, DYNAMOD, PENSIM and PRISM.

Our choice is difficult as we would like to be able to simulate private pensions. However without detailed longitudinal data, relating to pensions behaviour, this is difficult to do. The only data currently available is aggregate information from a special sample of employers, from the 1995 Labour Force Study and a special 1995 Survey of Pension coverage. At the micro level, all we have is knowledge about current scheme membership.

Simulating membership of a pension scheme involves a number of steps. Firstly we estimate a logit model of pension membership. Different models are estimated for employees and for the self-employed who are less likely to have pensions. Public sector workers are assumed to be members of their pension scheme These models take occupation, hours worked, experience, the size of employment income and other socio-economic characteristics into account. Without panel data, simply using a model based on cross-section data would produce too much mobility. For now we assume that once someone becomes a member of a pension plane, they continue as a member once joined, unless they lose their job. Transition probabilities are generated to create the same cross-section membership rates. This method it should be noted ignores a number of features. Firstly it ignores period effects. Hughes and Whelan (1995) noted that pension coverage rates pension coverage increased between the 1970's and the 1980's, but then decreased again between the 80's and 90's. Secondly it ignores the fact that individuals who move between jobs do not necessarily continue as a pension member. An issue that is an important influence on this process is the transferability rules of the pension scheme. It is hoped that with access to the 1995 wave which has detailed pension plan membership variables, plus the added panel dimension that the pension membership model can be improved.

Membership is only simulated for those in work. Although there are cases of individuals not in work who contribute to their pension scheme, this percentage is very low at 1.5% (Hughes and Whelan, 1996).

Once membership of a pension plan is estimated, we need to determine what type of pension plan an individual is a member of. Decisions which need to be made include whether a plan is a defined benefit or defined contribution plan, the benefit entitlements and the contributory requirements needed to fund these benefits. There are a number of approaches used, including the generation of hypothetical plans on the basis of average provisions or secondly to assign individuals characteristics of an actual plan. The former approach is that which has typically been employed in Dynamic models, including PENSIM and DYNASIM. Here individuals are assigned average characteristics of pension schemes. More innovatively, the PRISM model in the USA assigns members to actual pension plans on the basis of a database it holds of pension plan rules. In the future it may be possible to use the latter approach, as Hughes and Whelan collected a database. However for now we take a relatively simple approach. In a funded pension scheme, there are three sources of income to the fund: employee contributions, employer contributions and fund earnings. There are also a number of withdrawals including taxation, administration costs and payments to the member. As we are only interested in disposable income, we take the funding of the pension plan as being exogenous, assuming that individuals pay an average pension contribution rate, that pensioners receive pension benefits equal to the number of years worked/60 times their final pensionable income. Thus all pension members are assumed to be in defined benefit plan. All fund short falls are deemed to be made out of employer contributions. In the case of the self-employed higher contribution rates are assumed. Clearly this is simplistic, ignoring much of the heterogeneity of plan membership. This however has been postponed for future research.

Investment and Property Income

In this section we discuss the simulation of other incomes which result from the accumulation of assets. Ownership of assets can supply both cash income and resources that can be used in the future. Capital income can also be broken up into the types of income provided such as rent, cash income in the form of interest (both positive in the form of investments and negative in the form of loans), cash income in the form of dividends, cash income in the form of capital gains and non-cash incomes in the form of benefits in kind resulting from the ownership of durable assets such as housing and household appliances.

The accumulation of wealth and its usage is an important determination of current and potential living standards. In constructing a dynamic microsimulation model, we ideally therefore would like to simulate this process in a similar manner to the accumulation processes outlined above for pension income. (However there is a slight difference between pensions and other investments in that often individual specific funds may not be accumulated, in the case of company defined benefit funds and PAYG systems.) We can also draw an analogy to the modelling of labour market earnings which are partially accounted for as returns to *human* capital accumulation, for which we use experience and education as proxies. The processes that result in the accumulation of wealth include savings behaviour which relates to the individuals contribution to their wealth accumulation and inheritances.

Savings behaviour is the main way in which individuals can influence their own capital accumulation and thus the size of their capital income. Ideally a model of savings behaviour should incorporate the main aspects of theory of savings. Atkinson and Stiglitz (1980) outline a number of theories which influence savings decisions including the life-cycle motive, the precautionary motive and the bequest motive. The life-cycle motive revolves around the transfer of income across the lifecycle to when income does not match consumption. Examples include saving for retirement, financing education or house purchase. The second motive refers to savings for a *rainy day*, savings which can insure individuals against unexpected income or consumption shocks such as medical problems or unemployment. The final theory of savings refers to the desire of individuals to save in order to make bequest to later generations.

As outlined above we intend to ignore the capital accumulation process at present.[68] Ignoring wealth accumulation, we also ignore bequests. Instead we estimate for investment and property income, we estimate a two step model. Firstly we, estimate a logit model derived from cross-section data which depends on the size of income, labour market experience, age, education and other characteristics to model the probability of having the income (See Tables 19 and 21). In order to avoid excessive fluctuations in the possession of capital incomes, we constrain the variability of holding these assets using the alignment process. OLS regressions are then used to predict average capital incomes (See Tables 20 and 21). Harding (1993) highlights that the log-normal distribution may not adequately explain the distribution of capital incomes of those who actually have capital incomes. In this model, this feature needs further work.

[68] Little published information exists about income resulting from household wealth in Ireland. A number of studies have looked at the concentration of wealth amongst households such as Lyons (1972 and 1975) who used estate tax information, Sandford and Morrissey (1985) who used data published relating to the wealth tax of the 1970's and Nolan (1991 and 1997) and Honohan and Nolan (1993) who used a special household survey collected as part of the 1987 ESRI household survey.

Tables and Figures

Table 7.1. Logit Model of Entry to work

Gender	Male	Male	Female	Female
Previous State	In Work	Out of Work	In Work	Out of Work
Farmer	3.155152**	2.462763**	5.818126**	4.806795**
Higher Professional	-0.980	2.204623**	4.643494**	1.426053**
Lower Professional	-0.413	0.686	4.035565**	1.283574**
Employers and Managers	-1.168	1.823813**	4.460384**	1.994215**
Salaried Employees	0.170	1.396931**	5.546879**	1.071947**
Inter. Non-manual	0.028	1.452729**	6.297756**	1.963413**
Skilled manual	0.085	1.704272**	5.855839**	0.004
Semi-skilled	-0.268	1.920689**	6.307966**	1.198978**
Unskilled	-0.412	0.8081526**	4.599791**	2.908722**
Disposable 0 hours	0.000	-0.0000801*	-0.00001	-0.00002
Marginal Disposable PT	0.0463169**	-0.09992**	0.1315265**	0.008
Marginal Disposable FT	0.2737619**	0.0288636*	0.2529828**	0.031312**
Age	-0.2863877**	0.2969358**	-0.3427628**	0.2302391**
Age^2	0.001	-0.0034442**	0.000	-0.0024182**
Married	-0.230	2.184209**	-0.9536416**	-1.181522**
Lower Secondary Educated	-0.268	0.071	1.077538**	0.067
Upper Secondary Educated	-0.331	0.443286*	1.408424**	0.5121019**
Tertiary Educated	-0.9389031*	0.6612704*	0.734	0.7868909**
Years in Work	0.1416991*	-0.1066456**	0.2475233**	-0.1037943**
Years Unemployed	-0.071	-0.5935624**	-0.168	-0.4841042**
Years Disabled	-0.074	-0.112	0.973	-0.263
Years Inactive	-0.316	-1.061621**	0.3160017**	-0.1055354**
Years in Work^2	-0.000487	0.000039	0.000	-0.00017
Years Unemployed^2	0.0037296*	0.0186892**	0.012	0.0094854**
Father Ed. 2 (Low Sec)	0.064	-0.4531982*	0.065	0.3619669*
Father Ed. 3 (Up Sec)	-0.057	0.078	0.189	0.236

Father Ed. 4 (Other Tert.)	3.537258**	1.306095*	0.030	0.441
Father Ed. 5 (Under Grad.)	1.095	-1.652036*	-0.9831641*	0.360
Father Ed. 6 (Postgrad.)	-0.117	-0.412	-0.065	-0.758
Lone Parent	-0.227	0.828	-0.410	-1.825754**
Number of Children age 0-5	0.5813782**	-0.3455962*	-0.3569691*	-0.9314574**
Number of Children (6-20)	0.123	-0.091	0.309**	-0.069
Spouse Unemployed	1.199516**	0.404	0.330	-0.242
Spouse Inactive	4.974478**	-1.175731**	2.697329**	0.3857665*
Constant	4.799297**	-5.273911**	-0.511	-5.119761**
Proportion at Zero	0.927	0.34962406	0.87	0.15908142
Number of Observations	2832	1064	1458	2395
Log-Likelihood	-414.7	-454	-335.7	-761
Pseudo R^2	0.44	0.34	0.41	0.27

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.2. Probabilities of Working by Educational Status, Gender, and Work Status in the Previous Year.

	Male			Female		
Out of Work in Previous Period						
Education Level	Lower Secondary	Upper Secondary	Third Level	Lower Secondary	Upper Secondary	Third Level
15	0.175	0.412	0.000	0.139	0.329	0.000
20	0.232	0.554	0.696	0.131	0.262	0.584
30	0.263	0.380	0.285	0.122	0.142	0.244
40	0.214	0.327	0.780	0.107	0.203	0.332
50	0.278	0.168	0.526	0.077	0.185	0.147
60	0.084	0.142	0.338	0.045	0.024	0.097
In Work in Previous period						
Education Level	Lower Secondary	Upper Secondary	Third Level	Lower Secondary	Upper Secondary	Third Level
15	0.857	0.863	0.000	0.761	0.830	0.000
20	0.851	0.925	0.889	0.859	0.896	0.918
30	0.946	0.951	0.988	0.742	0.863	0.905
40	0.942	0.986	0.995	0.907	0.940	0.933
50	0.932	0.955	0.988	0.728	0.925	0.929
60	0.856	0.842	0.809	0.732	0.636	0.951

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.3. Probability of Entering Work after Education by highest education level achieved.

	Employment/Total		Unemployment/ Out of Work	
	Male	Female	Male	Female
Primary	0.30	0.24	0.89	0.81
Lower Secondary	0.72	0.61	0.96	0.78
Upper Secondary	0.79	0.74	0.85	0.64
Upper Secondary plus Vocational	0.91	0.81	0.75	0.76

Source 1996 School Leavers Survey

Table 7.4. First Destinations of University Leavers (1993). (As a proportion of those who entered the labour market)

Undergraduate	In-work	Not In Work
Undergraduate		
Arts and Social Science	81.9	18.1
Science	72.1	27.9
Commerce	84.7	15.3
Medicine	95.9	4.1
Engineering	75.1	24.9
Law	80.3	19.7
Agriculture	65.7	34.3
Veterinary Science	100.0	0.0
Architecture	92.5	7.5
Food Science	60.5	39.5
Postgraduate	87.4	12.6

Source: Higher Education Authority First Destinations of Graduates 1993.

Table 7.5. Probability of Entering Employment on entering work or unemployment if not in work after finishing education

	Employment		Unemployment	
	Male	Female	Male	Female
17	0.33	0.82	0.667	0.6667
18	1.00	0.85	0.808	0.619
19	1.00	0.93	0.741	0.5455
20	0.94	0.84	0.870	0.6129
21	0.96	0.92	0.786	0.5
22	0.95	0.88	0.962	0.381
23	0.89	0.89	0.800	0.5429
24	0.91	0.82	0.862	0.24
25	1.00	0.88	0.864	0.3636
26	0.96	0.95	0.800	0.1739
27	0.94	0.75	0.857	0.1875

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.6. Logit Model of Transition into Employment

Previous Employment Status	In Work		Out of Work	
Gender	Male	Female	Male	Female
Previous Employment	E/NE	E/NE	NE	NE
Farmer	-0.9148349*	0**	-4.622964**	0**
Higher Professional	-1.290697*	-3.79246	-2.026616*	0**
Lower Professional	-0.11238	-1.07111	-3.25537**	0**
Employers and Managers	-3.071644**	-7.135977**	-2.82397**	0**
Salaried Employees	1.66709	9.040285**	0**	0**
Inter. Non-manual	2.112046**	-2.09522	0**	0**
Skilled	-1.195832**	-1.73922	0.52102	0**
Unskilled	0.35178	0**	1.36651	0**
Disposable Income if Self-employed	-0.0014231**	-0.0031864*	0.00095	0.0015647*
Disposable Income if Employed Full-time	0.0016973**	0.0036285**	-0.00086	-0.0014951*
Employee last period	7.253409**	13.96386**	-0.16691	0**
Age	0.3273023*	-0.33978	0.00086	-0.03956
Age^2	-0.0034131*	0.00366	-0.51201	-0.00038
Married	-0.06111	-2.212259*	-0.68322	-0.77110
Lower Secondary Educated	0.55862	0.64013	-0.40090	-0.31172
Upper Secondary Educated	0.15601	1.45533	0.65375	0.07365
University Educated	0.61192	4.34570	-0.06073	-0.08248
Years in Work	-0.11742	0.51008	-0.11816	-0.01785
Years Unemployed	-0.3729091**	-0.41360	0.158093*	0.00335
Years Disabled	0.44655	0**	0**	-0.06323
Years Inactive	-1.064696*	0.23054	0.00205	0**
Years in $Work^2$	0.00129	-0.00819	0.00491	0.00021
Years $Unemployed^2$	0.0098526**	0.15792	-0.04335	-0.00029
Number of Children (0-5)	-0.03914	-0.19987	-0.03233	0.05136
Number of Children (6-20)	0.17496	1.995099*	0**	-0.29763

Spouse Unemployed	-2.335672**	2.62466	0.43913	0**
Spouse Inactive	0.09858	-1.29174	7.480918**	0.20668
Constant	-8.112857**	-5.03313	7.465671**	4.189831**
Proportion at Zero	0.944667201	0.944667201	0.18	
Number of Observations	1247	1247	362	
Log-Likelihood	-31.5	-31.5	-93.8	
Pseudo R^2	0.88	0.88	0.44	

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Note . E means formerly in Employment, NE means Formerly not in employment

Should this be the same?

Table 7.7. Transition Probabilities of Entering/Leaving Employment

Previous Work Status	In Work				Out of Work	
Current Period	SE	E	SE	E	SE	E
Last Period	SE	SE	E	E		
Age	*Female*					
16	0.50	0.50	0.02	0.98	0.06	0.94
20	0.89	0.11	0.02	0.98	0.13	0.87
25	0.87	0.13	0.01	0.99	0.26	0.74
30	0.95	0.05	0.01	0.99	0.18	0.82
35	0.93	0.07	0.01	0.99	0.21	0.79
40	0.95	0.05	0.01	0.99	0.29	0.71
45	0.97	0.03	0.01	0.99	0.13	0.88
50	0.97	0.03	0.02	0.98	0.67	0.33
55	0.95	0.05	0.03	0.98	0.20	0.80
60	0.90	0.10	0.06	0.94	0.20	0.80
Age	*Male*					
16	0.86	0.14	0.01	0.99	0.19	0.81
20	0.94	0.06	0.01	0.99	0.19	0.81
25	0.98	0.02	0.02	0.98	0.24	0.76
30	0.97	0.03	0.00	1.00	0.58	0.42
35	0.99	0.01	0.02	0.98	0.69	0.31
40	0.99	0.01	0.00	1.00	0.43	0.57
45	0.99	0.01	0.01	0.99	0.33	0.67
50	1.00	0.00	0.01	0.99	0.89	0.11
55	0.99	0.01	0.01	0.99	0.29	0.71
60	1.00	0.00	0.02	0.98	0.00	1.00

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.8. Logit Model of Probability of Entering Part-time Employment

	Male	Female
Employee last period	-1.000857**	-2.385227**
Disposable 0 hours	-0.00003	-0.00007
Marginal Disposable PT	0.081722**	0.0249404**
Marginal Disposable FT	-0.1225501**	-0.065752**
Age	-0.3481652**	-0.1268077*
Age^2	0.0033538**	0.00059
Married	-1.007461*	0.36113
Lower Secondary Educated	0.41799	-0.37598
Upper Secondary Educated	0.9643652*	-0.27165
University Educated	1.668912**	-0.08477
Years in Work	0.1371762*	0.0923687**
Years Unemployed	0.4960619**	-0.15299
Years Disabled	0.2817998*	0.14993
Years Inactive	0.21175	0.1731985**
Years in $Work^2$	-0.00094	0.00091
Years $Unemployed^2$	-0.009952**	-0.00312
Number of Children (0-5)	-0.02388	0.2170689**
Number of Children (6-20)	0.17564	0.6961717**
Spouse Unemployed	2.774805**	0.9641812**
Spouse Inactive	1.185883**	-0.49011
Constant	2.39864	1.17442

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.9. Transition Probabilities of Entering/Leaving Part-Time Employment

Previous Work Status	In Work				Out of Work	
Current Period	FT	PT	FT	PT	FT	PT
Last Period	FT	FT	PT	PT		
Age Group	*Female*					
16	1.000	0.000	0.278	0.722	0.766	0.234
20	0.990	0.010	0.571	0.429	0.880	0.120
25	0.990	0.010	0.571	0.429	0.880	0.120
30	0.977	0.023	0.400	0.600	0.724	0.276
35	0.977	0.023	0.400	0.600	0.724	0.276
40	0.938	0.062	0.293	0.707	0.739	0.261
45	0.938	0.062	0.293	0.707	0.739	0.261
50	0.919	0.081	0.320	0.680	0.423	0.577
55	0.919	0.081	0.320	0.680	0.423	0.577
60	1.000	0.000	0.429	0.571	0.600	0.400
Age Group	*Male*					
16	0.940	0.060	0.700	0.300	0.853	0.147
20	0.992	0.008	0.800	0.200	0.935	0.065
25	0.992	0.008	0.800	0.200	0.935	0.065
30	0.996	0.004	0.857	0.143	0.929	0.071
35	0.996	0.004	0.857	0.143	0.929	0.071
40	0.998	0.002	0.333	0.667	0.926	0.074
45	0.998	0.002	0.333	0.667	0.926	0.074
50	0.995	0.005	0.300	0.700	0.938	0.063
55	0.995	0.005	0.300	0.700	0.938	0.063
60	0.981	0.019	0.600	0.400	0.692	0.308
65	0.981	0.019	0.600	0.400	0.692	0.308

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.10. Logit Model of Probability of Becoming a Manager

	Male	Female
Age	-0.01	0.39
Farmer	1.38	0.00
Higher Professional	1.54	2.01
Lower Professional	1.20	1.73
Employers and Managers	3.91	4.12
Salaried Employees	0.81	0.97
Inter. Non-manual	1.04	1.14
Other non-manual	1.04	1.14
Skilled manual	1.04	0.72
Semi-skilled	0.15	0.41
Unknown occupation	1.57	0.00
Worked in Previous Period	0.89	1.57
Married	0.39	-0.10
Years in Education	0.08	-0.39
Years in Work	0.12	-0.33
Years Unemployed	-0.15	-0.83
Years Disabled	-0.35	0.01
Years Inactive	-0.14	-0.40
Years in Education^2	0.00	0.00
Years in Work^2	0.00	0.00
Years Unemployed^2	0.01	0.02
Father Ed. 2 (Low Sec)	0.32	-0.05
Father Ed. 3 (Up Sec)	0.60	0.04
Father Ed. 4 (Other Tert.)	0.49	-0.11
Father Ed. 5 (Under Grad.)	0.69	-0.17
Father Ed. 6 (Postgrad.)	0.85	1.12
Constant	-4.58	-8.42

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.11. Aggregate Probabilities of becoming a Manager if an Employee

Manager:	0	1	0	1
Age Group	Male		Female	
16	0.941	0.059	0.935	0.065
20	0.836	0.164	0.828	0.172
25	0.730	0.270	0.752	0.248
30	0.738	0.262	0.678	0.322
35	0.685	0.315	0.575	0.425
40	0.682	0.318	0.552	0.448
45	0.716	0.284	0.548	0.452
50	0.655	0.345	0.589	0.411
55	0.651	0.349	0.590	0.410
60	0.500	0.500	0.646	0.354

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.12. Probability of working in Public Service if an Employee

	Male	Female
Less than Primary	0.34	0.18
Primary	0.41	0.38
Lower Secondary	0.28	0.17
Upper Secondary	0.35	0.32
Tertiary	0.44	0.55

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.13. Logit Model of seeking work and thus becoming Unemployed if Out of Work

Last Work Status			Out of Work			In Work
Gender	Male	Female	Male	Female	Male	Female
Last Unemployment State	U	NU	U	NU	NU	NU
Spouse's market income	0.009	0.072	-.00838*	0.037	-0.001	0.004
Household Market Income	-0.011	-0.072	-0.001	-0.037	0.001	-0.004
Disposable Income if Unemployed	-0.001**	-0.0012**	-0.0001**	0.000	-0.00027*	0.000
Age	0.086	-0.187	0.4193**	0.042	0.262	-0.032
Age^2	0.000	0.000	-0.006**	-0.002	-0.007**	-0.004
Married	0.356	-1.467	5.06534*	-1.8248**	0.210	-1.195
Lower Secondary Educated	0.189	3.0339**	0.365	0.196	0.86729*	-1.929*
Upper Secondary Educated	-0.591	2.89618*	0.440	0.334	0.270	-1.893
University Educated	-1.176	3.57024*	1.34773*	0.104	0.998	-1.828
Years in Work	-0.122	-0.228	-0.419**	0.097	-0.009	0.297
Years Unemployed	-0.006	0.3878*	0.209	-0.076	0.21879*	0.273
Years Disabled	0.105	-0.134	0**	-0.034	0**	0**
Years Inactive	0**	-0.240	0**	-0.024	0**	0.175
Years in $Work^2$	0.001	0.022	0.0081**	-0.001	0.005**	-0.005
Father Ed. 2 (Low Sec)	0.926	-2.2376**	0.550	0.245	0.095	0.364
Father Ed. 3 (Up Sec)	-0.225	2.011	0.472	0.027	0.619	-0.130
Father Ed. 4 (Other Tert.)	-1.682	0**	0.995	1.334	0**	0**
Father Ed. 5 (Under Grad.)	0**	0**	1.148	0.180	1.863	0.089
Father Ed. 6 (Postgrad.)	0**	-1.935	0**	0**	0**	0**
Lone Parent	-2.2119*	-2.3736*	3.02423*	-4.0784**	0**	-0.908
Number of Children (0-5)	0.24565*	1.19338*	0.055	-0.107	0.009	-0.689**
Number of Children (6-20)	0.363	-0.109	0.047	-0.293	0.293	-0.505
Spouse Inactive	-1.147	0**	-3.985*	-1.726*	2.1081**	2.045
Constant	1.562	4.245	-4.9354**	0.425	-2.706	4.738

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.14. Transition Probabilities of seeking work and thus becoming Unemployed if Out of Work

Previous Work Status	Out of Work				In Work	
Current Period	NU	U	NU	U	NU	U
Last Period	NU	NU	U	U		
Age Group	*Female*					
16	0.43	0.57	0.35	0.65	0.58	0.42
20	0.76	0.24	0.36	0.64	0.31	0.69
25	0.96	0.04	0.32	0.68	0.35	0.65
30	0.93	0.07	0.36	0.64	0.57	0.43
35	0.97	0.03	0.60	0.40	0.85	0.15
40	0.98	0.02	0.50	0.50	0.71	0.29
45	0.99	0.01	0.68	0.32	0.95	0.05
50	0.99	0.01	0.75	0.25	0.75	0.25
55	0.99	0.01	0.63	0.37	0.98	0.02
60	1.00	0.00	0.93	0.07	1.00	0.00
Age Group	*Male*					
16	0.45	0.55	0.04	0.96	0.35	0.65
20	0.22	0.78	0.06	0.94	0.36	0.64
25	0.60	0.40	0.02	0.98	0.32	0.68
30	0.97	0.03	0.03	0.97	0.36	0.64
35	0.75	0.25	0.02	0.98	0.60	0.40
40	0.97	0.03	0.09	0.91	0.50	0.50
45	0.91	0.09	0.07	0.93	0.68	0.32
50	0.50	0.50	0.03	0.97	0.75	0.25
55	0.91	0.09	0.12	0.88	0.63	0.37
60	0.97	0.03	0.17	0.83	0.93	0.07

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Note U: Out of work and seeking work (Unemployed),, NU Not Unemployed

Table 7.15. Hourly Logged Employee Earnings Equation

Variable	Male	Male	Female	Female
Age Group	16-22	23-65	16-22	23-65
Age	0.094	-0.0340771**	0.485	0.0190886*
Age2	-0.001	0.0003053*	-0.011	0.000
Farmer	0.028	-0.9974675**	-0.186	0**
Higher Professional	0.8002734**	0.5290941**	0.8800166**	3.205381**
Lower Professional	0.250	0.3321084**	0.7080922**	3.110241**
Employers and Managers	0.273	0.3584554**	0.479	2.95765**
Salaried Employees	0.233	0.2511267**	0.6573541**	2.923909**
Inter. Non-manual	0.138	0.107	0.337	2.622433**
Skilled manual	0.256	0.216747**	0.5298952*	2.808247**
Sem-skilled manual	0.4406093**	0.2231642**	0.7229319**	2.891422**
Unskilled	0.094	-0.033	0.431336*	2.679291**
Part-time work	0.2735025**	0.2648407**	0.1741177**	0.1191961**
Married	0.291	0.1187239**	-0.099	0.0580057*
Number of Children aged 0-5	0**	0.012	0**	-0.014
Number of Children aged 6-20	-0.130	-0.006	-0.014	0.015
Lower Secondary Educated	-0.016	0.042	0**	-0.031
Upper Secondary Educated	-0.071	0.1710451**	-0.045	0.0953867*
Tertiary Educated	-0.068	0.2859277**	0.066	0.2976244**
Years in Work	0.0699847*	0.055794**	0.0703003*	0.0161707**
Years Unemployed	0.000	-0.005	-0.1809213**	-0.011
Years Disabled	0**	-0.0827146**	-0.7914316*	-0.036
Years Inactive	-0.124	0.046	0.093	-0.0083938**
Years in Work2	-0.009	-0.0008518**	-0.005	-0.0003072**
Years Unemployed2	-0.015	0.0007653**	0.0303937**	0.0006948*
Public sector Worker	-0.0882752**	-0.0686455**	-0.040	0.1648158**
Member of a Pension Scheme	0.4490786**	0.377767**	0.4903651**	0.2178539**
Manager	0.1953843**	0.1301084**	0.1397548*	0.006

Father Ed. 2 (Low Sec)	-0.014	0.038	0.056	0.021
Father Ed. 3 (Up Sec)	0.078	0.158994**	0.1249265*	-0.048
Father Ed. 4 (Other Tert.)	-0.2417633**	0.005	-0.076	0.058
Father Ed. 5 (Under Grad.)	0.085	0.1457359**	0.017	0.179362**
Father Ed. 6 (Postgrad.)	-0.4000061**	-0.068	-0.064	0.032
Constant	-0.788	1.337581**	-5.003	-2.035481**

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.16. Logged Monthly Earnings Equation for Secondary Job

Variable	Male	Female
Age	0.031	0.011
Years in Work	-0.017	0.012
Years Disabled	-0.162	-0.016
Years Inactive	-0.162	-0.016
Years in Education^2	0.002	0.000
Private Sector	0.707	1.298
Manager	-0.487	0.000
Farmer	0.154	0.000
Unemployed	-0.024	0.159
Constant	4.231	4.607

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.17. Logged Monthly Earnings Equation from Non-Agricultural Self-Employment

Variable	Male	Female
Age	-0.089	0.000
Age^2	0.000	0.000
Farmed in Last Period	-1.075	0.000
Married	0.225	0.000
Years in Education	0.006	0.075
Years in Work	0.108	0.000
Years Unemployed	-0.025	0.000
Years Disabled	0.333	0.000
Years Inactive	-0.078	0.000
Years in $Education^2$	0.011	0.000
Years in $Work^2$	-0.001	0.000
Years $Unemployed^2$	0.004	0.000
Father Ed. 2 (Low Sec)	0.211	0.000
Father Ed. 3 (Up Sec)	-0.089	0.646
Father Ed. 4 (Other Tert.)	0.245	0.000
Father Ed. 5 (Under Grad.)	0.298	0.984
Father Ed. 6 (Postgrad.)	-0.332	0.000
Constant	6.051	5.314

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.18. Logged Monthly Earnings Equation from Agricultural Self-Employment

Variables	Male	Female
Farming Occupational Group	13.255	0.000
Age	-1.165	0.364
Age^2	0.002	0.003
Married	-4.327	2.870
Years in Education	2.725	1.226
Years in Work	0.905	-0.713
Years Unemployed	-1.155	-1.665
Years Disabled	-0.417	-0.204
Years Inactive	6.463	-0.647
Years in $Education^2$	-0.136	-0.124
Years in $Work^2$	0.002	0.008
Years $Unemployed^2$	0.054	-0.021
Number of Children	0.453	-0.101
Constant	10.049	-9.382

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.19. Logit Model of decision to be an investor

Variable	Male	Female
Employment Income	0.000506	0.022351
Self Employment Income	0.001489	
Married		0.000183
Years in Education	0.171011	0.418299
Years in Work	0.034833	0.212557
Years in Not Participating		0.211289
Years in $Education^2$	-0.00176	0.271554
Years in $Work^2$		0.175724
Number of children	-0.15667	0.172063
Spouse Unemployed	-0.22579	0.172063

Father Ed. 2 (Low Sec)	0.416254	0.311134
Father Ed. 3 (Up Sec)	0.787978	0.210626
Father Ed. 4 (Other Tert.)		0.212846
Father Ed. 5 (Under Grad.)	0.887609	9.05E-05
Father Ed. 6 (Postgrad.)		0.000836
Constant	-3.41676	0.115555

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.20. Investment income

Variable	Male	Female
Age	0.06182	-0.11217
Age^2	-0.00103	0.001597
Number of Children	-0.03905	
Married	5.62E-01	0.251925
Employment Income	-0.00052	
Private Sector	0.105226	0.527315
Manager	0.6979	0.659004
Years in Education	0.017587	-0.69184
Years in Work	0.042227	
Years Unemployed	0.240242	
Years Retired	0.10046	
Years in $Education^2$	0	0.032444
Years in $Work^2$	0.008987	
Years $Unemployed^2$	-0.01278	-0.02582
Constant	-0.58292	6.067734

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.21. Model of decision to be a property investor

Variable	Male	Female
Age	0.395219	
Age^2	-0.00312	0.000383
Investment Income	0.379912	0.00625
Employment Income	-0.05872	-0.00019
Manager	-0.35505	
Private Sector	0.295618	
Years in Education	-1.91485	0.021564
Years Unemployed	-0.6996	
Years in Not Participating	-0.92182	
Constant	-1.09487	-5.82818

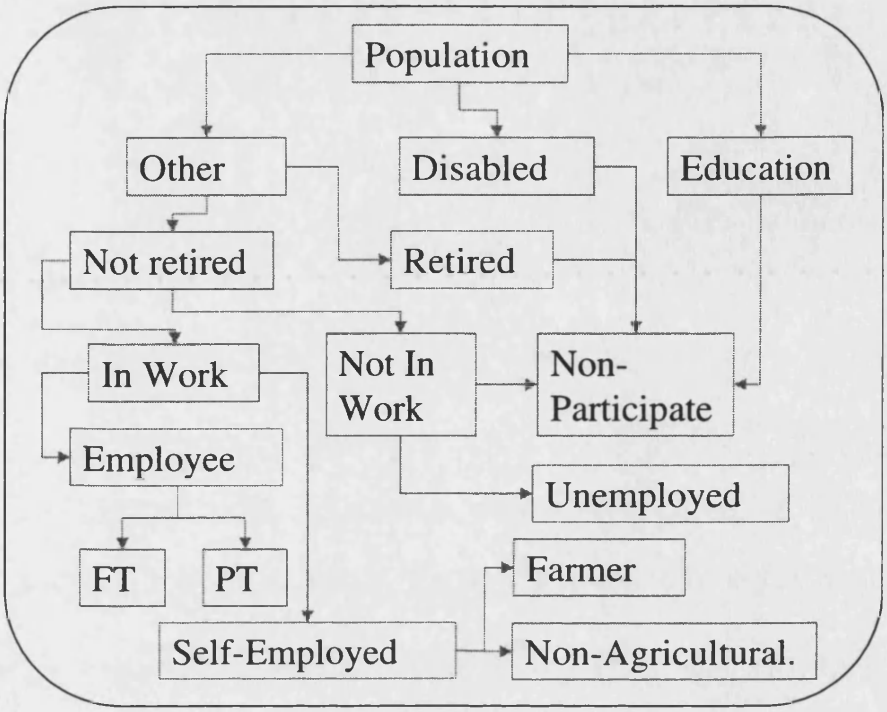
Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Table 7.22. Property income

Variable	Male	Female
Age	0.447597	0.021077
Age^2	-0.00462	
Married	0.592516	
Self-Employment Income	0.000175	
Years in Work	0	
Years Retired	0.147412	-0.07808
Years in Education2	-0.00611	-0.00582
Years Unemployed		-0.87787
Constant	-5.35096	4.513248

Source: Author's Calculations based on 1994 *Living in Ireland Survey.*

Figure 7.1. Overview of Labour Market Processes



Chapter 8. Life-Course Redistribution

8.1.Introduction

In chapter 3, we examined the extent of distribution of current income and the redistributive effect of the tax-benefit system, taking current monthly income as our accounting unit. In this part of the thesis, we consider inter-temporal aspects of redistribution. The dynamic microsimulation model described in chapters 4-7 has been used to generate a set of synthetic life-histories for a single cohort in Ireland. Behaviour is simulated according to a steady state world, assuming that all behaviour occurred as if individuals had been alive in the mid 1990's.

This chapter considers the characteristics of the population over the life-course and the degree of redistribution at each point. The chapter is divided into a number of sections. Section 2 gives some background to redistribution over the life-course. It looks at a cross-section of the population in 1994 and considers the incidence of taxes and benefits for different groups. It also considers a number of outcome measures such as average income, the variation of income and the poverty rate for individuals at different parts of the life-course. Section 3 assesses the characteristics of the simulated population at each point of the life-course. Section 4 discusses some methodological issues related to the measurement of income. Section 5 considers how individuals interact with the tax-benefit system at different points of the life-cycle. In addition to considering the incidence of taxes and benefits, it also looks at the variability of income and how much the tax-benefit system reduces this variability. Section 6 decomposes the life-course to examine life-course redistribution for individuals with different education levels.

8.2.Background: Life-course Redistribution at a Point in Time

As background to this chapter we report the degree of redistribution and the characteristics of individuals at different points of the life-course at one point in time. In this we use a survey collected by the *Economic and Social Research Institute*, the 1994 "*Living in Ireland Survey*". It is a large-scale household survey conducted on the Irish population and contain information on income, labour market and demographic characteristics.

There are a number of methodological difficulties in measuring the incidence. Firstly payments targeted on children are paid to their parents. In this study, we assume that child and orphans' benefits are incident on children, but that the child components of income replacement benefits such as unemployment assistance are incident on their parents. Secondly, the joint taxation of income may result in a lower taxation for married couples than for two singles. It may therefore be more appropriate to assign the full tax rate on the main earner with the tax reduction seen as a tax expenditure on the dependent spouse.

Table 1 outlines the average tax payments (including income tax and employee social insurance contributions) and average benefit receipts per month per person by age band in 1994. We notice that the average benefit per person increases with age. Average benefits are lowest for children because child benefits, although universal are relatively lower than income replacement benefits. Those of working age receive about the average payment per person. Although benefits are higher, coverage is lower as most people in these age groups are at work. Average benefits rise for older age groups with the very oldest least likely to have other sources of income. Taxes on the other hand peak for those of prime working age, between 30-50, with those in their 20's and 50's having on average relatively less due to lower earnings and lower participation rates respectively. Combining the taxes and benefits, we find the typical U-shape curve with the young and old being net beneficiaries and those of working ages being net contributors. In this section incidence of taxes and benefits by age is examined. A previous study in Ireland, Rottman et al. (1982) has examined the incidence by the 10 stages as they define it of the family life cycle. They too find a similar conclusion that redistribution in the Irish tax-benefit system tends to shift resources towards families during the child rearing stages and in retirement from families at other stages.

The first part of table 1 details the average payment per person in each age band. Combining this with the distribution of the population, we get the distribution of taxes and benefits across the age band. In the data the population peaks in the teenage age-band, with the youngest cohort exhibiting the reduction in fertility over the last decade. The relatively smaller size of the older cohorts results in a much more even spread of expenditure across the age cohorts. As taxation is concentrated in the working age groups, the effect is similar to the age incidence distribution. We note however, the impact of the smaller cohort size of those in their fifties, who although paying more per capita, pay in total less than 80 per cent of that paid by the 20's cohort and receive less than 70 per cent of benefits despite on average receiving more than twice as much per capita.

Given this distribution how does this affect the lifestyle outcomes of people of different ages. In table 2, we focus on an outcome measure, the numbers of different age groups in relative poverty, the standard of living of households with individuals from different age groups and the distribution of incomes for households of these types. Again the *LII Survey* of 1994 is used. The definition of poverty used is a percentage of median equivalised disposable income, where the square root of household size is the equivalence scale, with individual weighting. Because the numbers in poverty are quite sensitive to the method used, we describe poverty rates using 3 different percentages of median income, 50%, 60% and 70%. We notice one thing clearly that regardless of the poverty line used, children and elderly are most likely to be in poverty. This corresponds with Rottman et al.s (1982) conclusion based on data from the 1970's that redistribution was not sufficient in relation to either dependency or low income. When one focuses on the 50% line, where we notice the concentration in poverty of the 25-44 age group. This however features relates to the presence of children in their households. These results are confirmed in Callan et al. (1996) who find that poverty rates rose for children and elderly since the previous survey was carried out in 1987. This indicates that despite the distribution of public expenditure that is targeted particularly at children and the elderly, these groups are still relatively disadvantaged relative to the rest of the population.

Examining average incomes, we find again that families with children and especially elderly have below average standards of living as measured by the mean equivalised household disposable income. The reason for this is that although benefits do exist for children, they are not sufficient to maintain living standards at a level of those of families without children. For the elderly, the reason is because they are reliant on savings or benefits, which will tend to be lower than market labour incomes. The final column of table 2 reports the Gini inequality measure for households with individuals in the various age groups. The higher the value of the Gini measure the higher the income inequality. Here we see that inequality is greater at the extremes of the age distribution. Inequality is lowest for the 20-24 group, the group with the highest standard of living.

This is because at the start of ones career there is less differentiation in earnings and people in this group will be less likely to have children. In the 20-55 age groups, inequality increases to about 0.32, due to the fact that some households will have children and some not. We also see the impact of children as the average standard of living falls for these groups, to a low for the 35-44 age group, before increasing again for the 45-54 age group. Inequality levels are low for children aged 5-14, but higher for children younger and older than this. However the average standard of living is low for the households with children in the 5-14 age group, even though this below average income is more evenly spread. Inequality is higher for other children because families with children in these age groups will have less children than families with children in the middle age groups. This is as a result of the fact that with young children some families will just have started to have children and for older children, children will start to leave home. For the 55-65 age group, the average standard of living although above average because of the existence of market incomes, falls. This is due to the fact that people will start to early retire in this age group and hence one sees income inequality rise significantly. Once most individuals have retired at the age of 65 household standard of living falls to the lowest amount and inequality also falls to the lowest level. Interestingly for the oldest pensioners, the standard of living rises. Although benefit levels increase slightly, the higher average income is a result of the fact that the over 75's once their spouse dies, may often move in with working age relatives and hence we see that inequality rises to the highest amount.

8.3. Life-Cycle patterns of behaviour.

In the previous section we examined the tax-benefit position of the population across the age spectrum. The population examined consists of different cohorts that lived through very different times and as a result are of very different sizes. In the rest of the chapter we utilise output from the dynamic microsimulation model described in chapter 4-7 to look redistribution over the life-course for a synthetic simulated cohort.

Before discussing the trend in living standards over the lifecycle and the redistributive effect of the tax-benefit system, we shall firstly try to explain some of the main characteristics of life-cycle behaviour.

Table 3 describes the average characteristics of the males and females at different points of the life-course. Characteristics are classified under a number of headings, employment, family characteristics, education, occupation and parental background. The table reports only the adult population that has completed full-time education. Those currently in full-time education are excluded.

The employment rate of males is higher than that of females at each point of the life-cycle. Over the main working years about 85% of males are in work, while for females only about 65% are in work. In both cases the employment rate over the lifecycle takes an inverted U shape, rising from the 20s to a peak and then falling as retirement approaches. The peak for females occurs at an earlier point than for males. For females the employment rate peaks in the 20-30 age group, while for males it occurs later in the 30-50 age group. For both males and females, the employment rate falls over the 50s and 60s. In this model although early retirement is allowed, we do not simulate work during the post retirement period and so employment falls to zero at 66.

Unemployment in this context means that an individual is out of work and seeking work. Again for males the unemployment rate is higher than for females over the course of the life-cycle. The seeking work condition is primarily simulated because it is required for benefit eligibility purposes. Because most unemployment related benefits take a family based assessment unit, only one partner needs to seek work. This partially explains the difference in the unemployment rate. In the case of both genders, unemployment is higher during the earlier part of the life-cycle. Gradually as most of the cohorts get jobs or get married and thus have spouses who either have work or themselves claiming benefit, the percentage seeking work falls. For males however this trend reverses when the cohort reaches their fifties. At this point the employment rate falls. It seems much of this group seek work for a while, increasing the unemployment rate again. Over the age of 55, where individuals can avail of early retirement provisions in private and public pension schemes the proportion of this age group seeking work falls.

The family related variables highlight life-cycle changes. We see that the marriage rate rises rapidly over the twenties average 0.33 during this period to an average 0.8 in the thirties to a peak of 0.85 in the 40-50 age group. Although we are looking at a single cohort the marriage rates are different. This is as a result of slight difference in the distribution of males and females. In the Irish population there are slightly more males in a cohort than females. In a similar fashion the average number of children per person rises with age to a peak in the 40-50 age group. The biggest increase is between the 20-

30 and 30-40 age bands due to the highest fertility rates for this age group. The unit of analysis is the nuclear family in this model. When children finish schooling or reach the age of 18 they are assumed to leave home.

Although educational, occupational and parental background characteristics do not change once full-time schooling is finished, we notice for these sets of variables that the composition for the different age bands varies a great deal. This is as a result of differential mortality. Mortality in this model is simulated on the basis of gender, age and occupation. Higher occupational groups such as the professional classes have lower mortality. Because education levels are related to parental background and own occupation is related to the education level achieved, we see differential mortality by these characteristics as well. Because of relatively low mortality during the main working ages, the percentage with these characteristics remains the same. However in retirement, we see that the proportion of university educated individuals rises, as they are more likely to live longer. For example the proportion of university educated males increases from 40% at age 66-70 to 50% for the over 80 age group. Similarly the percentage of professionals and employers/managers also rises, while lower education and occupational groups diminish. The relationship between parental education and mortality is modelled only indirectly and in fact we find that the percentage of individuals with parents with below upper secondary education levels actually increases.

8.4.Methodology

A number of income definitions are used in this analysis. The first definition is disposable, which is market income after taxes, contributions and benefits. We do not consider here, social insurance contributions paid by employers, as it is not clear on whom they are actually incident. Contributions paid employees in the public and private sector and by the self-employed are included in the analysis. Market income is the sum of employment earnings, self-employment earnings, farm income, income from a secondary job, investment income, property income and private pension income. In this study, we do not subtract housing costs from disposable income. A question raised by Björklund (1993) is whether capital income should be included in a measure of lifetime income. If capital income was solely the result of life-cycle savings, then one should more appropriately deduct savings from disposable income if one includes returns from savings as part of the lifetime income measure. This clearly the case for occupational pension provision. Therefore as pension contributions are accumulated to produce a pension in retirement, we subtract these contributions from disposable income. For the other sources of capital income, because we do not simulate wealth accumulation, we are not aware of the source of the wealth that results in capital income. It may be that this income results from bequests. Because capital income is relatively small, but important for some groups such as the elderly, we have decided to make the same assumptions as Björklund and leave investment and property income included in the definition of disposable income. We must note therefore that our estimates of lifetime welfare may therefore be an overestimate.

Disposable income is broken up into a further six components, market income, means tested social assistance benefits, social insurance benefits, income taxes, social contributions and income levies. All figures are for 1998 and the 1998 Irish tax-benefit system is simulated. These instruments are simulated by linking the dynamic model that produces a synthetic panel of the whole life-cycle of a single cohort with the EUROMOD tax-benefit microsimulation model that was used to measure the level of redistribution over a cross-section of the Irish population.

To account for within household sharing, we make the assumption that individuals share resources equally within the household and that the household contains economies of scale resulting from living together. We utilise the equivalence scale of 1, 0.7 for adult dependants and 0.5 for child dependants aged 18 or under and in education.

8.5.Redistribution and the Life-Cycle

In this section we consider the distribution of income and the impact of redistribution over the life-cycle. In this analysis, we report separately the situation for men and women. In particular we focus on the inequality-reducing effect of the tax and benefit system.

Tables 4 describe average income components for males and females grouped by age band. We consider only the situation of those who have left schooling as we do not simulate income characteristics of the cohort's parents and thus cannot estimate the standard of living of students.

We notice for both men and women that the trend of market income over the life-cycle has the familiar hump-backed shape. Although an actual cohort will tend to have rising market income until retirement, setting the discount rate equal to the average growth rate of incomes will result in this shape which is similar to what one would find in a cross-section. The ratio between female and male incomes is quite high initially, falling again in the thirties before rising in middle age due to the falling labour market participation rates of women relative to men. For women and especially men, average incomes rise after the age of 70. This is a result of differential mortality observed in table 3, where those with higher educational levels and occupations live longer. Consequently, the average income of the survivors increases.

In table 4, two measures of market and disposable income are described, individualised income that refers to income realised directly by the individual concerned and the second measure assumes that there is equal sharing of resources between spouses. Comparing individualised income and *shared* income we can see the effect of the assumption of sharing. We see the discrepancy between male and female income over the life-cycle, especially for the older ages.

We now return to look at the equalising effect of the tax-benefit system over the life-cycle. We examine where in the life-course most redistribution occurs. We notice in table 4 the strong life-cycle related redistribution in the tax-benefit system due to the fact that equivalised disposable income is distributed across the life-course more equally than market incomes. The points of the life-cycle with the lowest disposable incomes (early working lives and retirement) are much closer to the periods with the highest incomes than is the case for market income.

This equalising effect is highlighted in figure 1, which plots the net benefit-tax rate (benefits minus taxes divided by market income) for both men and women over the life-course. Two measures are used, one where we consider the individual benefit-tax rate, where no sharing is assumed within the household. In the second measure, we assume that all components of disposable income, are shared equally within the household. We see that the points during the life-cycle with the highest market incomes ages 40-60, coincide with the highest benefit-tax rate.

We also notice here the degree of redistribution that takes place between men and women using both sharing assumptions. At every point on the age distribution the net benefit-tax rate for women is higher than for men. During the working ages the difference is quite small. Using the no sharing assumption, we see that the distinction between women and men is greater.

The age distribution of the net benefit-tax rate for both men and women, except for the very top of the age distribution, has the expected U shape redistributing income to older and younger people from the working ages. Again returning to table 4 we find that, as one would expect from figure 1, income taxes are concentrated in the middle of the age distribution from 30-65. Income taxes due to progressivity, rise at a faster rate than market income. Part of the reason also for this is that the tax-base is wider than simply market income, including some benefits. Thus as benefits rise, the tax base widens as well. Income taxes for both genders fall initially in retirement, however at the end of the life-cycle, due to the differential mortality noted above, average tax rates increase again. This effect is stronger for men than for women. Also factors which influence life length also influence decisions to have a private pension and therefore men who survive into their 80's are relatively better off than those who die in their 70's or earlier, hence the rise in the average tax rate.

Turning to benefits, we find that social assistance rates tend to be focused on the youngest. This is partially due to the fact that as we see in table 3 that employment rates are lowest for the under 30's. As they will often not have built up sufficient social insurance contributions to be entitled to social insurance benefits, they will primarily be reliant on means tested benefits. It must be noted that a single cohort model such as this ignores interactions with household members outside the core benefit unit. For example in Ireland, many young unemployed people live at home rather than by themselves. If this were the case then their means tested benefits would be reduced to take account of their parents income. We find that social insurance benefits are concentrated in the post retirement period due to the importance of the old age and retirement pensions. Child Benefits meanwhile follow the life-cycle effect of children.

Overall we find that the most important instruments for reducing life-cycle income variability are social assistance during the early working lives, income tax during the main working years and social insurance in retirement.

Table 4 described the pattern of average disposable income over the life-course as well as the impact of its components. In table 5, we describe the variability of income amongst individuals at various points of the life-course. We also consider the redistributive effect of the tax-benefit system in reducing the variability of market incomes at each point in the life-cycle. Here we take as a measure of the redistributive effect of taxes and benefits, a measure described in chapter 1, the Reynolds-Smolensky (R-S) Index. The higher the value of the index the more redistribution.

Here we see that for both disposable income and gross income, income variability is highest for the youngest and oldest age groups. This pattern corresponds with that reported in table 2 for the actual 1994 population. It appears however that the variability reported here is of an order of magnitude greater than that reported in table 2. The primary reason for this, as mentioned above, is that our simulation model ignores interactions with other household members. In Ireland the average household size is 3.4, one of the highest in Europe. This is partially because of a relatively higher birth rate, but mainly because young people often live with their parents and older people with their children. Because of the paucity of data, we are unable to model the process of household formation (as distinct to family formation) and as a result we focus solely on nuclear families in the simulated cohort. If one compares the Gini of the 1994 population where the unit of analysis is the nuclear family, equal to 0.43, we see that it is quite similar to the variability found here.[69] The differences highlight the important role the wider family plays as a means of financial support in Ireland.

In addition to reducing variability of incomes for the population on average over the life-course, the tax-benefit system also substantially reduces variability of incomes within these age bands. We notice the Reynolds-Smolensky Index, or the degree of redistribution within the age group is highest for the age groups with the highest variability of incomes, so that the variability of incomes after taxes and benefits is much more similar over the whole life-course of the cohort. Again we see the importance of income taxes during the working ages and social insurance in retirement. Although less important in terms of total expenditure, because of the degree of targeting, means-tested benefits are quite important sources of redistribution at each point of the life-cycle.

8.6.Decomposing Life-Course Behaviour and Redistribution

In the previous sections we described how behaviour, income sources and redistribution varies over life-course on average. In this section we consider how these characteristics and incomes differ for individuals with different education qualifications.

[69] This based upon calculations made by the author using the EUROMOD tax-benefit microsimulation model, where the 1998 tax-benefit system is simulated on the same data used to estimate this model.

Table 6 describes the employment rate for individuals with different educational qualifications over the life-course. In order to validate outcomes simulated by the model, we compare life-cycle employment rates simulated by the dynamic microsimulation model with actual employment rates for the population as a whole taken from the a cross-section in 1994, *the Living in Ireland Survey*. When we compare simple average employment rates, we find that employment rates are much higher for the cohort for each age group than for the total population in 1994.

At first glance one may question the validity of the model. However when one decomposes by the employment rates for different educational attainment groups, we find that employment rates are much closer.[70] The upward shift in the overall employment rates result from the compositional shift in the distribution of education levels in the population. The 1980's and 1990's saw a very large increase in the proportion of the population going on to post compulsory schooling and university. Thus there will be significant differences in the proportion with higher educational levels for older people. Correspondingly, employment rates are relatively higher for older age groups. This is especially true for women as the employment differential for women is more highly related to educational attainment. The upward shift in the educational attainment for women results in a much higher employment rate for women. Even for the 20-30 age group, the employment rate is slightly higher for the simulated cohort than for the 1994 population. Graduate employment rates improved dramatically over the mid 1990's. Therefore, the 1994 population will reflect the poorer employment rate that had existed from the late 1980's, while the simulated cohort will encompass the effect of the improved employment prospects.

Lastly the employment rate of women aged 50 or older even when decomposed by education level is higher in the simulated cohort than in the population. This is because of an observation made that there has been a behavioural shift, even when accounting for educational attainment between the participation rates of women between later generations and younger generations. We make the assumption in these simulations that women take the behaviour of younger women (aged under 35). By this we assume that a higher proportion of women will work continuously from when the leave education until they retire.

[70] One must be caution about conclusions drawn for the population whose highest education level is lower secondary as the numbers involved are very small.

Even when we compare employment rates by education level, we would still expect overall employment rates to be different. Firstly other characteristics that influence labour market behaviour such as the marital and fertility behaviour are different. Secondly the model primarily simulates the flow into and out of work rather than the stock in employment.

Table 7 describes these transition rates into work for men and women by their educational qualifications achieved and also by their work status during the previous year as estimated in 1993/1994 data. These numbers are based on the population of individuals who are not in education or retired in either year and so do not reflect transitions from education or retirement transitions. We see the high degree of persistence observed. For both men and women and for most age groups, for those in work, over 90 percent of individuals who worked in the previous period, work in the following period. For those who were not in work in the previous period the situation is very different. Here we observe that the transition rate into work is quite low. It is however higher for younger age groups. Out of work younger people are much more likely to move into employment. We especially notice that the more highly educated have higher transition rates. We see that 62 and 75 percent respectively of university educated 20-30 year old females and males who were out of work in one period move into work in the next. Only 20 per cent or less of upper secondary move into work.

We also decompose the redistributive impact of the tax-benefit system over the lifecycle be educational attainment. Tables 8 and 9 report the distribution of disposable income and its components over the life-course decomposed by education level for males and females respectively.

We first notice that for each education level, the life-course distribution of average disposable income and its components follows a similar pattern to the population as a whole, rising to a peak in middle age, falling in retirement and then rising again in the older age groups due to differential mortality. We see that average income at all points of the life cycle for both males and females are positively related to education levels.

Turning to the redistributive impact of the tax-benefit system, we see that the tax-benefit system reduces the variability of incomes across the life-cycle for all education groups. Figure 2 reports the tax-benefit rate for each education group for males and females separately. We again see the U-shape we saw for the population as a whole. Again we see the effect of differential mortality as the tax-benefit rate falls for those aged over 70.

For university graduates however, this fall in the benefit tax rate is less than that exhibited by the cohort as a whole. This gives further evidence to the fact that it is the increasing weight of the more highly educated in the population that leads to the fall in the benefit-tax rate. Differential mortality within the lower education groups is visible as those who had better life chances are more likely to live longer and thus the benefit-tax rate falls for these groups.

Life-cycle variability is reduced to a greater extent for lower education groups than for University educated. This reflects the progressive nature of the tax-benefit system, where groups with higher average incomes such University educated face higher average net tax rates. Again reflecting the progressive nature of the system, this effect is stronger for females than it is for males.

Turning to the driving forces of this redistribution, we find that for the university educated income taxes are more important as a proportion of income than for the less well educated. This effect is stronger for males than for females. Due to the regressivity of social insurance contributions, less well educated face a relatively higher rate. Private pension membership is more important for the better educated. While both social assistance and insurance benefits are more important instruments at all points in the life-cycle for less well educated individuals, because of the need for work-based contribution histories, social insurance benefits are more evenly distributed across the life-cycle.

8.7.Conclusions

This chapter examined the degree of redistribution over the life-cycle. As background we considered the position of people at different parts of the life-cycle in 1994. The age incidence of taxes and benefits follows a familiar U-shape pattern, where benefits exceed taxes early in life and in retirement, while taxes exceed benefits in the main working years. As part of this analysis, we also considered some outcome measures. We considered the average equivalised household income for different age groups. Children and elderly were found to live in households with a lower standard of living than working age people. Poverty rates were also found to be higher for these groups.

This analysis however does not look at the life-course of a single cohort. Rather each part of the life-cycle here is based on different cohorts having lived through different periods. It must be noted that the results of the cross-section and simulated cohort are not directly comparable for a number of reasons.

- As noted above in the data based examples, the unit of analysis is the household, while here we can only examine the family unit of analysis.

- In 1994, the social insurance system had not fully matured and therefore many elder pensioners were recipients of social assistance in 1994. Social Assistance therefore plays a more important role than in our simulated population, where the whole cohort is assumed to spend their lives paying contributions for social insurance pensions and then receiving them in retirement.

- A similar point can be made about the coverage of occupational pensions, where coverage in this cohort is higher than in the population as a whole in 1994.

- Another important difference that we will come back to later is that the average education level in this cohort is much higher than for the population as a whole. This will result in correspondingly higher employment rates.

- Lastly as a steady state model based on transition rates that applied at the start of an economic boom will produce higher stocks of employment than the stock that existed as a result of flows in the pre-boom period.

In later sections we utilise the dynamic microsimulation model described in chapters 4 – 7 to simulate the life-course of a synthetic cohort. We first considered individual demographic and labour market behaviour over the life-cycle. Comparing employment rates of the simulated life-course with individuals with different life-courses in the 1994, we find that total employment rates are higher in the simulated cohort. This is a result of the different education attainment of the simulated cohort and the population. Given the huge social and economic changes that have occurred in Ireland in the last 20 years, a cohort of the population living their lives under mid 1990's behaviour than the population that have lived their lives in the period to 1990. When one decomposes by education level, we find that employment rates across the life-cycle are quite similar to those experienced by the population in 1994.

The pattern of redistribution over the life-course is similar to that of the population, where the points during the life-cycle with the highest market incomes ages 40-60, coincide with the highest benefit-tax rate. The exception is the tax-benefit position of the elderly. While the current elderly have relatively low education levels and low pension entitlement, the simulated cohort will have a much higher education level and much higher accumulated pension rights and savings. As a result income in retirement is much higher. We find also, that because the poorest people die earliest, that the benefit – tax rate falls as the cohort ages through retirement as the oldest are richer on average than younger retired people.

In addition, at every point on the age distribution, especially in retirement, the net benefit-tax rate for women is higher than for men, indicating redistribution from males to females at each point of the lifecycle. This redistribution takes place both through the tax-benefit system as women on average receive more benefits than taxes relative to men and through the family. If one makes the assumption that there are equal sharing of resources within the household, then the net- tax-benefit position is even closer.

Overall we find that tax-benefit system substantially reduces life-course income variability. The most important instruments for reducing life-cycle income variability are social assistance during the early working lives, income tax during the main working years and social insurance in retirement.

Decomposing by education level, we see that the tax-benefit system reduces the variability of incomes across the life-cycle for all education groups. Life-cycle variability is reduced to a greater extent for lower education groups than for University educated. This reflects the progressive nature of the tax-benefit system, where groups with higher average incomes such University educated face higher average net tax rates. Again reflecting the progressive nature of the system, this effect is stronger for females than it is for males.

Tables and Figures

Table 8.1. Age Incidence of Benefits and Taxes in Ireland 1994

Age Group	0	10	20	30	40	50	60	70	80	Total
Average per person										
Benefit pp	20.2	25.5	75.9	84.9	83.9	81.2	169.0	237.8	263.7	78.2
Tax pp	0.0	4.0	118.2	180.2	187.2	138.8	34.1	4.1	0.3	79.6
Net Gain pp	20.2	21.5	-42.4	-95.2	-103.3	-57.6	134.9	233.7	263.3	-1.5
Distribution across population										
Population	16.7	20.2	14.1	13.3	12.4	8.9	7.2	5.4	2.0	100
Benefits	4.3	6.6	13.7	14.4	13.3	9.2	15.5	16.4	6.6	100
Taxes	0.0	1.0	20.9	30.0	29.2	15.5	3.1	0.3	0.0	100

Source: LII (1994)

Table 8.2. Percentage of Age Group living in Households in Poverty, 1994

Age Group	Poverty Line (M50)	Poverty Line (M60)	Poverty Line (M70)	Average Income	Gini
0-4	14.1	19.4	26.8	91.2	0.324
5-9	13.8	21.1	30.3	83.9	0.306
10-14	11.4	18.1	24.4	86.5	0.305
15-19	8.5	15.8	22.8	98.2	0.326
20-24	3.3	7.5	13.5	119.9	0.300
25-34	9.1	13.7	18.4	117.1	0.319
35-44	9.6	15.2	22.5	101.9	0.320
45-54	5.9	11.0	16.8	118.0	0.319
55-64	11.2	18.4	26.3	106.7	0.343
65-74	17.1	36.6	47.0	72.9	0.294
75-	14.3	35.4	48.9	77.0	0.348
Total	10.3	17.7	25.0	100.0	0.335

Source: Living in Ireland Survey, 1994.

Notes: 1. Definition of Poverty Line of MXX, as XX % of Median Equivalised Household Disposable Income, using Square Root of Household Size as the Equivalence Scale and weighted by the number of people.

Table 8.3. Personal Characteristics by Age Group

	Employment			Family		Education			Occupation				Parental Educ.		
Age Group	In work	Unemp	Marr	LP	Child	UpSec	Univ.	Prof.	Employers/ managers	Inter. Non-man.	Other non-man.	Skilled man.	Losec	Upsec	Univ.
Males															
18	0.69	0.25	0.00	0.00	0.00	0.88	0.03	0.01	0.01	0.23	0.32	0.28	0.61	0.22	0.18
20	0.76	0.20	0.33	0.00	0.22	0.60	0.34	0.15	0.06	0.19	0.25	0.21	0.64	0.19	0.17
30	0.85	0.13	0.80	0.00	1.17	0.55	0.40	0.17	0.08	0.19	0.24	0.20	0.65	0.18	0.17
40	0.86	0.09	0.85	0.00	1.25	0.55	0.40	0.17	0.08	0.19	0.24	0.20	0.64	0.19	0.17
50	0.83	0.12	0.84	0.00	0.32	0.55	0.40	0.17	0.08	0.19	0.24	0.20	0.64	0.19	0.17
60	0.70	0.08	0.79	0.00	0.01	0.55	0.41	0.17	0.09	0.19	0.24	0.20	0.63	0.19	0.18
66	0.00	0.00	0.73	0.00	0.00	0.55	0.40	0.16	0.10	0.19	0.24	0.21	0.63	0.19	0.18
70	0.00	0.00	0.65	0.00	0.00	0.53	0.42	0.17	0.13	0.21	0.20	0.23	0.65	0.19	0.16
80	0.00	0.00	0.37	0.00	0.00	0.44	0.50	0.23	0.16	0.17	0.10	0.28	0.69	0.16	0.15
Females															
18	0.58	0.07	0.00	0.10	0.15	0.83	0.05	0.13	0.08	0.31	0.16	0.12	0.60	0.22	0.18
20	0.68	0.07	0.33	0.15	0.45	0.49	0.45	0.32	0.09	0.22	0.14	0.08	0.62	0.22	0.16
30	0.66	0.04	0.81	0.07	1.28	0.46	0.49	0.34	0.09	0.22	0.14	0.08	0.63	0.21	0.16
40	0.65	0.01	0.84	0.04	1.30	0.45	0.49	0.34	0.09	0.21	0.14	0.08	0.63	0.21	0.16

50	0.60	0.01	0.81	0.02	0.32	0.45	0.50	0.34	0.10	0.21	0.13	0.07	0.63	0.21	0.16
60	0.50	0.00	0.69	0.00	0.01	0.44	0.51	0.34	0.10	0.20	0.13	0.07	0.63	0.21	0.16
66	0.00	0.00	0.56	0.00	0.00	0.43	0.51	0.34	0.10	0.20	0.14	0.07	0.62	0.20	0.17
70	0.00	0.00	0.39	0.00	0.00	0.43	0.51	0.36	0.10	0.21	0.14	0.07	0.62	0.20	0.17
80	0.00	0.00	0.14	0.00	0.00	0.38	0.58	0.43	0.11	0.21	0.11	0.06	0.64	0.21	0.16

Source: Author's Calculations.

Table 8.4. Average Equivalised Monthly Income by Age Group

Age Group	Disposable Income	Market Income	Income Tax	Social Insurance Contributions	Pension Contributions	Income Levy	Social Assistance Benefits	Social Insurance Benefits	Child Benefits	Individualised Market Income	Individualised Disposable Income
Males											
18	642	773	184	28	4	13	84	14	0	774	643
20	676	896	231	28	17	17	65	6	1	1120	840
30	608	876	226	25	29	18	23	1	6	1640	1146
40	670	1002	274	26	39	20	20	2	6	1982	1331
50	754	1126	302	30	45	22	19	6	1	1896	1267
60	707	999	266	23	40	19	34	21	0	1529	1071
66	702	659	221	0	0	12	19	256	0	968	1029
70	768	751	258	0	0	14	21	269	0	1036	1068
80	1067	1197	454	0	0	24	13	335	0	1376	1123
Females											
18	480	433	79	12	0	4	131	10	2	453	511
20	552	654	147	19	3	12	67	8	4	838	714
30	435	598	156	18	14	12	26	5	8	1120	821

40	432	621	176	17	19	12	21	7	7	1179	821
50	489	697	201	19	21	13	23	21	1	1090	757
60	508	642	181	15	17	10	33	56	0	906	696
66	451	323	107	0	0	5	17	223	0	410	573
70	578	474	166	0	0	8	16	262	0	527	657
80	783	693	254	0	0	11	12	344	0	714	813

Source: Author's Calculations.

Table 8.5. Redistribution Outcome Measures by Age Group

Age Group	Gini (Disp)	Gini (Gross)	R-S (System)	R-S (SIB)	R-S (SAB)	R-S (CB)	R-S (Tax)	R-S (SIC)	R-S(Levy)	R-S(Pension Contributions)
18	0.34	0.58	0.24	0.02	0.15	0.001	0.04	-0.034	0.003	0.001
20	0.38	0.54	0.16	0.01	0.08	0.003	0.03	0.001	0.002	0.002
30	0.41	0.48	0.08	0.00	0.03	0.006	0.02	-0.001	0.000	0.003
40	0.42	0.49	0.07	0.00	0.03	0.005	0.02	-0.001	0.000	0.003
50	0.43	0.49	0.07	0.00	0.02	0.001	0.02	-0.001	0.000	0.003
60	0.44	0.60	0.15	0.06	0.04	0.000	0.01	0.001	0.000	0.003
70	0.43	0.67	0.24	0.15	0.02	0.000	0.02	0.000	0.001	0.000
80	0.48	0.63	0.15	0.15	0.01	0.000	0.02	0.000	0.001	0.000

Source: Author's Calculations. Note 1: Annualised income in £ per annum. 2. SIC means Social Insurance Contributions.

Table 8.6. Employment Rate by Education Level

Age Group	18-19	20-29	30-39	40-49	50-59	60-65
Simulated Life-Course						
Males						
Lower Secondary	0.60	0.57	0.62	0.67	0.58	0.49
Upper Secondary	0.68	0.71	0.79	0.79	0.76	0.56
University	1.00	0.89	0.97	0.98	0.96	0.92
Total	0.69	0.76	0.85	0.86	0.83	0.70
Females						
Lower Secondary	0.27	0.26	0.25	0.55	0.41	0.19
Upper Secondary	0.60	0.61	0.53	0.51	0.49	0.47
University	1.00	0.82	0.83	0.78	0.72	0.57
Total	0.58	0.68	0.66	0.65	0.60	0.50
Cross-Section Data						
Males						
Lower Secondary	0.47	0.60	0.79	0.78	0.77	0.49
Upper Secondary	0.43	0.72	0.88	0.89	0.85	0.40
University	0.58	0.75	0.93	0.96	0.94	0.87
Total	0.43	0.65	0.81	0.78	0.75	0.53
Females						
Lower Secondary	0.22	0.40	0.27	0.33	0.24	0.18
Upper Secondary	0.39	0.67	0.55	0.51	0.46	0.13
University	0.59	0.73	0.78	0.74	0.66	0.39
Total	0.35	0.59	0.44	0.38	0.28	0.14

Source: Author's Calculations.

Table 8.7. Employment Rate by Education Level and previous Status

Age Group	18-19	20-29	30-39	40-49	50-59	60-65
	In-work in previous period					
Males						
Lower Secondary	0.77	0.95	0.97	1.00	0.95	0.88
Upper Secondary	0.72	0.93	0.98	0.99	0.97	0.93
University		0.92	1.00	1.00	0.99	0.97
Females						
Lower Secondary	0.57	0.99	0.74	0.99	0.91	0.77
Upper Secondary	0.65	0.93	0.91	0.96	0.96	0.96
University		0.89	0.94	0.95	0.95	0.94
	Out of work in previous period					
Males						
Lower Secondary	0.53	0.07	0.09	0.00	0.07	0.09
Upper Secondary	0.67	0.20	0.12	0.03	0.07	0.02
University		0.75	0.32	0.21	0.13	0.31
Females						
Lower Secondary	0.21	0.01	0.09	0.06	0.02	0.04
Upper Secondary	0.57	0.14	0.09	0.04	0.03	0.03
University		0.62	0.31	0.17	0.11	0.01

Source: Author's Calculations.

Table 8.8. Life-course Incomes and Redistribution by Education Level for Males

Age Group	Disposable Income	Market Income	Income Tax	Social Insurance Contributions	Pension Contributions	Income Levy	Social Assistance Benefits	Social Insurance Benefits	Child Benefits	Individualised Market Income
Lower Secondary										
18	475	450	72	17	2	5	115	7	0	450
20	383	364	63	12	6	5	101	3	2	536
30	325	380	79	12	11	8	43	1	10	895
40	371	466	109	14	15	9	42	0	9	1131
50	456	592	136	18	20	12	48	1	1	1028
60	435	520	109	13	15	11	63	0	0	828
66	409	241	74	0	0	5	94	152	0	359
71	479	286	91	0	0	6	91	199	0	392
80	686	517	179	0	0	11	57	303	0	580
Upper Secondary										
18	630	747	172	28	3	12	84	15	0	748
20	544	632	138	21	7	11	83	4	1	795
30	492	657	153	20	16	13	31	1	6	1223
40	538	753	192	22	23	15	28	2	6	1507

50	584	817	200	24	26	16	27	5	1 1395
60	494	612	148	15	20	11	51	25	0 954
66	511	370	115	0	0	6	23	238	0 567
71	564	450	147	0	0	8	25	245	0 640
80	786	762	276	0	0	15	14	302	0 909

Table 8.8 contd.

Age Group	Disposable Income	Market Income	Income Tax	Social Insurance Contributions	Pension Contributions	Income Levy	Social Assistance Benefits	Social Insurance Benefits	Child Benefits	Individualised Market Income
University										
20	963	1461	425	44	35	30	25	10	1	1803
30	808	1248	348	34	49	26	9	1	6	2320
40	890	1411	407	34	64	29	5	2	6	2739
50	1024	1614	460	39	73	32	5	9	1	2687
60	1025	1574	444	33	70	29	9	19	0	2382
66	999	1106	385	0	0	22	5	294	0	1589
71	1062	1190	421	0	0	23	7	309	0	1638
80	1358	1657	642	0	0	33	8	368	0	1879

Source: Author's Calculations

Table 8.9. Life-course Incomes and Redistribution by Education Level for Females

Age Group	Disposable Income	Market Income	Income Tax	Social Insurance Contributions	Pension Contributions	Income Levy	Social Assistance Benefits	Social Insurance Benefits	Child Benefits	Individualised Market Income
Lower Secondary										
18	346	140	21	3	0	0	223	0	7	159
20	270	133	16	3	1	1	143	0	15	240
30	182	101	15	3	0	2	84	2	15	244
40	260	262	51	6	4	4	54	0	9	506
50	248	253	49	6	4	5	55	1	2	404
60	251	188	39	4	2	2	77	32	0	226
66	240	78	19	0	0	0	60	121	0	97
71	316	90	22	0	0	0	42	205	0	90
80	432	95	24	0	0	0	8	353	0	95
Upper Secondary										
18	486	447	81	13	0	4	124	12	1	467
20	452	463	88	12	2	7	87	9	3	588
30	293	351	80	10	7	7	32	6	8	655

40	264	327	81	10	8	6	26	9	8 660
50	302	372	94	10	9	6	25	24	2 603
60	381	419	105	10	10	6	29	63	0 579
66	345	167	49	0	0	1	19	209	0 212
71	460	296	96	0	0	3	18	245	0 333
80	655	486	167	0	0	5	17	324	0 492

Table 8.9 contd.

Age Group	Disposable Income	Market Income	Income Tax	Social Insurance Contributions	Pension Contributions	Income Levy	Social Assistance Benefits	Social Insurance Benefits	Child Benefits	Individualised Market Income
	University									
18	702	937	231	29	4	19	35	9	4	938
20	597	884	242	27	22	19	13	3	7	1197
30	605	930	276	26	30	19	13	7	5	1653
40	683	1038	313	28	33	19	17	21	1	1730
50	645	883	261	21	25	15	33	52	0	1602
60	563	481	164	0	0	9	11	245	0	1260
66	706	666	240	0	0	13	12	282	0	627
71	887	863	325	0	0	16	8	356	0	757
80	844	836	307	2	1	16	8	326	0	896

Source: Author's Calculations

Figure 8.1. Net Benefit-Tax Rate by Age Group for Males and Females as measured by Equivalised Income components with sharing

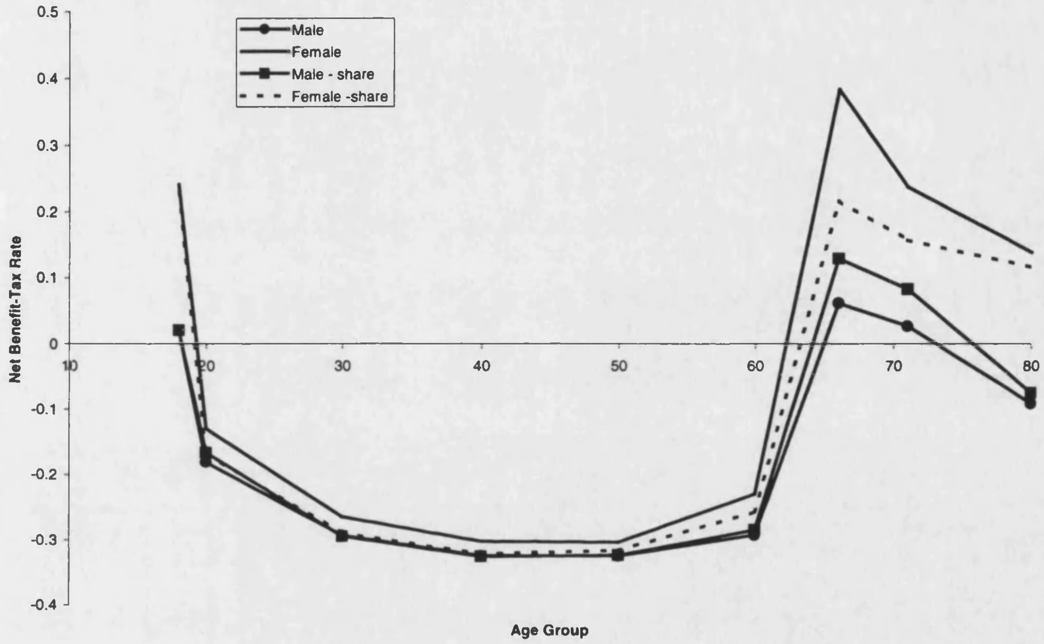
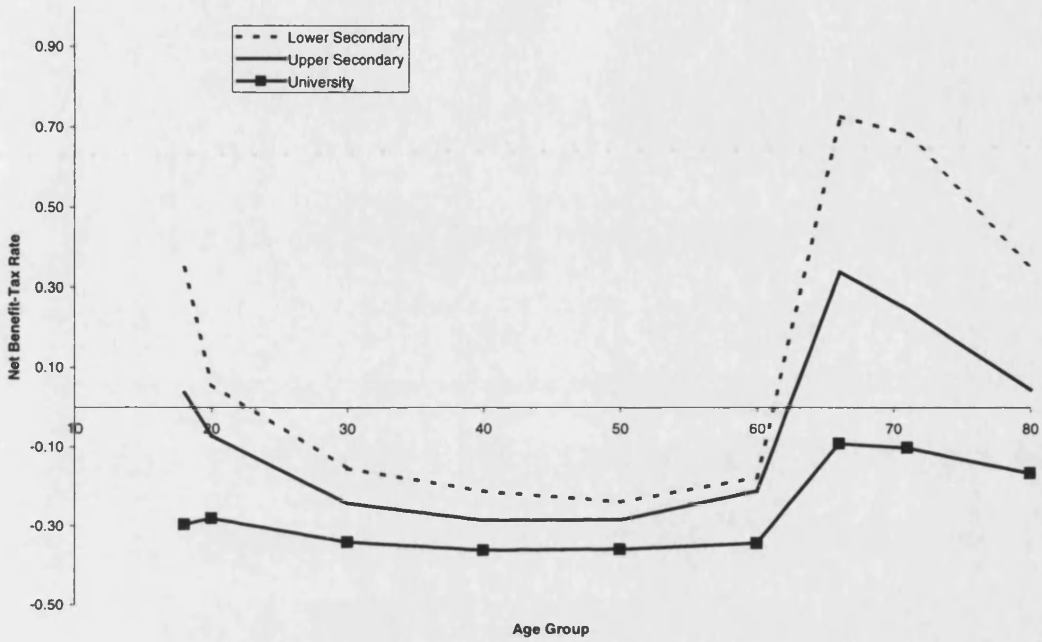
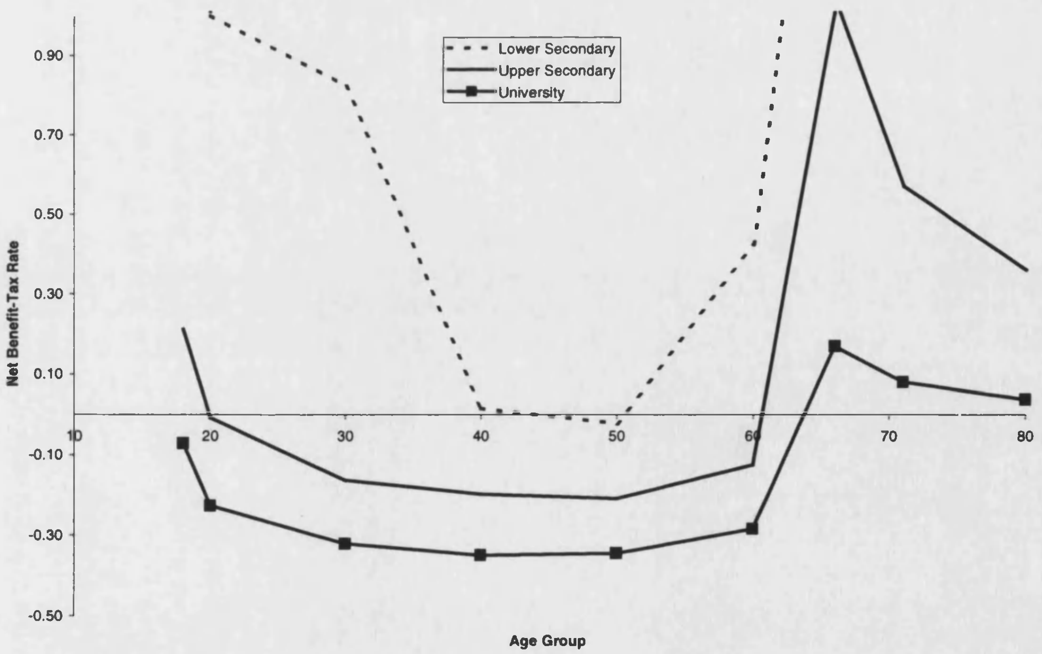


Figure 8.2. Net Tax-Benefit Rate by Education Level across the life-course

Males



Females



Chapter 9. Redistribution over the Lifetime

9.1.Introduction

Drawing on the life-course trajectories described in chapter 8, in this chapter, we aggregate over these trajectories to produce estimates of lifetime income. In chapter 3, we examined the degree of redistribution using short accounting periods. Here we examine the distribution of lifetime income and the level of redistribution over the lifetime.

The primary reasons for studying lifetime income is that income measures that cover short periods, a year for example, *depend too much on chance*. Short accounting periods will tend to increase the degree of income inequality measured within a population. This is because of the nature of short-term income volatility, life-cycle effects and different career trajectories. Empirically, panel studies have shown that there is considerable income mobility over time. For example Jarvis and Jenkins (1996) found that in Britain only 37% of the poorest decile group were still in the bottom decile after 4 years, 1991-1994. Björklund (1993), found in a study of market incomes in Sweden, that lifetime income dispersion was about 40% lower than that of annual income.

The first point relates to the impact of short-term mobility. For example, an individual, who becomes short-term unemployed from high paid employment, will be classified as poor in a snapshot at this time. However over their lifetime, they may be classified as rich. Friedman (1957) argued that potentially as much as 30% of the variation of annual incomes over a lifetime was due to transitory incomes. Nelissen (1998) felt that this percentage had probably increased over time due to greater mobility.

Turning to life-cycle effects, students may be classified as currently poor but in fact have been rich over the entire lifetime. At the other end of the life-cycle, pensioners will tend to be lower down the income distribution, but yet during their working lives, may have been higher up the distribution. Likewise child rearing periods are also likely to result in lower standards of living.

Nelissen (1998) has highlighted the importance of career trajectories on lifetime income. Individuals who invest more in education are likely to have lower income earlier in their lifetimes, but will tend to have career trajectories, so that income levels generally pass out those with lower levels of income. Characteristics that result in higher education levels of education are also likely to be related to effects such as higher life expectancies. Annual information will not be able to incorporate this information.

For these reasons a number of writers have advocated that long-term income measures are better measures of welfare. Friedman (1957) advocated the use of a permanent income concept which ignored the effect of temporary income changes and life-cycle effects. Lifetime income therefore more fully explains an individuals potential standard of living.

Layard (1979) describes some of the methodological issues related to the measurement of lifetime income. The first issue he considers is the question of what discount rate to use. Because income is preferred earlier in ones life than later (interest can be earned on accumulated wealth), it is commonplace to use a discount rate when comparing incomes at different points in a lifecycle. Layard argues that if ability and interest rates are independent, then lower discount rates should be used. Harding (1993) however abstracts completely from discounting. She argues that as income growth tends to follow economic growth rates and because it is reasonable to set discount rates equal to the economic growth rates, discount rate and growth rates are equal to each other and thus cancel each other out. In this chapter, as in the case of similar studies for the Canada (Wolfson, 1988) and the UK, Falkingham and Hills, 1995) assume that discount rates and economic growth rates are equal. One problem highlighted by Falkingham and Hills (1995) is that not all income sources rise at the rate of economic growth. For example, in the UK, benefits and income tax thresholds tend to increase at the rate of prices rather than economic growth. Likewise, occupational pensions will tend to rise at a lower rate than growth. However, because their objective is to focus on the lifetime redistributive effect of a particular system, rather than the long term effect of government policy, they continue with Harding's assumption. In Ireland, where, at least in the past 15 years, benefits and tax thresholds have tended to rise at a faster rate than prices, it is less of an issue.

Another issue raised by Layard is the significance of lifetime length. He highlights the fact that those with same lifetime income but different lifetime lengths, will have different annual incomes. The person living longer will have lower welfare levels for each year of life. Annualising lifetime income by dividing by the years of life (or by the years of post schooling lifetime) may therefore be a better measure of lifetime average welfare. Another impact of annualising is that those with shorter lifetimes will tend to have higher annualised lifetime income. This is because, they will have proportionally less of their lifetimes in retirement, that tends to be a period of lower income and therefore proportionally more of their lifetime in work. Also having a longer lifetime, may result in higher transfers from the state, through pension payments for longer. In Caldwell et al. (1998), it was found that the longer length of life of those in higher social classes resulted in a much less progressive tax-benefit system over the lifetime.

Fiscal policy instruments that depend on income also tend to use short accounting periods (i.e. of a year or less). For example benefits and social insurance contributions depend on weekly income and income taxes, annual income. As a result during *poor* periods of the life-cycle individuals will tend to be net beneficiaries from redistributive polices and net losers at other times. For example, Callan and Nolan (1993 and 1999), using short accounting periods, found that taxes and benefits had a significant redistributive effect that became more important over time. However when one factors in the points about life-cycle income mobility, the redistributive effect of taxes and benefits may be less strong if a longer accounting period were used. Pensioners are one of the largest net beneficiaries from the tax-benefit system in any one period. As most pensioners receive contributory benefits, receipt of benefit represents a return on contributions made during the lifetime rather than as a pure distribution from rich to poor. Similarly short term unemployed may end up paying more back into the system when in work than they received out of work. Finally there are also life-cycle effects on earnings, with those with more experience receiving higher earnings. Because of the progressive nature of the income tax system, they will tend to pay a higher average tax rate during periods of their lifetime when in receipt of higher earnings. Harding (1993) quotes a number of other studies, including, Layard(1977), who finds that using short accounting periods "exaggerates the basic inequality of incomes and then it exaggerates the amount of redistribution" and

The chapter is designed as follows. Some initial results of the lifetime incidence of the tax-benefit system are shown in section 2. Section 3 investigates the distribution of lifetime income in Ireland. The redistributive effect of the tax-benefit system, using lifetime income as a basis is also considered. The characteristics that influence lifetime income and redistribution are examined in section 4. Section 5 concludes.

9.2. Characteristics of the Population over the Lifetime

This section attempts to summarise average characteristics of the population over the lifetime. We consider family, demographic and labour market characteristics separately for males and females and by the level of education achieved.

Table 1 describes a summary measure of labour market activity over the lifetime. It reports the distribution of number of years not worked between leaving education and entering retirement, classifying individuals by gender and education level. In order to assess the validity of the simulated life-courses, we compare the proportion of individuals with no years out of work in the simulated population with that actually reported in the population in 1994.

Looking first at the proportion of the population who worked the entire period between finishing education and entering retirement (those with zero years out of work), we see that the rate is highly related to the level of education achieved. 44 per cent of lower secondary educated males worked their entire lives, compared with 52 per cent of upper secondary educated and 75 per cent of university educated. Females typically have lower years in work regardless of education level. In addition to the level being different to males, the relative education related differential is greater for females than for males. While only 11 per cent of lower secondary educated females work their entire career, the ratio for upper secondary and university educated females is 35 and 52 per cent respectively.

For the remainder of the population, who spend part of their lives out of work, we find that regardless of gender or education level, the distribution of years not worked takes a bell shape around a mode. For males this mode tends to be 5 years lower than for females. For lower educated individuals, the mode occurs in the 10-20 years out of work range for men and in the 15-25 years out of work for women. For upper secondary the mode is in the 15-25 years range for men and 20-25 for women. Finally for university educated the mode is in the 15-20 range for men and 20-25 for women. Caution needs to be taken when drawing conclusions from this information. Although labour market transitions depend upon the duration in various employment states, labour market transitions are still based upon data from a two year period at a time of large changes in behaviour.

Finally comparing the simulated percentage of individuals with zero years out of work with the actual distribution in the 1994 data broken down by education level achieved, we see that this proportion is very similar in both cases. For males we look at the proportion of those aged 55-65 who spent none of their lifetime out of work. For women however because of a large step-change in the behaviour of women older and younger than 35, we look at the proportion of women in the younger age range who did not have any years out of work. Another note of caution relates to measurement error. The duration data contained in the data that is both used for validation and for the estimation of the labour market models is based on recollections. Individuals are likely not recall perfectly their careers by say ignoring short periods out of work or underestimate in general the proportion of their lives spent in secondary employment states (unemployment for those who predominantly worked and employment for those who predominantly were out of work). It is possible therefore that this recall data will over-estimate the amount of people who worked their entire careers.

In table 2, we consider some other personal characteristics. Personal characteristics considered include measures related to the family, labour market, occupation, and parental background and life length.

The first heading considered is the proportion of males and females contained in each of the education groups. We see that for females the education level is on average higher for females with nearly 50 per cent with university level qualifications compared with 40 percent for males. As highlighted in the previous chapter, this reflects the huge expansion in tertiary education during the 1990s. Only about 5 per cent of males and females are simulated to leave school after the compulsory schooling period.

In general the more highly educated are more likely to marry. The education level differential however is not that strong for the proportion ever married. While 88 per cent of males with university education ever marry, 85 per cent of lower secondary educated marry. For females the differential is higher between lower and upper secondary at 82 and 90 per cent respectively.

We now consider the lifetime labour market experience of different individuals. The labour market characteristics we consider are the average years spent in work, the average years when out of work spent unemployed and seeking work, the average number of years spent in employment as opposed to self-employment and the average number of years spent in part-time work. We see that males work more years than females. Females however spend a higher proportion of their time in work in employment. Males are much more likely to be self-employed. This reflects the importance of farming and small businesses in Ireland. In total about 20 per cent of male work years are spent in self-employment. Part-time work in general is less important in Ireland than in other countries. However as in other countries, part-time work is more important for females than it is for males. Males when out of work are more likely to seek work than women.

As we have seen in section 3 in this chapter and in the previous chapter, lifetime labour market outcomes are highly related to the education level achieved. Higher educated people are more likely to spend longer in work than less well-educated. As we have seen, this differential is stronger for women than it is for men. Because the lower educated spend longer out of work, they are also more likely to spend time seeking work. For males, those with upper secondary education spend a greater proportion of years in self-employment than for other education levels. For women however the self-employment rate increases with education level. Finally, while for females, part-time work is inversely related to education level, for males the opposite relation applies. One needs however be to be cautious about this result due to the small number of males actually simulated to be in part-time work.

Table 2 reports that females are more likely to be in the higher occupations such as professional and white collar non-manual occupations than males. We see a strong link between education and occupation. While historically women were more likely to undertake white collar jobs such as clerical positions, the greater proportion of females with university education results in a higher proportion of higher professionals. Males are more likely to be employers or managers or have lower non-manual and manual occupations.

Because of the relatively low levels of education amongst parents of the current generation, parental education is a less important determinant of educational outcomes. While children of university educated parents are more likely to go to university than children of less educated parents, the link is not very strong. Finally again while average life-length is related to education level, the relationship also is not very strong, with life-expectancy for males university educated males being 73.2 compared with 71.7 for upper educated males. For females the ratio is 81.7 to 78.7.

9.3.Lifetime Income

This section summarises the level of lifetime income and the characteristics that influence it. We decompose average lifetime disposable income into its components to indicate the relevant importance of different income sources. We also consider the influence of family, demographic and labour market characteristics. In measuring lifetime income we utilise the same income definitions that are described in chapter 8.

Table 3 describes the ratio of lifetime disposable income and its components for males and females. In column (1), we make the assumptions about the incidence of taxes and benefits described above, but assume no sharing. Thus the measures examined here are essentially individual incomes irrespective of the incomes of other people in the household. We notice that disposable income for males is 1.3 times that for females. For market income the ratio is 1.5. Thus over the lifetime there is redistribution from men to women.

We now consider the instruments that drive this redistribution. The higher the ratio of taxes and contributions relative to the ratio for market income, the more the redistribution. For benefits the lower the ratio is, the more the redistribution from males to females. We see that without sharing the ratio of income tax of males to females is lower than for market income, implying a relatively lower tax rate for men compared with their incomes. Part of the reason for this is that benefits are also included in the taxbase. Because females receive more benefits, their taxbase would increase relative to males. In addition, working men are more likely to have non-working spouses than working women. As a result of joint taxation, men will face lower tax rates. While the ratio of employee social insurance contributions is higher for men it is of the same order as for gross income and so there is little redistribution from men to women relative to their market income. Males are however far more likely to be members of occupational pension schemes and so the ratio of pension contributions is higher. For each of the benefits, women are more likely to be recipients than men. The ratio is closer for social assistance than social insurance benefits. As we saw in chapter 8, this is because social assistance is more important during the working life than insurance. Because of higher mortality rates for men than for women, less men survive during the years of retirement.

The working years as a proportion of their whole lives are therefore relatively more important for males than females. Thus even though men have higher social insurance benefits per survivor in retirement, insurance benefits taken over their whole life are less on average than for women.

The previous paragraph relates more to the power over resources in households, rather than average living standards. This is because there is likely to be some degree of sharing within a household. In a cross-section, one can account for this by pooling income between members of the same unit and applying an equivalence scale to take account of economies of scale of living together. However over time the units do not remain constant. There is variation in the composition of household units due to marriage, dissolution, death and leaving home and thus there are particular problems in defining lifetime welfare measures of individuals. To account for actual living standards faced by individuals when members of multi-individual households, we assume some degree of sharing of resources within households and economies of scale. In assumption (2), we assume equal sharing of resources within the family. We also assume that there are economies of scale in having more than one person in the household, assuming an equivalence scale where a value of 1 is given for the first adult, .7 for other adults and .5 for children under 18 and in education. The living standard of individuals in a household at a point in time is the equivalised household disposable income and summed over their lifetime to produce a lifetime welfare level. We do the same to the sub-components of disposable income to see how they impact on the standard of living.

The impact of our assumptions about sharing and economies of scale is that although men are still on average richer, average the ratio of male to female lifetime disposable and market incomes is closer. The average disposable income of males is 24 per cent more than females'. However the ratio of market income is still higher than the ratio for disposable income, indicating that the conclusion of a transfer of resources between gender over the lifetime is robust to assumptions about sharing.

So far we have examining only differences in average lifetime incomes and have ignored the influence of average life length. In assumption (3) we factor in the effect of life-length considering average standard of living for the years individuals were alive. ? Because men live longer than women, we find that although we use the same income concept as assumption (2), the average living standard gap between for women and men widens.

In table 4 we examine the relative lifetime incomes of males and females with different education levels. Again we decompose total lifetime disposable income into its constituent components. Here we take assumption 3, that life length adjusted income is shared equally within the household and that 1/0.7/0.5 equivalence scale is used. As one would expect, for both males and females, the higher educated have higher disposable income than the less well educated. Males, in terms of both market and disposable income, have a higher premium for university education relative to the average than for females. However, for females, the differential of university and upper secondary is greater. Turning to the redistributive impact of the tax-benefit system we find that redistribution is greatest for females. For each education level, the gap between the relative disposable and gross incomes is greater for females than for males.

So far we have considered the relative welfare of men and women and the effect of educational qualifications. We are also interested in quantifying the effect of other characteristics on lifetime income and their components. In order to do this, we employ a regression method, taking the relevant equivalised market income or disposable income as regress~~or~~and and various demographic, human capital and labour market characteristics as explanatory variables. We do not annualise income in this instance, so that we can determine the influence of life length on lifetime income.

Table 5 reports the impact of personal characteristics on lifetime disposable and market income. We note that in both cases signs and relative values of coefficients are similar. Life-length and years worked are important positive influences on lifetime income. We also see that occupation has an important influence, with as expected, being employers and managers or professionals, having the highest influence on income, with non-manual workers having the lowest. The relationship with education is as expected, with higher education levels as we saw in table 4 being positively correlated with both market and disposable income. We also notice that being married has a negative influence on equivalised income. Although those in work are more likely to marry, as are those in the relatively higher earning occupations, these characteristics are likely to be correlated with other factors. Having children, because public transfers are proportionally less than the equivalence scale used, results in a lower standard of living than if the families did not have children.

Comparing the coefficients between market and disposable income, we can measure how the influence of different characteristics changes when the redistributive effect of the tax-benefit is included. Disposable income in this model is 20 per cent less on average than market income. As a result if these characteristics had the same absolute effect on both types of income, then coefficients would remain the same, with the coefficient on the constant adjusting by 20 per cent. This does not happen. The coefficient on the constant adjusts by the amount expected, but the relative contribution of the other characteristics changes. The impact of characteristics such as the labour market, human capital and gender fall in absolute terms as does the impact of children. All of these characteristics are important influences on income. The progressive nature of the tax-benefit system, will result in individuals with characteristics that positively influence income having their income reduced to a greater extent. Characteristics that are more likely to have lower incomes, will be more likely to receive benefits. The coefficient on life length and marriage increase however. The longer an individual lives the longer they will spend in retirement and hence the longer they will receive state benefits. Thus disposable income will increase relative to market income the longer they live. The equivalence scale used in this analysis assumes less economies of scale than that used for the tax-benefit system. As a result we see that the impact on marriage becomes even more negative.

9.4.The Distribution of Lifetime Income

In this section we examine the distribution of lifetime income and its composition. In this way, we can examine the lifetime redistributive effect of taxes and benefits.

Table 6 describes the distribution in quintiles of disposable income decomposed by income sub-components, income tax, social contributions, child, social assistance and insurance benefits. Individuals are ranked by annualised equivalent disposable and market incomes, where income is assumed to be shared equally between spouses in a family, and with the equivalence scale described in the previous section. Table 8 is equivalent, where we see that the tax-benefit system is quite equalising, when we contrast the distribution of market incomes and disposable incomes. While average annualised market incomes of the bottom disposable income quintile are only about 4% of average for the top quintile, disposable incomes are 13% of the top quintile.

Women are more likely, even under the assumption of shared incomes within a household, to be in the bottom of the income distribution. While two thirds of the bottom disposable income quintile are female, two thirds of the bottom quintile are males.

To examine the redistributive impact of tax benefit instruments, we consider incomes ranked by market incomes. Income tax is the most important instrument in the tax benefit system. We notice the progressivity of the income tax system, where income tax as a percentage of market income rises by market income quintile. The next most important instrument is social insurance benefits. Because eligibility for social insurance benefits depends upon having a work history, those in higher quintiles, receive on average more social insurance benefits. However taken as a percentage of market income we find that social insurance is quite targeted, where the relative amount falls with lifetime income. This is due to the lack of an earnings related component to the social insurance benefit system. Social insurance contributions themselves are largely flat rate across the income distribution. Because the social insurance system is not self-financing additional transfers are made from general progressive income taxation. Thus the social insurance system as a whole is quite redistributive. As one would expect means tested social assistance benefits are also targeted at the bottom of the income distribution. Although less important, child benefits too are proportionally more important to people at the bottom of the income distribution than at the top.

9.5.Redistribution: Lifetime versus Annual

We now consider the progressivity of lifetime taxes and benefits. As we saw in table 6, income taxes are quite highly targeted on the top of the income distribution, while social assistance benefits are more targeted on the bottom of the distribution. Table 7 uses statistical measures to quantify the progressivity and redistribution of the tax-benefit system. We use the Kakwani index, the difference between the Lorenz curve for market income and the concentration curve of the instrument to be examined to measure progressivity. We use the Reynolds-Smolensky index, which is the difference between the Lorenz curve for market income and the concentration curve of the sum of the instrument and market income taken together to measure the redistributive effect.[71]

Table 7 measures the redistributive effect of different instruments using two measures of income, annualised lifetime equivalent income and annual income. While chapter 3 measures the redistributive effect of the tax-benefit system on the 1994 population, it is not directly compatible with the measures described here. As highlighted in the chapter 8, structure of the simulated population is very different from the 1994 cross-section. Higher levels of education and improved economic circumstances result in more of the population in work in the simulated cohort than in the population cross-section. Secondly the simulated cohort considers individuals grouped into a narrower family unit, ignoring other household members. The results in chapter 3 meanwhile consider the wider household as the unit of a analysis. As household sizes in Ireland are the largest in Europe due to the presence of other *non-dependent* individuals[72], it is likely to have a strong effect on the Gini-based measures used here. Instead therefore we utilise a similar method to Harding (1993) and Falkingham and Hills (1995) to measure annual income. In a steady state the distribution of the annual incomes over the lifetime of a single cohort will be comparable to the distribution of incomes of a cross-section. Therefore we use the distribution of annual incomes over the lifetime of our cohort as our measure of the distribution of annual income.

Although the same equivalence scale is used, because income components are adjusted for life length, the rate of each instrument as a proportion of market income are not the same for the annual data and the lifetime data. The tax-benefit system taken as a whole has taxes and contributions greater than benefits. The net tax-benefit rate is about 20%. This compares to a largely revenue neutral system in chapter 3. While this may appear to be erroneous, if one considers what actually happened in the period since 1994 in Ireland, our figures are not so far from reality. During this period, employment rates and tax returns did increase substantially and benefit expenditure fell, resulting in very large current budget surpluses. The next chapter discusses these issues in more detail.

Overall, the entire tax-benefit system is less redistributive when one considers the entire lifetime compared with a point in time. This is consistent with the influence of mobility within the lifetime that results in individuals who pay taxes at one point and receive benefits at another point in the lifecycle. The system is more progressive when the annual accounting period is used than the lifetime.

We can decompose the overall redistributive effect into the impact of income taxes, social contributions, social assistance benefits and social insurance benefits. The redistributive effect of the income tax system is marginally lower over the lifetime,

[71] Because reranking over lifetime income is less important than across a cross-section, we ignore horizontal equity here.
[72] Individuals that are not married to the head of household or dependent children.

again consistent with life-course mobility and because of the inclusion of income levies, which are less progressive. Overall income taxes are less redistributive over the cohort than over the population.

Turning to benefits, we find that average social assistance rates are slightly lower than for the population as a whole because of the higher incomes of the cohort. Progressivity and the redistributive effect of the assistance benefits are also slightly lower than the annual distribution. Social insurance benefits have about the same average benefit rate as for the population as a whole, however insurance benefits are less concentrated than for the population. This is best example of the influence of life-course mobility on the incidence of benefits. Because individuals are required to have a work record to receive insurance benefits, long term income for this group will be higher than for individuals who receive assistance benefits. Meanwhile if one focuses on a *snapshot* picture of the population as a cross-sectional analysis does, because benefits are flat rate benefits and less than average income, these individuals will appear to be in the lower portion of the income distribution. The converse of this explanation gives the reason for the lack of difference between cohort and cross-section for assistance benefits.

9.6.Decomposition of Lifetime Income by Personal Characteristics

This section considers the impact of personal characteristics on the distribution of lifetime income and the redistribution of taxes and benefits over the lifetime. Characteristics considered include Gender, Lifetime Labour Market Experience, Family Composition and Lifetime duration. We use the method due to Morduch and Sicular (1998), described in chapter 1 to do this.

We first consider the distribution of personal characteristics by annualised equivalent disposable income quintile in table 8. We notice that because of the equivalence scale and relatively low benefits, those with children are more likely to be in the bottom of the income distribution. Average years worked and time spent in unemployment are as expected, with work being concentrated in the top two quintiles. Average years worked in this quintile is only about 6 year over the lifetime, and hence illustrating why social assistance payments are concentrated at the bottom of the income distribution.

Interestingly, despite having taken life length into consideration, life length tends to increase with income. This is due to the impact of differential mortality. When we look at the bottom of the distribution for men, we notice that the average life-length is higher than in the second quintile. This is due to the fact that benefits and pensions tend to be lower than working age incomes. Therefore those who live a long life will tend to have relatively lower annualised disposable income. This is a result found in other studies. In fact a number have found the relationship to reverse completely. However this may be due to the fact that decisions to take out private pensions have not been related to the factors which drive mortality such as socio-economic background which were found to be important factors.

Some of these characteristics may themselves be related to each other. For example life-length and social background are related. Here we utilise the approach due to Morduch and Sicular (1998) to examine the joint effect of these characteristics on the distribution of income. In this part of the discussion we examine non-annualised incomes as we would like to investigate the influence of life length on redistribution. In the USA, it was found that because richer people lived longer and because the worked less due to schooling and early retirement, the redistributive effect of the social security system was reversed (See Caldwell et al. 1998). The regressions described in section 3 have been used as the basis of this method. Table 9 describes the contribution different categories make to overall inequality. We notice that for market income, differences in labour market characteristics such as the number of years worked, the number of years unemployed and occupation etc are the most important factors driving the variability in market income. Human capital is the next most important characteristics. Family characteristics such as the number of children account only for about 6 per cent of total variability. Interestingly, we notice that when one examines disposable income we find that labour market characteristics have much less of an impact. This illustrates the impact the tax-benefit system has on reducing market inequalities. The contribution life length makes to this distribution is relatively limited at 5 per cent. This percentage remains the same for both measures. The impact of family on the variability of incomes falls.

9.7.Conclusions

This chapter assesses the redistributive effect of the Irish tax-benefit system over the lifetime. In order to generate a synthetic cohort to be used in this analysis, a dynamic microsimulation model is used. The principle conclusions are that broadly speaking the tax-benefit system over the lifetime redistributes from men to women, largely because of the income disparity between men and women in Ireland. This result is robust to assumptions about sharing between spouses within the household.

Overall the system redistributes from rich to poor, but the overall degree of redistribution is less than that exists from rich to poor when income is based on shorter accounting periods. The principle reason for this is because social insurance benefits are much less redistributive over the lifetime than at particular points in time. Because they are an insurance benefit, their object is to act as an income replacement mechanism during periods of low income. However because they are dependent on previous income, individuals who become eligible for these benefits must have had sufficient previous contributions and by extension income to be eligible. As a result, especially for long term instruments such as state pensions, these individuals will tend to be wealthier over the lifetime than individuals who do not meet these eligibility criteria, even though at one point in time when actually in receipt of these benefits they will be classified as poor.

In the final section we decomposed the inequality of incomes into the effect of personal income characteristics using a method due to Morduch and Sicular (1998). The most significant result was the impact of the tax-benefit system in reducing the inequality due to the effect labour market history and human capital have on incomes.

Our findings therefore confirm that the Irish tax-benefit system operates in a similar way to other countries that have applied this method (such as the UK, Australia and Italy) when redistribution is measured over the lifetime. The chapter has also highlighted the existence of intra-personal redistribution, a topic that will be examined in the next chapter.

Tables and Figures

Table 9.1. Distribution of Years Not Worked between Leaving Education and Retirement by Education Level

Simulated:	0	1	3	5	10	15	20	25	30+	0 (Data)
Males										
Lower Secondary	44.4	3.7	0.0	3.7	18.5	22.2	3.7	0.0	3.7	49.9
Upper Secondary	52.0	0.7	0.4	6.5	5.7	14.3	14.7	3.9	1.8	52.0
University	74.5	0.0	0.0	0.5	7.0	11.0	7.0	0.0	0.0	74.1
Females										
Lower Secondary	11.1	0.0	0.0	0.0	3.7	44.4	40.7	0.0	0.0	10.3
Upper Secondary	35.3	0.0	0.0	1.8	2.7	11.6	42.0	5.8	0.9	34.4
University	52.7	0.0	0.4	0.0	1.6	6.6	34.6	2.1	2.1	55.4

Source: Author's Calculations and Living in Ireland Survey 1994.

Table 9.2. Personal Characteristics by Level of Education Achieved

	Male				Female			
	Lower Sec.	Upper Sec	University	Total	Lower Sec.	Upper Sec	University	Total
Percentage of Population	5.4	55.2	39.5	100.0	5.5	45.2	49.3	100.0
Ever Married	85.2	85.6	87.9	86.5	81.5	89.7	87.2	88.0
Number of children	2.6	1.6	1.6	1.6	3.1	2.0	1.4	1.8
Average Years Worked	25.1	33.0	39.4	35.1	16.2	24.4	33.0	28.2
Average Years Unemployed	13.7	8.1	1.2	5.7	0.6	1.8	0.9	1.3
Average Years as Employee	20.4	25.4	31.8	27.6	15.6	22.0	30.8	26.0
Average Years Part-time Work	0.0	0.2	0.4	0.3	2.9	2.4	1.9	2.2
Higher professional	0.0	0.0	23.6	9.3	0.0	0.0	24.3	12.0
Lower professional	0.0	0.0	19.6	7.7	0.0	11.7	33.7	21.9
Employers & managers	0.0	0.0	19.6	7.7	0.0	8.5	11.5	9.5
Salaried Employees	0.0	0.0	2.0	0.8	0.0	5.8	4.5	4.9
Intermediate non-manual	7.4	24.5	11.1	18.3	40.7	29.1	11.9	21.3
Other non-manual	14.8	32.0	15.1	24.4	14.8	17.9	9.1	13.4
Skilled manual	55.6	27.7	4.0	19.8	11.1	13.0	2.1	7.5
Semi-Skilled Manual	3.7	2.9	1.0	2.2	18.5	3.6	1.2	3.2
Other Occupations	18.5	12.9	4.0	9.7	14.8	10.3	1.6	6.3
Father Lower Secondary	66.7	64.4	65.3	64.9	48.1	64.1	63.4	62.9

Father Upper Secondary	18.5	20.1	16.1	18.5	22.2	20.2	21.8	21.1
Father University	14.8	15.5	18.6	16.7	29.6	15.7	14.8	16.0
Average Life length	71.8	71.7	73.2	72.3	78.9	78.7	81.7	80.2

Source: Author's Calculations

Table 9.3. Ratio of Lifetime Income for Males to Females

	(1) No sharing	(2) Sharing/ EqSc	(3) Annualised/ Sharing/EqSC[1]	(4) Annualised/ No Sharing/EqSC[1]
Disposable	1.31	1.24	1.31	1.44
Market	1.46	1.41	1.50	1.61
Income Tax	1.43	1.37	1.45	1.57
Social Insurance Contributions	1.48	1.48	1.62	1.65
Income Levy	1.52	1.48	1.58	1.67
Pension Contrib.	2.27	2.21	2.42	2.49
Social Assistance	0.81	0.87	0.97	0.89
Social Insurance	0.65	0.59	0.57	0.67
Child Benefit	0.79	0.74	0.76	0.87
Employment Income	1.48	1.46	1.58	1.63

Source: Author's Calculations

Note 1: Annualised income is £ per annum.

Table 9.4. Ratio of Lifetime Income for each Education Level Achieved to the Average by Male and Female

	Male				Female			
	LoSec	UpSec	Univ	Total	LoSec	UpSec	Univ	Total
Disposable	57.3	80.4	133.2	100.0	53.5	74.2	128.8	100.0
Market	45.0	73.0	145.1	100.0	28.9	62.3	142.5	100.0
Income Tax	35.9	65.6	156.8	100.0	19.1	54.2	151.0	100.0
Social Insurance Contributions	51.1	82.2	131.5	100.0	27.0	61.9	143.1	100.0
Income Levy	43.4	70.1	149.4	100.0	20.4	52.3	152.6	100.0
Pension Contrib.	37.1	56.3	169.6	100.0	15.0	50.1	155.2	100.0
Social Assistance	195.9	140.4	30.5	100.0	258.5	128.2	56.5	100.0
Social Insurance	67.8	87.7	121.6	100.0	64.9	91.6	111.6	100.0
Child Benefit	157.4	97.9	95.1	100.0	218.3	104.0	83.2	100.0
Employment Income	45.7	75.5	141.7	100.0	31.6	63.1	141.5	100.0

Source: Author's Calculations

Note 1: Annualised income is £ per annum. 2. SIC means Social Insurance Contributions.

Table 9.5. Characteristics that influence equivalised lifetime Income

Independent Variable	Coefficient	SD	Coefficient	SD
Dependent variable	Disposable		Market	
Explanatory Variables				
Life Length	590	34	581	59
Years Worked	572	83	846	142
Years Unemployed	-102	57	-189	98
Years in Employment	55	84	177	144
Years Farming	295	113	410	194
Years in Part-Time Work	-503	163	-875	281
Private Sector	-69	17	-130	30
Upper Professional	10442	1902	19612	3270
Lower Professional	9231	1737	17033	2986
Employer and Manager	9116	2090	15569	3593
Salaried Employees	-451	2636	-1744	4532
Intermediate non-manual	-3475	1506	-5905	2589
Other non-manual	-3155	1493	-6218	2567
Skilled manual	2258	1624	4257	2793
Married	-7897	1253	-5948	2155
Number of Children	-1938	260	-2844	447
Upper Secondary Educated	1258	1812	2315	3116
University Educated	6771	1999	13524	3437
Father Upper Secondary Educated	-492	994	-671	1708
Father University Educated	4411	1076	8290	1849
Male	8421	1169	13616	2011
Constant	-29721	3409	-39790	5861
R^2	71.7		68.2	

Source: Author's Calculations

Table 9.6. Average Annualised Equivalent Disposable income and its components over the income distribution

Annualised Equivalent Disposable Income Quntile	1	2	3	4	5	Total
Disposable	111.3	269.8	405.7	544.7	832.1	433.1
Market	48.6	253.9	500.7	730.4	1239.4	555.2
Income Tax	10.4	54.9	120.9	193.2	390.3	154.1
Social Insurance Contributions	1.0	6.4	13.7	18.7	25.4	13.1
Income Levy	0.5	3.8	9.2	14.1	25.0	10.5
Pension Contributions	0.5	3.3	9.8	18.5	36.3	13.7
Social Assistance Benefits	47.5	42.1	12.7	6.6	4.2	22.6
Social Insurance Benefits	24.9	39.7	43.5	50.2	64.3	44.5
Child Benefits	2.7	2.6	2.4	2.1	1.2	2.2
Employment Income	38.2	228.4	440.2	625.9	966.9	460.4
Distribution of Males	31.2	45.7	55.5	55.3	65.0	50.6
Annualised Equivalent Market Income Quntile	1	2	3	4	5	Total
Disposable	123.2	264.7	408.7	542.5	824.6	433.1
Market	27.6	265.2	493.5	734.7	1252.0	555.2
Income Tax	5.1	56.3	114.4	194.3	399.6	154.1
Social Insurance Contributions	0.5	6.5	13.3	19.3	25.8	13.1
Income Levy	0.2	3.8	8.8	14.3	25.5	10.5
Pension Contributions	0.2	3.6	8.1	18.9	37.7	13.7
Social Assistance Benefits	69.5	23.5	10.5	5.7	3.9	22.6
Social Insurance Benefits	29.5	43.4	46.7	46.9	56.1	44.5
Child Benefits	2.5	2.8	2.4	2.0	1.3	2.2
Employment Income	20.6	233.7	430.0	628.3	987.0	460.4
Distribution of Males	30.7	44.7	53.5	54.8	69.0	50.6

Source: Author's Calculations

Table 9.7. Progressivity and Redistributive effect of the tax-benefit system lifetime versus annualised income.

	Rate	Progressivity	Redistribution
Lifetime Annualised			
Disposable	-0.201	0.349	0.097
Income Tax	-0.273	0.061	0.021
Social Insurance Contributions	-0.024	-0.046	-0.001
Income Levy	-0.019	0.039	0.001
Pension Contributions	-0.027	0.128	0.003
Social Assistance	0.048	-0.773	0.034
Social Insurance	0.087	-0.274	0.019
Child Benefit	0.007	-0.468	0.003
Annual			
Disposable	-0.199	0.586	0.124
Income Tax	-0.280	0.062	0.022
Social Insurance Contributions	-0.023	-0.021	-0.001
Income Levy	-0.019	0.036	0.001
Pension Contributions	-0.024	0.088	0.002
Social Assistance	0.056	-0.805	0.037
Social Insurance	0.087	-0.520	0.034
Child Benefit	0.004	-0.655	0.002

Source: Author's Calculations

Table 9.8. Distribution of Annualised Lifetime Income by Personal Characteristics

Annualised Equivalent Disposable Income Quntile	1	2	3	4	5	Total
Ever Married	97.5	85.9	90.5	84.9	77.5	87.3
Average Number of children	2.2	2.0	1.9	1.5	1.0	1.7
Average Years Worked	5.7	27.0	39.9	42.2	43.5	31.7
Average Years Unemployed	10.8	4.7	1.1	0.7	0.3	3.5
Male	31.2	45.7	55.5	55.3	65.0	50.6
Higher professional	2.0	3.0	8.5	11.1	28.5	10.6
Lower professional	8.0	6.5	13.5	19.1	26.5	14.7
Employers & managers	6.5	5.0	5.5	10.1	16.0	8.6
Salaried Employees	2.5	2.5	3.0	5.0	1.0	2.8
Intermediate non-manual	18.6	29.6	26.5	19.1	5.0	19.8
Other non-manual	31.2	24.6	20.0	14.6	4.5	19.0
Skilled manual	18.6	15.1	11.5	12.1	11.5	13.7
Upper Secondary Educated	68.3	66.3	54.0	42.7	20.0	50.3
University Educated	19.6	25.6	40.5	56.8	79.0	44.3
Father Lower Secondary Educated	70.4	72.9	64.5	56.3	55.5	63.9
Father Upper Secondary Educated	17.6	16.6	19.0	23.6	22.0	19.8
Father University Educated	12.1	10.6	16.5	20.1	22.5	16.3
Average Life length (women)	77.2	79.3	81.3	81.3	84.7	80.2
Average Life length (men)	70.0	67.1	71.5	72.9	77.1	72.3

Source: Author's Calculations

Table 9.9. Decomposition of income variability into personal characteristics

	Market Income	Disposable Income
Life Length	5.1	5.1
Human capital	21.5	11.3
Labour market	35.6	21.9
Family	6.4	4.4
Residual	31.5	57.3
Total	100.0	100.0

Source: Author's Calculations

Table 10. Intra-Personal Redistribution

10.1.Introduction

In chapter 8 we saw that the tax-benefit system reduces life-course variability of incomes, while in chapter 9, we saw that the tax-benefit system was more redistributive at points in time than over the lifetime. The income smoothing that these results exhibit indicate that there is intra-personal redistribution, or redistribution over different parts of individuals' lifetimes. When examined over the lifetime, income smoothing and horizontal transfers may not in fact have any vertical redistribution. Therefore, when considering the effect of life-cycle redistribution, the redistributive impact of the tax-benefit system between persons may be less. This chapter focuses on the extent to which tax-benefit systems redistribute between individuals as opposed to over individual lifetimes.

As tax-benefit systems are largely, progressive, those with variable incomes are likely to have greater intra-personal redistribution. Those with consistently low lifetime incomes are likely to have more inter-personal redistribution. The extent of intra-personal versus intra-personal redistribution is likely to increase with income. In addition to lifetime earnings, a number of other factors also affect the level of redistribution. Because transfers are more concentrated on the elderly, those who spend longer in retirement are more likely to receive more transfers. Although this affects both inter and intra-personal redistribution, because those with higher incomes are likely to live longer, this phenomenon is likely to increase intra-personal redistribution.

A number of papers calculate the extent of intra-personal redistribution within tax-benefit systems. Falkingham and Harding (1995) ~~found that~~ for a system with a more important social insurance component such as in the UK found that intra-personal redistribution was more important than inter-personal redistribution. On the other-hand they found that in a more means tested system as in Australia, inter-personal redistribution was more important. Björklund and Palme, (1997) found that the degree to which taxes and benefits reduced inter-personal as opposed to intra-personal variability to some extent depended upon the inequality measure used. In the USA

Caldwell et al. (1998) meanwhile found that intra-personal redistribution has fallen over time largely due to the fact that earlier generations had higher returns from the tax-benefit system.

The chapter is designed as follows. The next section describes the modelling approach used to generate the lifetime panel dataset. Section 2 describes the methodology used to measure the intra-personal redistribution in the tax-benefit system. Section 3 looks at life-cycle redistribution for individuals with different education levels. Section 4 examines the extent of lifetime mobility. Section 5 utilises a decomposition method to decompose redistribution into inter personal and intra-personal components and measures the degree of income smoothing in the tax-benefit system versus inter personal transfers.

10.2.Methodology

In this section, we discuss the methods to be used to measure the level of intra-personal redistribution in the tax-benefit system. Five income definitions are used in this analysis. The first definition is disposable income, which is market income after taxes, contributions and benefits. We do not consider here, social insurance contributions paid by employers, as it is not clear on whom they are actually incident. Contributions paid by employees in the public and private sector and by the self-employed are included in the analysis.

Disposable income is broken up into a further four components market income, self-financed benefits, net benefits and net taxes/contributions as done by Falkingham and Hills (1995). Market income is the sum of employment earnings, self-employment earnings, farm income, income from a secondary job, investment income, property income and private pension income. In this study, we do not subtract housing costs from disposable income. However because pension contributions are accumulated to produce a pension in retirement, we subtract this from disposable income.

The reason for the decomposition into net taxes, benefits and self-financed benefits, is to highlight our chief area of interest in this chapter, the extent of intra-personal redistribution in a tax-benefit system. Self-financed benefits are defined as the proportion of taxes in any particular accounting period that are used to finance benefits received by the individual. So for example, in the case where taxation is greater than benefits self-financed benefits are equal in value to all benefits received. Remaining taxes here are net taxes/contributions. Where benefits exceed taxes all taxes are compensated by benefits received and thus self-financed benefits are equal in value to the taxes paid. The remaining benefits are net benefits. Because the personal tax-benefit system is not neutral as personal taxes exceed benefits by about 20%, we focus only on the taxation required to finance the benefit system to make the system neutral.

10.3.The Life-course and Lifetime Income

One of the main reasons for intra-personal redistribution found in other studies is the life-course (See Harding, 1993 and Falkingham and Hills, 1995). In chapter 8, we looked at redistribution over the life-course by considering the net tax-benefit position for *average* life-course trajectories, while in chapter 9 we considered the distribution of lifetime incomes. Life-cycles considered so far have been average life-cycles for all individuals. It would be expected that those with the highest lifetime incomes would have very different life-cycles to those in the bottom of the income distribution. In this section we use the output of both chapters compare the level of redistribution over the life-course for individuals with different lifetime incomes.

In figure 1, we plot separately for males and females average benefits minus taxes over the life-course by annualised equivalent disposable income quintiles. We see that there is clear ranking between average net benefit-taxes, except for very old people, where because of longer employment histories, individuals are more likely to receive state insurance pensions, which are more valuable than assistance pensions on which the bottom quintile depend. The bottom quintiles consistently receive more in benefits than the pay in taxes and contributions, while the top quintile consistently pays more taxes. The other quintiles are more representative of the population as a whole, pay more taxes during their working lives and receiving more benefits in retirement.

10.4.Lifetime Income and Mobility

In this section we compare the volatility of incomes over the lifetime with overall lifetime income. In table 1 we explore a simple measure of income volatility, classifying for each lifetime income quintile, the proportion of years spent in different annual income quintiles. To do this, we pool the annual income information of all individuals in the study to produce annual income quintiles. This is analogous to the approach taken by Harding (1993) and Falkingham and Hills (1995) who used this *pseudo cross-section* approach to compare annual versus lifetime income distributions. In a steady state, pooling the annual incomes of the lifetimes of a cohort will be equivalent to the distribution of income taken from a cross-section for one year.

We notice that there is quite a degree of immobility at the top and the bottom with people in the bottom lifetime equivalised disposable income quintile spending 69.7% of their lives in the bottom quintile, while the top quintile spend 58.5% of their lives in the top quintile. Results shown are quite similar to other studies, with the majority of individuals staying plus or minus one quintile over the lifetime away from their annual position. One might expect however for mobility to be higher over the lifetime. Other studies such as Harding (1993) used artificial methods to hit desired levels of mobility, while in this study we utilise information about the duration of time spent out of work to limit the amount of lifetime mobility. Without incorporating this feature there is too much mobility as too few people would work from education completion to retirement without break. Retrospective information is however likely to be affected by measurement error, with one imagining that individuals would be likely to underestimate the time out of work. It would be interesting therefore to test the sensitivity of the model to different assumptions about mobility. However due to computing constraints this is presently beyond the scope of this study. It would also be interesting to look at longer-term mobility once later waves of the *European Household Panel* are released.

In other studies such as Björklund (1993), annual incomes of middle aged people (30-65) in Sweden were found to be highly correlated to that of lifetime income. Greater volatility however was found for younger people. In table 1 we divide up the proportion of time spent in different annual quintiles into three age groups, 20-35, 36-65, 65+. The lowest age group will tend to overestimate the proportions of those in the bottom quintile, primarily due to the fact that we do not simulate information about the parental incomes of those in education. Nor are educational transfers simulated, which in any case are so low as to keep students in the bottom quintile.

This table also shows the proportion of their lives, quintile members spent in annual quintiles when aged in one of the three age bands. It confirms Björklund's finding that mobility is greater for younger age groups. Except for the second quintile, there is more mobility for all lifetime quintiles for the under 35 age group than for the 35-65 age group as less spend all their lives in the same quintile as their lifetime quintile.

Comparing the 35-65 age group with the other two age groups, we find that mobility is least for quintiles 1, 3, 4 and 5 thus we see that this age group drives lifetime incomes. Those in lifetime income quintile 2 however are least mobile only in old age when their lifetime quintile is also the dominant annual quintile. We notice therefore that those in the top three lifetime quintiles have very little labour mobility, as most of their lifetime mobility comes from periods in education or in retirement when incomes were relatively lower.

At the other end, those in the bottom quintile also experienced some mobility in the under 35 age group. However due to the influence of the cumulative duration spent out of work, this group became more likely to stay virtually permanently in low incomes in the period aged 35-65. Once they reach retirement age this group enter a more mobile phase as some become eligible for higher valued insurance benefits.

In retirement, we see that quintiles 3 and 4 have quite a lot of downward mobility. This is largely a life-cycle effect as their incomes fall in retirement relative to their working lives. Much of the top quintile remains in the top quintile in retirement having saved sufficiently to maintain their income position.

It is the quintile 2 where most of the mobility occurs. This re-emphasises the point made in chapter 7, where we noticed that these two quintiles spent moderate amounts of time unemployed and employed, compared to high employment for the top two and the low employment bottom quintile. The story one therefore gleans from this picture is that at the bottom of lifetime income distribution are the long term out of work, in the next quintile, we have primarily individuals engaged in as Atkinson and Micklewright (1990) define *marginal* workers, who spend periods in and out of employment and with lower incomes due to lower on the job human capital, while in the top three quintiles, we have those who are in reasonably well paid *regular* jobs.

10.5.Inter-Personal versus Intra-Personal Redistribution and Lifetime Income

Having considered the redistributive impact of the tax-benefit system and the degree of life-time mobility for different lifetime income groups, we now consider the degree to which the tax-benefit system redistributes within individual's lifetimes (intra-personal redistribution) or between individuals (inter-personal redistribution). Two measures shall be used to compare these two measures of redistribution, decomposing an inequality measure and by looking at the distribution of intra-personal redistribution.

Firstly we shall use a standard decomposition method for income inequality indices into between and within group components person described in chapter 1. Instead of viewing groups as collections of different individuals, we treat ? the groups as being the individuals, while the within group component are the years that make up each individual's lifetime.

Table 2 breaks up total variability in incomes as measure by the I_2 measure (half the square of the coefficient of variation). Two measures of income are compared, market and disposable income. Considering the population as a whole, we notice that total disposable income is less variable than market income. The ratio of within person to between person variability is less than 1 for both income types. We therefore see that between person lifetime variability is greater than within person variability across their lifetime. The lack of lifetime variability in incomes, highlighted in table 1, is evidence of this. The ratio for disposable income is greater than market income indicating that the tax-benefit system reduces between person lifetime variability more than within person variability as a result of the progressive nature of the tax-benefit system.

We now consider the intra versus inter personal redistribution over the lifetime using our second measure, self-financed benefits. We decompose taxes and benefits over the lifetime into self-financed components and net gains/losses, described above. Measured over the lifetime as a whole, self-financed benefits will be more important. We noticed in figure 1 that the top quintile on average were net tax payers and that the bottom quintile were net benefit recipients, thus on average benefits received by the former groups and taxes paid by the latter group will be self-financing.

In table 3, we report the distribution of self-financed benefits, net taxes and net benefits. We see that average annualised equivalent self-financed benefits increase with income. While only 6 per cent of benefits in the bottom quintile are self-financed, 97 per cent of the top quintile are self financed. This compares well with Falkingham and Hills (1995) finding for the UK. Overall we find that redistribution within a persons lifetime as measured by the proportion of benefits that are self-financed, is slightly more important than between persons as self-financed benefits represent about 54% of all benefits. While this conclusion is at odds with the conclusion of table 2, we note that in both cases intra-personal and inter-personal redistribution are quite similar. In addition different assumptions are made in the two calculations. In order to measure self-financed benefits, we make the assumption of revenue neutrality, focusing solely on taxes that are required to finance benefits. In Decomposing the I_2 inequality measure into within person and between person components, we considered the entire tax-benefit system. The difference in assumptions will tend to place more weight on the reduction of between person inequality.

Self-financed benefits are more important for men than for women. Looking at net taxes and benefits, we naturally find that they are more redistributive than gross components.

Table 4 describes the proportion of self-financed benefits in different countries. Falkingham and Harding (1995) found that in a system with a more important social insurance component such as in the UK found that intra-personal redistribution was more important than inter-personal redistribution. On the other-hand they found that in a more means tested system as in Australia, inter-personal redistribution was more important. In Italy, Baldini (2001) found that self-financed benefits comprised 76% of all benefits due to the strong link between benefits and previous employment in a mainly social insurance based system. Comparing these results with the position in Ireland, we find that overall the level of intra-personal redistribution is somewhere between Australia and the UK, illustrating the targeted nature of the Irish tax-benefit system.

The results obtained however are quite dependent on the level of life-course mobility within the population. It would be interesting to examine the sensitivity of the model to mobility assumptions.

10.6.Conclusions

This chapter focuses on the degree of redistribution across an individuals life-cycle relative to the amount of redistribution between individuals. We now describe the principle conclusions.

Examining the life-course for different lifetime income groups, we notice that the top quintile are on average net losers at each point of the life-cycle, while the bottom quintile are on average net gainers, with the remaining quintiles following the average trend. This confirms that those with higher incomes will tend to have more intra personal redistribution.

Given that we are looking at the impact of redistribution over individual's life-cycles due to mobility or life-cycle effects, the first issue to examine is the degree of mobility. Here we notice quite a degree of immobility for those at the very top and the bottom of the income distribution. The lifetime can be characterised as permanently poor at the bottom, those in regular well paid employment in top three quintiles, with those in quintile 2 being characterised as being in lower paid marginal employment, moving regularly in and out of work. Most mobility tended to occur in individuals earlier years.

Between person variability was found to be more important than intra-lifetime income variability. The first evidence that inter-person redistribution is more important is illustrated when we find that the tax-benefit system as a whole reduces inter person variability more than intra personal variability over the life-course.

In the final section intra-personal redistribution is measured in terms of self-financed benefits over the whole lifetime. It was found that these benefits were more important than inter-personal transfers. Although this conclusion is at odds with the conclusion that the tax-benefit system reduces between person variability by more than within person variability incomes, the result is sensitive to the assumption made about which proportion of the system one considers. Overall intra-personal redistribution was found to be less important than for the UK and Italy, but more important than Australia, highlighting the targeted nature of the Irish tax-benefit system.

On a note of caution however, the degree of intra-personal redistribution found in a tax-benefit system is quite sensitive to the degree of mobility within the population as a whole. Because the panel data on which models like the one used here, have typically been poor, assumptions have to be made about the degree of mobility. This assumption may have a strong bearing on the results. It would be useful therefore to extend this analysis to measure the sensitivity of the results to different mobility assumptions.

Another area for analysis would be to examine the impact of a policy reform that extended income replacement in retirement as at present Ireland has no earnings related pension, nor any compulsory savings for retirement. This coupled with an increasingly flexible labour market, means that social assistance must be used more extensively in Ireland for retirees than in other countries. The existence of such a model as this will allow issues such as these to be examined.

Finally, because the model links a dynamic model that generates a synthetic panel to a tax-benefit microsimulation model that contains the rules for each tax-benefit system in the European Union, it would be possible to examine the inter and intra-personal redistribution in different European countries. As we have seen most redistribution in the system is inter-personal and therefore inter-generational redistribution may be important. Unfortunately at present the dynamic model focuses only on a single cohort. Although the software itself can simulate a multi-cohort panel, specifying the behavioural equation to this are beyond this study. Instead we use simpler aggregate methods in the next chapter to examine this issue.

Tables and Figures

Table 10.1. Percentage of Life spent in different quintiles annually relative to lifetime income

	Annual Equivalised Disposable Income Quintile					
Lifetime Equivalised Disposable income Quintile	1	2	3	4	5	Total
1	69.7	23.1	4.4	1.9	0.8	100
2	23.5	41.3	23.8	9.0	2.5	100
3	9.3	22.7	35.6	24.5	7.9	100
4	4.2	11.9	26.0	35.6	22.3	100
5	1.4	4.5	10.0	25.6	58.5	100
Aged under 35						
1	45.0	40.1	8.9	5.2	0.8	100
2	13.6	40.4	24.9	17.0	4.1	100
3	5.5	23.1	32.5	29.1	9.8	100
4	2.8	13.1	26.8	35.4	21.9	100
5	1.0	5.4	13.4	28.3	51.9	100
Aged 35-65						
1	86.2	11.0	2.5	0.3	0.0	100
2	31.0	36.2	25.8	6.3	0.8	100
3	10.8	18.7	37.5	26.0	7.0	100
4	4.9	8.1	24.7	38.4	23.9	100
5	1.8	2.8	9.5	27.8	58.1	100

Table 10.1.

Aged Over 65						
1	63.6	29.7	2.5	1.1	3.2	100
2	16.7	59.0	15.4	3.9	5.0	100
3	10.3	33.5	34.6	13.7	7.9	100
4	4.1	20.2	28.3	28.5	18.9	100
5	0.9	6.8	8.3	19.6	64.4	100

Source: Author's Calculations

Table 10.2. Intra Personal (across lifecycle) and Inter person Income Variability

	Market	Disposable
Total	0.541	0.306
Between	0.333	0.181
Within	0.208	0.125
Ratio (within/between)	0.626	0.692

Source: Author's Calculations

Table 10.3. Intra-personal versus inter personal redistribution

	Disposable Income	Self Financed Benefits	Net Taxes	Net Benefits	Self-financed as a % of all Benefits
Annualised Equivalent Disposable Income Quintile					
1	111	4	0	65	6.0
2	270	22	5	63	25.4
3	406	40	19	21	65.7
4	545	51	39	12	81.2
5	832	74	96	2	96.9
Gender					
Male	490	40	44	25	61
Female	375	36	20	40	47.4
Education Level					
Low. Secondary	241	18	4	68	21.1
Upp. Secondary	342	30	15	44	40.9
University	559	49	55	16	76.1
Total	433	38	32	33	53.9

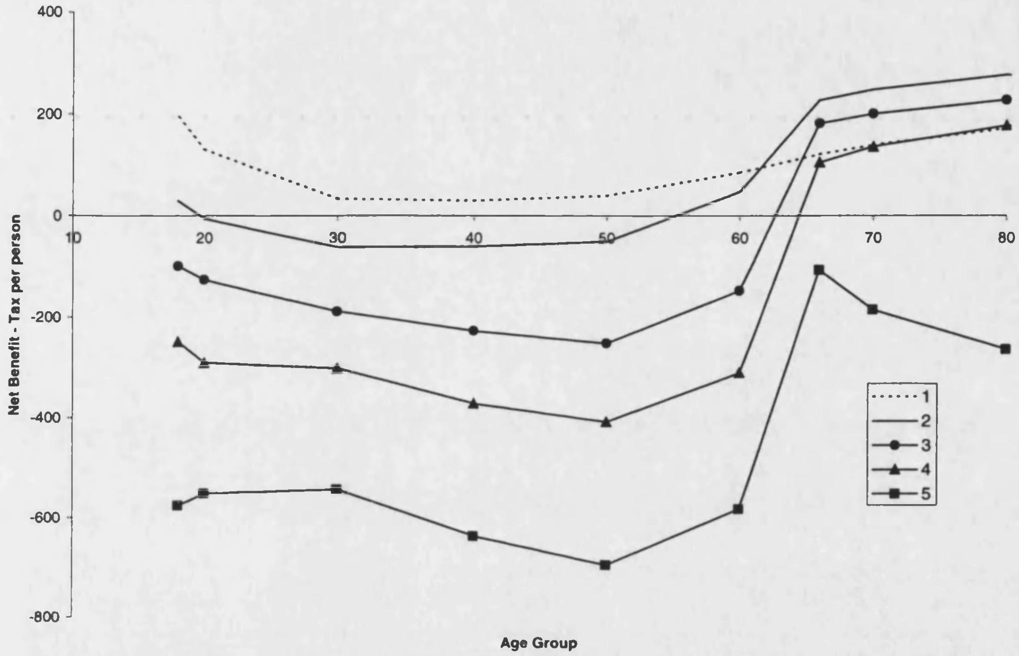
Source: Author's Calculations

Table 10.4. Intra-personal versus inter personal redistribution, in Different Countries (Self-Financed Benefits as % of Total Benefits)

	Average Rate
Australia	38%
Ireland	55%
Italy	76%
UK	62%

Source: Author's Calculations, Harding and Falkingham (1996), Baldini (2001).

Figure 10.1. Average Net Tax-Benefits by Age group by Annualised Lifetime Disposable Income Average Net Tax-Benefits by Age group by Annualised Lifetime Disposable Income



Chapter 11. Intergenerational Redistribution

11.1. Introduction

In previous chapters we have measured the degree of redistribution between persons based on current and lifetime income, redistribution over the life-course and intra-personal redistribution. In this chapter we attempt to quantify the degree of intergenerational redistribution in the Irish Welfare State.

The motivation for this chapter comes from a number of sources. Firstly the development of a large public debt in the space of two decades, together with the forecasted elimination of this debt over the next two decades (Department of Finance, 1998) will clearly result in an intergenerational transfer of resources; from those who pay for the public debt to those who consumed it. Secondly, the rapid ageing of the Irish population during the next century is expected to result in further deficits.

Whereas the development of the public debt in the late 20th Century was largely driven by economic factors, this century's deficit will be driven by demographic factors. In Ireland as in other countries, as population age, the ratio of those of non-working ages to those of working ages rises and thus increases the pressure on the public finances, increasing in turn the degree of intergenerational redistribution. The Budget Strategy of Ageing Group of the Department of Finance (DOF) find that the cost of ageing is set to rise by 7% of GNP over the next half-century (DOF, 1999).

Because of the desire to look at the distribution of public expenditure between generations, one needs to look at the net gains of generations from the State over the entire lifetime. In order to do this, forecasts of public finances and demographic projections over the next 100 years are necessary. Without question, one needs to take extreme caution in the interpretation of the results. Instead they should be seen as a *"dim light trying to pierce the impenetrable fog of the future. This light may help us perceive the hazy outlines of an iceberg, but will certainly not be able to discern detail with any reliability"* (Wolfson and Rowe, 1998).

This chapter is broken up into a number of sections. The next section quantifies the extent of intergenerational redistribution between generations alive in the 1990's. Drawing on chapter 8, this section measures the age-incidence of social welfare expenditure, health care, education and taxation and social contributions. Section 3 using a database of public expenditure and taxation in the Irish State documents the evolution of public expenditure and taxation by type since the 1920's. Using age incidence assumptions, section 4 assigns each year's public expenditure to across cohort alive at the time.

In order to measure the redistribution between generations, one needs to estimate in addition to past net gains, future net gains from public expenditure and taxation. The first step is to consider future demographic trends. Section 5 using assumptions made by the Central Statistics Office (CSO), describes this trend. The next step is to examine the effect these demographic changes on the public finances. Section 6 looks at the future evolution of the public finances under a number of different scenarios. Having generated demographic and public finance trajectories, we decompose this by generation to look in section 7 at the degree of intergenerational redistribution in 2025, 2050 and 2075. Section 8 looks at the net gain over the lifetime of each cohort alive in 1998. Section 9 drawing upon other work of the author examines the degree of fiscal sustainability currently within the system, using the method of generational accounts.

11.2.Age Incidence of Public Expenditure and Taxation

Changing demographic patterns combined with the age incidence of tax receipts and public expenditure drives the demographic and generational imbalances. This section examines the age incidence rates of public expenditure and tax receipts. This chapter however only considers the incidence of a proportion of total public expenditure and receipts. In this respect, we are limited by the availability of data, but also by the ambiguity as to the distribution of benefits of public goods such as the justice system, defence and the environmental protection. In addition the incidence of public transfers are often difficult to determine. For example are government subsidies/taxes on the corporate sector incident on shareholders, customers or even employees? In this respect the incidence may not even be on the national population. Therefore in this section we only focus on welfare expenditure and taxation on the household sector.

In this study, spending is only allocated to those on whom it is spent. Therefore education is targeted only at younger cohorts. However this does not account for returns to education, whereby an increase in the level of education in an economy may lead to positive externalities in the whole economy. This is also relevant to Buiter's (1995) criticisms of the approach for ignoring general equilibrium responses. Similarly children may spend less on parents because of the existence of pensions. Another issue relates to the cost of services to be provided. We take the cost to be that incurred by the state, even where this may be below the market value as in the case of health expenditures.

The tax and benefit age incidence is drawn from 1994 cross-sectional data in table 1 in chapter 8. The incidence of education expenditure is on a per capita basis rather than a per student basis. In terms of health expenditure we take figures from Nolan (1991) which indicate a ratio of 12.8 : 1.0 : 18.0 : 131.5 for the ages <5, <25, 25-64 and >=65 respectively. All other expenditure was assigned equally amongst all persons.

This study does not simply focus on the intergenerational distribution in 1994, but rather between generations over time, for which one needs to know the age incidence of these instruments over the period of this study from 1921 to 2100. Unfortunately data is limited and assumptions have to be made. Hills (1995) in his study made a "high" variation assumption and "low" variation assumption about health care expenditure, while income taxes were allocated equally across age groups. Auerbach et al. (1993) assumed that later distributions of taxes and benefits applied in the past. Although it would be useful to investigate the age incidence of taxes and benefits using historic micro datasets such as the 1955, 1973, 1980 and 1987 Household Budget Surveys, this is beyond the current study. Here we follow the Auerbach et al. approach and use the current distribution applied to historic and projected total expenditures.

11.3.The Evolution Public Expenditure 1921-1998

This section details the patterns in public spending and taxation since independence and measures the distribution of past spending and taxation across cohorts, following the method of Hills (1996), by tracking the average spending and taxation as a percentage of GNP per capita for each cohort over time. Although typical redistribution studies focus on the welfare state or simply the tax-benefit system, when comparing across generations and over time it is important to look at all public expenditure. This is because of the changing relative importance of different forms of expenditure. Direct taxes and social benefits are currently very important, however like many in developing countries at present, in the early years of the state, public expenditure was primarily focused on non-cash benefits and the means of collecting revenue was primarily through expenditure and property taxes. Also as local government expenditure was historically an important expenditure and revenue source, we include both state and local expenditure in the analysis.[73]

Discount Rate

In order to be able to compare incomes at different points in time, Economists use a concept known as a discount rate. We need to discount future net benefits as economic theory suggests that income received earlier is worth more than received later. As interest rates can vary substantially over time and even go negative, Hills uses the GDP per capita deflator to combine the effect of interest rates and inflation. This is a reasonable assumption to make as a measure of the average rate of return in an economy over time. Future income streams are not known however with the same certainty as past income streams. One should therefore incorporate the riskiness of these incomes when calculating the discount rate. Future income should be discounted by a value higher than the growth rate assumed. This assumption is also necessary in order to be able to calculate the net present value. Therefore, in this study we assume a discount rate of the growth rate in GNP for historical values and for future values a discount rate of GNP growth plus 2 per cent per annum.

Measuring Costs and Benefits of Public Expenditure

The budget deficit is a typical method for tracking public expenditure. However, ter Rele (1997) highlights that it is not a good measure for comparing the costs and benefits of public expenditure over time. Here a measure known as the net-benefit concept is used instead. The reason for this is that in comparing net benefits of generations, one needs to take account of when individuals received the benefit of public expenditure. For example in the case of capital expenditure, all the benefits do not occur during the year of the expenditure, but rather until the asset purchased has depreciated to zero value. Another problem with the deficit as an indicator of the strength of the public finances is that it does not include the cost of unfunded future pension liabilities. This can be quite severe as witnessed by the recent concern in Ireland about both state pension liabilities and the occupational pension liabilities of ~~pension~~ public ? sector workers,

[73] Local expenditure since 1977 has been primarily financed out of transfers from central

which are funded out of future revenue streams. Another issue relates to debt interest. If debt interest paid each year, although a component of public expenditure, is included in the net benefit concept, then financing current expenditure with debt will result in higher *benefits* for the generations financing the benefits for an earlier generation. Rather, the benefits result from the original net expenditures and should be apportioned to the generations alive at the time of the expenditure. Profits of the Central Bank should be regarded as a private commercial transaction and not included in our incidence analysis.

Instead of using actual capital and interest expenditures in the annual net benefit concept, we instead incorporate measures that more accurately indicate where the benefit of these expenditures accrues. In the case of capital expenditure, gross physical capital formation (GPCF), we transform this expenditure into an imputed income stream of depreciation and rate of return, spreading the benefits over the generations that use the assets. Depreciation is estimated at 1.4 per cent of the value of net physical assets per annum[74] and the rate of return equivalent to imputed rent from the holding of assets, assumed to be equal to the long run growth rate in the economy, 2 per cent. The value of the asset base used is a combination of annual public sector GPCF and a value for the initial public sector capital stock based on an estimate for 1950 in Henry (1989) and public sector capital formation 1921-1950. Turning to debt interest, we ignore previous debt interest in the calculation of the benefit concept. This allows us to measure net benefits as the difference between total benefits and total receipts. Total accumulated debt is however a liability for the future and as such reduces potential future consumption relative to future taxes. With regard to future debt or savings, we assume that the interest rate is equal to the discount rate used and therefore firstly the discounted value of current accumulated debt remains constant, and secondly future debt (savings) is simply the sum of future net benefits (costs).[75]

Figure 1 describes the trend of costs and benefits of public expenditure from independence until 1998 as a percentage of GNP. By costs to the population we include taxes and contributions. Benefits cover a wider term than simply social welfare benefits

---

government due to the abolition of local property taxes.

[74] The depreciation rate is estimated as the average rate across the whole capital stock of Ireland as defined in the study of Henry (1989) over the period 1950-1989.

[75] It must be remembered that if actual interest rates fall below the discount rate, then discounted debts will fall over time. This has occurred during a number of times in Irish history, when real interest rates went negative.

but include all current public expenditures, depreciation and imputed rent. The dotted line signifies the more conventional method of total expenditures, containing debt interest and capital expenditures. We notice that benefits to the population from public expenditure exceed costs in terms of taxation for almost the whole period. The difference between benefits to the population and costs narrows dramatically with the fiscal contraction of the late 1980's/early 1990's. With costs exceeding benefits by the late 1990's. We notice that the benefit and expenditure lines do not coincide. Benefits are initially higher than expenditures and cross about in 1960. The reason for this is that latter does contains debt interest payments which are more heavily weighted towards the end of the period, while the benefit of public capital infrastructures was proportionally higher during the early years of the state.

Table 1 breaks the trend of public expenditure into components. Before 1965, we notice a relatively insignificant welfare state, where with the exception of health expenditures, social welfare and education expenditures largely keep track with economic growth at about 3.5-5% and 2.5-3.5% of GNP respectively. Public health expenditure sees a gradual rise from 0.4% in 1921 to 1.7% in 1960. From 1960 to 1985, we see a large expansion in the welfare state with social welfare, education trebling and health expenditure increasing by a factor of 5 as a proportion of GNP. Benefits from capital expenditure (depreciation and imputed rent) fall over entire the period due to a diminishing public sector fixed capital stock as a percentage of GNP over time (See Henry, 1989). The fiscal contraction post 1985 saw a fall particularly in other and social welfare expenditure, but also to some extent education and health expenditure as a percentage of GNP.

11.4.Inter-Generational Expenditure

In this section, we apply the incidence assumptions to the trend in costs and benefits to decompose net benefits into actual cohorts. The benefits and the costs described in section 2 are allocated year on year to the cohorts alive during that period. Then the totals for each cohort are found by summing over each cohort's yearly total. Figures 2 to 6 present this decomposition over the lifetimes of individual cohorts. Each line represents the cumulative gain or loss per survivor of the instrument being described in the graphic from birth until the cohort's age in 1998. Therefore, for those born in 1921, the cumulative sum of 80 years is described, while for the cohort born in 1998 only the gain of the first year of life is described.

In Figure 2 we describe education spending over the lifetime of 9 cohorts. We notice that education spending is zero for the first years of each cohort, rises from school entry age until university leaving age and then levels out into a plateau as education spending diminishes to very low amounts to cover those in adult education and mature students. In terms of between cohort variation, we notice the trend of increasing education expenditure per cohort member. Although there was little difference between the cohorts born in 1921 and 1931, each cohort from 1931 to 1971 experienced higher average spending. This is a product of two factors, increasing expenditure per student and rising student numbers. Although those born in 1981 had not in general reached the end of their education, it seems likely that trend will be reversed for this generation. We must remember here that spending reported has been discounted using GNP per capita growth rates. So although expenditure per student may have increased in real terms, education expenditure fell during this cohort's school going period because education expenditure did not increase in line with GNP.

Figure 3 describes the trend in social welfare expenditure over these cohorts' lifetimes. Here the trend is towards higher expenditure later in life, highlighting the importance of pension expenditures in the social welfare system, which accounted for nearly 40% of social welfare spending in 1998. We must remember however that the results reported relate only the average amount per *survivor*. Therefore in terms of total expenditure one should place more weight on expenditures going to younger ages of each cohort than for the older ages as the latter group will have decreased in size due to emigration and mortality. We notice the effect of the expanding welfare state in that each succeeding cohort has a higher spend than the previous generation. The expanding welfare state had different stages. In particular looking at younger ages, we notice the effect of the introduction of Child Benefits in the late 1940's so that the cohort who were children before this period, have little child related transfers until about 1951 when child related transfers reached a steady state. Subsequent transfers to the under 18's remained relatively constant. The next effect we notice, is the increasing generosity and coverage of social welfare transfers to the working age population from the early 1960s until the late 1990s. This expansion is related to increased generosity of payments, but also mainly due to the expansion in client groups such as the unemployed, the sick and lone parents. Transfers to older people expanded for some of the earlier cohorts as social insurance pensions were introduced in 1960 and as a result, total pension payments rose ahead of economic growth until the late-1980's.

Figure 4 describes the trend in average health expenditure over the lifetimes of cohort members. We notice two trends. Firstly the age incidence of health care is significantly skewed towards the elderly and secondly the rising proportion of expenditure for each successive cohort. Health care expenditure rose particularly quickly between 1969 to 1975 from 2% of GNP to 6%. This represents a major change in health care provision. Therefore the longer a cohort lived after this change, the higher the health expenditure on the cohort. Before this period, expenditure as a percentage of GNP had been fairly constant, and as a result the pre–1971 cohorts had similar levels of spending while young. The 1971 cohort represents a transition cohort as the young received health care during the expansion of the health care system and thus have higher expenditure than the earlier cohorts, but less than the later cohorts, who were born after the reforms and thus had similar levels of health expenditure.

The expansion of the tax system occurred over a longer period. There was a gradual rise until 1965 and then quite a rapid expansion until a peak in the mid-1980's, before falling back over the remainder of the century. As a result, later cohorts will pay successively higher taxes (see figure 5). For the cohorts who have reached middle age and retirement in 1998, the effect of the reversal in the trend will not have been enough to reduce cumulative average tax rates below that of earlier cohorts. However later cohorts if current trends continue, will pay less tax relative to their income than will earlier cohorts.

Figure 6 draws the results of each of the components of benefit and cost of public expenditure together. The effect of aggregating costs and benefits is that we get the familiar N shape found by Hills (1995) for the UK. Initially the effect of increased education and health expenditures for young people is most noticeable as later cohorts have higher net benefits. Once cohorts leave education and enter the workforce the impact of the tax system dominates as public expenditure tends to be focused on early and late in life. As result, for this part of cohort's lives, cumulative net benefits fall. However, later expansions of the welfare state and corresponding rise in the tax rate benefited earlier cohorts to a relatively greater extent. This is because they paid relatively little tax during earlier low tax periods, but benefited later and in retirement from increased expenditure levels. Therefore, cumulative net benefits fall to a lesser extent for earlier cohorts over their working years and thus around the age of 20 the cumulative net benefit curves cross. For the cohorts who were older than 30 in 1998, the position the cohorts had in terms of early years cumulative net benefit is completely reversed. In fact for the 1921 cohort, they hardly reach a point of average cumulative net loss at any point during their lifetime. Other cohorts go substantially negative before the end of the working age, when the trend reverses again due to retirement benefits, increased expenditure and lower taxes.

11.5.Demographic Pressures

The motivation behind the interest in intergenerational equity is in the changing demographic picture. Ireland unlike many other countries in Western Europe currently still has a relatively young population, with about 50 per cent of the population aged under 25 and only about 10 per cent of the population aged 65 or over. The proportion of elderly has remained relatively constant at about 10 per cent over the whole 20th century. Despite historically high birth rates, migration has tended to offset this inflow to keep the population constant or in fact falling over the period.

Underlying the analysis of this chapter is a forecast of the potential demographic situation in Ireland over the next century. However it must be noted that Irish demographic forecasts are notoriously poor. This is a result of volatile cycles of migration and the unpredictable nature of fertility. Caution therefore needs to be taken with any long term forecast.

A number of assumptions need to be made. The mortality assumption is based on that made by CSO (1996), assuming a gradual reduction in the mortality rate over time, increasing the life expectancy at birth in 1992 from 72.3 to 77.2 in 2027 for men and from 77.9 to 83.2 for females. Thereafter life expectancy is assumed to be constant. We do not follow the birth rate assumptions made by the CSO as their prediction scenarios assumed a long-term fall in the birth rates. However in the years following this projection, the birth rate increased from 13.4 per 1000 in 1994 to 14.5 in 1998. Part of this recovery in the birth rate results from a rise in the number of women of childbearing age, however nevertheless the total fertility rate has increased over the period. Although little research exists on the topic, it may be no coincidence that the birth rate fell the most during the low growth years of the 1980's and has risen again during the second half of the 1990s, a period of high economic growth. We make the assumption that Age Specific Fertility Rates remain constant over the forecast period. Migration forecasts too have been fraught with difficulty. Both projection scenarios of CSO (1996) assume net emigration during the period 1996-2006. However Punch and

Finneran (1999) report rising net immigration in the period 1995-1998. In our forecast we assume a continuation of the net immigration rate of 1998 through 2007, a period of expected continued growth, with no net migration during the rest of the forecast.

The result of these assumptions is that the population will gradually rise by nearly 25% between 1991 and 2025, declining afterwards. Although fertility rates are below the long-term replacement rate, the number of births will rise as the large birth cohorts of the 1970's and 1980's have children. Forecasted immigration levels will also increase the population. However after this period the population will fall due to the lower fertility rate. Unless behaviour changes, the projected population will fall to less than 75% of the peak level by the end of the century. One however must be very cautious about such long-term projects. Given the problems forecasting 10 years in the future which Irish demographers have had recently, future trends could be very different.

Figure 7 describes the distribution of the Irish population by age group for 1961, 1991 and forecasts for 2050 and 2100. The large dip in the 20-30 age group in 1961 deviating what one would expect to be a relatively concave curve reflects the very high emigration levels of the 1950's. In contrast to today, this gave Ireland the highest old age dependency ratio in Europe in 1960. The following generations were not greatly affected by emigration and in addition continued to have the high birth rates. In addition, Fahey and Fitzgerald (1997) point out that although significant improvements have been made in the child and young adult mortality rates, improvements in mortality amongst the elderly has not matched that in other countries and thus longevity has not had much of an impact on the demographic structure.

Over the short term the elderly dependency ratio looks very positive (See Figure 8). This is due to a number of factors. Firstly, large-scale emigration in the 1950's from the cohort born in the 1920/30's, means that the generation currently entering retirement will be small. Over the next 50 years however, the picture is expected to change, with the proportion of 65+ expected to double and the proportion of the very old (80+) expecting to treble. The reasons for this lie in factors that influence short-term trends and also due to the rapid drop in fertility since 1980. The numbers retiring will naturally rise as a result of larger cohorts reaching retirement; both 20-year cohorts who succeeded the current retirement cohort born in the 1920's/30's are much larger. In addition this is coupled, with a dramatic reduction in birth rates since the 1970's. Since 1971, the total fertility rate has dropped about 4 to 1.8 in 1994 and it is unlikely that birth rates will return to the levels of the 1960's and early 70's again. If this pattern of low birth rates does in fact continue, then large retiring cohorts will be accompanied by small and decreasing working cohorts. In addition, increased education levels may through improvements in public health improve elderly mortality rates.

In order to reverse this process of long-term population decrease and short-term increased elderly dependency ratios, we have considered what changes in future fertility rates would be necessary. To ensure the long-term stability of the population, fertility levels would have to increase by 17%, not too large an increase given recent changes, only twice the increase which occurred between 1994 and 1998. However, even with this rise in fertility elderly dependency ratios would increase by a third by 2060, before levelling out. In order to maintain elderly dependency rates at the present level, fertility rates would have to rise by a third, resulting in a fast growing population, increasing by over 200% in 2100. Nevertheless because of the very low starting position, even the forecasted rise is likely to produce dependency rates that are lower than many European countries have today.

11.6.Demographic Ageing and Intergenerational Redistribution

Given the expected change in the demographic position, what will be the change in the distribution of public expenditure? Falling numbers of children coupled with an ageing population should result in a shift in expenditure up the age distribution. Figure 9 compares the degree of intergenerational redistribution in 1998 and 2050 in Irish Public Expenditure plotting discounted net expenditures by age. Here we use the same discount rate and growth rate for comparative purposes so that we can isolate the effect of the ageing population.[76] As expected, we notice an upward shift in the age expenditure distribution. Because the fertility rate decrease happened before 1998, there is only a small impact on child related expenditures. We notice however, a large increase in the net expenditures for the 20-30 age group as net taxes fall because of the fall in the size of this cohort by a third. The increase in the size of the 50-60 population will also increase the level of tax paid by this age group. However the biggest effect is seen in the over 65 population which increases in size by over 125%.

11.7.Public Finances and Demographic Change

[76] Other assumptions such as the changed levels of unemployment are maintained however.

The focus of this chapter is the degree of inter-generational redistribution of the Irish public finance system. So far we have only looked at the distribution of fiscal policy in the past. However as the Irish state was only founded in 1921, no full cohort has lived its full life within the state. It is therefore necessary to forecast future public spending and taxation to complete the lifetime profiles for all currently living generations.

We now forecast the trajectory of public finances. This section takes the assumptions underlying the Department of Finance's Long-term Issues Group predictions of future government receipts and expenditures (DOF, 1998) and examine a number of alternative scenarios:

- Growth
- Department of Finance Assumptions
- Tax Cut
- Recession
- Price Linked Social Security Increments

The first scenario assumes that expenditure and taxes per person increase at the same rate as GNP per capita, averaging 6% until 2000, 4% until 2010 and 2% thereafter. The next scenario is the Department of Finance assumptions:

- Taxes increase at the rate of GNP.
- Social Insurance Contributions increase at 80 per cent of the rate of GNP. Other revenues increase at the rate of prices. As a result revenues will tend to fall slightly relative to average income over time.
- Public Service Pay and Pensions are expected to rise a rate of 2 per cent per annum above inflation.
- Social Welfare benefits per recipient will rise at 1 per cent above the rate of inflation. As this is below the growth rate, it will have the effect of a falling replacement rate over time and as a result will cause benefits to fall relative to earnings. The numbers of unemployed are assumed to decrease to 100,000 by 2050

and recipients of lone parent, carers, disability and supplementary welfare benefits increasing by 10, 10, 6 and 7 per cent respectively per annum until 2010.

- Health Expenditure which has risen steadily over recent decades, with a slight dip recently is expected to rise to 10% of GNP in 2035 due to the age population and due to the greater expectations from a public health service.

- Although the number of children will fall, education expenditure is assumed to follow the rate of growth of GNP. Therefore either the expenditure per student will increase or the number of students will increase.

- EU expenditures are expected to rise to £300m and other non-capital expenditures to grow at 2 per cent above the rate of inflation. Capital expenditures will remain at 4.5 per cent of GNP. Also it is assumed that a contingency fund of 2.4 per cent of GNP will be maintained over the course of the forecast.

The third scenario, assumes a once off cut in taxes in 1999 of 1 per cent of GNP. Over the remainder of the forecast, the DOF assumptions are followed. Scenario 4 takes the DOF assumptions but holds social welfare payments constant in real terms. The final scenario examines a less optimistic scenario. It assumes a 15 year downturn with similar rises in recession related welfare benefits such as unemployment, disability, lone parent etc to the rise during the period 1980-1995. In addition rather than following the DOF forecast we use the assumption that current spending patterns are otherwise maintained.

Figure 10 compares the trend in the resulting annual budget position of each economic scenario. The Department of Finance projections forecast taxation rising at the rate of economic growth, while most expenditures rise at below the growth rate below the growth rate of the economy. Starting from a position of a budget surplus, in the absence of policy change, on the basis of the assumption, this will result in an increasing budget surplus over time. Part of the reason also is a fall in the numbers of the groups with the highest usage of public services, the young and the elderly, combined with not only an increase in the working age population, but also an increase in the labour participation rate. However once the population starts ageing, the budget surplus diminishes. If taxes and benefits rise at the rate of economic growth, then the picture is less rosy. Although budget surplus initially rises, it peaks earlier and starts falling sooner. A once off tax cut will result in a trend parallel to the DOF trend, while price linked social security increments will result in a progressively better budget position than the DOF central forecast. All of these assumptions however assume a reasonable stable economic climate with falling and then moderate unemployment levels. In the final scenario, we assume that there is an economic downturn that lasts 15 years with a similar year on year change in the expenditures on recession related social expenditures as the economic downturn of the period 2010-2025. The effect of this recession would have quite a strong consequence on public expenditures coming in tandem with demographic changes.

11.8.Lifetime Redistribution across Generations

The next step is to apply the economic and demographic projections to our age fiscal incidence assumptions. This will allow us to examine the differential lifetime redistributive impact on different generations and identify which cohorts will do relatively better from the state over their lifetime.

Figure 11 describes the cumulative net gain per survivor over the lifetime of 5 cohorts, born in 1921,1941, 1961, 1981 and 1998. This figure follows the Department of Finance projection. Here we see the continuation of the trend identified in figure 6. Amongst the cohorts born 1921-1961, there is a progressive worsening of their lifetime position as the each pay more taxes, while the earlier cohorts received higher public expenditure without the higher taxes. For the 1921 cohort, those living into retirement will be net beneficiaries from public expenditure. For the 1941 cohort only those living into their 80's will on average be net lifetime beneficiaries. However by the time of the 1961 cohort will on average be a net loser from the state at all ages. It must be noted that these figures represent averages. Those who spent their lives in receipt of benefit will always be likely to be net beneficiaries regardless of their birth cohort. Likewise the lifetime rich will tend to be net lifetime losers. For these cohorts, the trend is similar to that reported by Hills (1995) for the UK. However at this stage, the pattern changes. Public expenditure levels fall, but so does, taxation levels. As a result the cumulative age distribution is flatter. Although cumulative gains are higher at the end of the education cycle, because of increased participation, the cumulative losses are lower for the 1981 and 1998 cohorts. Meanwhile because of the assumption about the relatively lower increase in pension in old age, these cohorts do not have has great a net gain in retirement as the other generations.

In this figure we examined the average net gain *per survivor*. However with rising life expectancy over time, it can be expected that cohorts with higher survival rates will have over the whole cohort higher lifetime gains than those with lower survival rates. Bigger cohorts will also tend to have higher gains. We can see this effect in figure 12. Later cohorts have returns by the end of their lifetime more similar to that of the earlier cohorts. We also notice the fact that the 1961 and 1981 cohorts are larger than the 1998 cohort is. Total expenditures during the education cycle are higher and result in a higher net gain peak, while because of larger size combined with the higher average tax rates faced, the net losses are lower than we saw under the per survivor basis. Because benefits are similar in size and because life expectancies are not that different the relative size of the cohort is the most important factor determining their relative position into retirement and the end of their lifetime.

These analyses have used the Department of Finance central projections. We now examine the sensitivity of the results to different economic forecast assumptions in table 2. The values represent the average net lifetime gain of each cohort relative to the size of the cohort at birth. For each scenario, we observe a similar pattern. The oldest cohorts will have had the highest net gains, which will tend to fall for the next cohorts before going negative and then with the lowest point reached around the cohort born in 1961. Thus this cohort will face the highest burden of financing the relatively good position of the early. For the remaining cohorts alive in the 1998, the position looks relatively better, rising almost continuously by cohort until the 1990's when the average net benefit remains constant. Because of the assumptions used, the later cohorts net benefits are as a result almost entirely from the projections made. The earlier the cohort the more accurate the lifetime position because most of the net benefits will already have occurred. Amongst the economic scenarios, in terms of the net benefit of public expenditures, the one which provides the highest benefit for each cohort, is the one that assumes a continuation of current expenditure patterns, followed by a recession (Recession) around 2010. The constant spending pattern (Growth) is the next most beneficial, followed by the tax cut, the Department of Finance projection and lastly because of the gradually diminution of social welfare payments, Price indexed SW is the least beneficial. Conversely however, the assumptions that are most beneficial to current generations are least good for the public finances. Finally, we notice for the later generations, under 3 of the assumptions, although better off than the 1950-1970 generations, no generation becomes a net beneficiary of public expenditure. Only in the case of the two assumptions based on constant expenditure patterns do any generations become lifetime net beneficiaries.

11.9.Fiscal Sustainability: Generational Accounting

So far we have examined the position of generations alive in 1998. The relative generosity of previous generations will have an effect on the net relative position of later *unborn* generations. Thus expenditure on current generations affects the fiscal sustainability of current government policy. Relatively generous provision will have the effect of placing a burden on future generations, while relatively cautious provision will have the effect of giving a bequest to later generations. In order to measure the fiscal sustainability we utilise a concept due to Auerbach, Gokhale and Kotlikoff (1991), known as *Generational Accounting*.

Generational accounts compare the position of current generations in terms of future net government expenditure with the position of future generations. Under the generational accounting hypothesis, it is assumed that current public policy is continued for those currently alive. Thus the government's intertemporal budget constraint does not affect these generations. The constraint however is assumed to apply to future generations. The intertemporal budget constraint can therefore be regarded as a source of conflict between generations as fiscal policy that benefits current generations will place a burden on future generations.

Within the generational accounting framework, two measures are typically used. The first measures the inheritance of future generations due to fiscal policy applied to currently alive and past generations. It is defined as current net government wealth minus the present value of the net benefit of current generations. Here generational accounts only focus on future net expenditures. Past net expenditures are incorporated by the net wealth of the public sector currently. In any case, the cohorts examined in the previous section consider only these generations born since the foundation of the Irish State. Many other generations lived part of their lives in the Irish State and thus make an impact on current net wealth. This *level* measure is therefore a measure of the net future burden of current fiscal policy. The second measure typically used is a measure of the difference between the average net benefit obtained by current generations and that achieved by future generations. This *difference* measure therefore provides a measure of the fiscal sustainability of current government policy. If the net tax burden of newly born and future generations is equal, then current fiscal policy is sustainable. However if the net benefits of current generations are greater than that of future borns, then fiscal policy is unsustainable. Conversely if net benefits of the future born are higher, there may be cause for greater expenditure on current generations.

Generational accounts have now been developed for many countries. 17 are included in Kotlikoff and Leibfritz's (1998) paper. Of these only 3 countries have negative imbalance and thus do not have substantial fiscal sustainability problems. This is a finding also found in a recent study of generational accounts for Ireland by McCarthy (1995).

There are a number of concerns about generational accounts however. Firstly generational accounts typically compare the position of the newly born with future generations. Doing this they make the assumption that the treatment of newly born is representative of all generations currently alive. This is a steady state assumption that is not justified by the analysis in the preceding section, where we have seen that fiscal policy most definitely has not been in a steady state for past generations. Banks et al. (1999) argue that rather than maintaining the assumption of a continuation of current policy, one should maintain the current longer term *fiscal stance* in the projections. The projections should therefore incorporate announcements about future policy developments. They also argue that generational imbalance does not correspond with conventional measures of fiscal sustainability such as the Golden Rule. As Samuelson pointed out intergenerational redistribution can be infinitely lived, with each generation gaining more than they put in. Another criticism of the approach is the static nature of the analysis. In other words, generational accounting does not incorporate the fact that much of the information used by the account is in fact endogenous (See Buiter, 1995). Therefore generational accounts should more properly by taken into account in a general equilibrium framework. Thus the generational account does not incorporate the welfare changing second order effects to private welfare. He also notes that the equal sharing rule of unallocated public spending does not necessarily effect all groups equally. Another empirical problem noted by Banks et al. (1999) relates to the fact the generational accounts typically are based on age-income profiles produced using cross-section data. Because of age and cohort effects, these may not represent the true permanent age-income distribution and thus may in fact bias the future projections on which the accounts are based. Nevertheless, despite these criticisms, generational accounts serve a useful illustrative tool. Buiter (1995) describes them as being useful but that should be *handled with great care.*

Our projections are described in table 3. We divide the total into 2 groups, the total net present value of the generational account for each generation cited and the average generational account per member of the particular generation. Within these groups, we consider:

1. The generational account for all generations alive in 1998, bar those aged 0.

2. The generational account for the newly born generation in 1998.

3. The resulting generational account for those born in the future assuming a fixed intertemporal budget constraint.

4. The forecasted generational account for those born in the future assuming a continuation of the projection assumptions.

Result 3 when taken for all members of the generations is equal to the sum of result 2 plus 1 plus the net public sector wealth of £ 30 billion in 1998. Result 4 relates to the budget constraint of future generations if current policy is continued. The first consequence we notice is that the residual budget constraint for future generations for each scenario is positive. Therefore the result of each scenario is a bequest from current generations to future generations. The reason for this is that most of the later generations alive in 1998 are expected under the policies examined to be lifetime net losers from public expenditure. Price indexation of social welfare payments causes the biggest transfer of resources to future generations, thus resulting in a transfer from the poor to future generations. The next most generous transfer is on the basis of the Department of Finance assumptions. However a large component of this assumption is on the basis also of quite modest indexation of social welfare benefits and thus the direction of the transfers will be similar. At the other extreme are the scenarios based on current spending patterns, GROWTH and RECESSION. Here the extent of the transfer is much less.

We now turn to the second measure, the difference of the average gain per member of each cohort examined. The amounts described here for result 2 are the same as the result reported in table 2 for the 1998 generation. Here, we find that in every case, except for the RECESSION scenario, on the basis of a revenue neutral budget constraint, that future generations have higher net benefits per capita than the newly born generation in 1998. Therefore on this basis, fiscal policy is sustainable. Unexpected shocks to the economy may however reverse this finding. In each case however, because transfers to future generations are primarily being financed from older generations currently alive in 1998, that the average per capita net present value for these generations is substantially lower than that for the newly born and the future generations.

The results may be sensitive to the assumption about the discount rate. In table 4, we examine the sensitivity of the Department of Finance projection to the discount rate assumed. Here we see that substantially the same conclusions can be drawn when using discount rates of either 1% or 3% higher than the growth rate. Although the direction of the results are broadly the same, the difference between the net present value is quite different.

11.10. Inter-Generational Redistribution

In this final section we try to gauge a measure of total redistribution between generations. The standard measure of redistribution as discussed in chapter 1, is the Reynolds-Smolensky index. This index measures the difference in income variability for income after government intervention through taxes and public expenditure with income variability before this intervention, *ceteris paribus*. The more redistributive the system the less variable disposable income will be relative to pre-intervention income. A problem exists however, when one examines income between generations due to the use of a discount rate. Discounting will tend to equalise the inter-generational pre-intervention income and may even reverse the direction of the standard of living. Therefore any measure of redistribution will strongly depend on the discount rate used.

In order to construct this index, we need to know both the pre (gross) and post (disposable) government intervention lifetime income of each generation. Like other static incidence studies, we assume that gross income is disposable income minus net government expenditure. So far we have derived measures of net government expenditure per generation under various assumptions. Unfortunately there are no household level national accounts available for Ireland. As a result it is not possible to impute generational gross income in the same manner as we have done in the rest of this chapter. We do however know the level of GNP in Ireland for the period studied. Examining the relationship between gross household income and GNP in other countries (in the OECD national accounts for example), one notices a clear relationship between the two numbers, with household gross income consistently 75-80% of GNP. Utilising the method described above, we can impute a value for gross income by multiplying GNP by 0.775 and assigning gross income using the age incidence assumption for gross income described in table 1 each year. Summing discounted gross income we can produce lifetime gross income.[77] Disposable income is net benefits plus gross income. Although the measure of gross income is quite crude, the Reynolds-Smolensky depends mainly on the distribution of net expenditure over the distribution.

We decompose the Reynolds-Smolensky index into a component that accounts for progressivity or in this case the transfer of income from rich to poor cohorts and horizontal redistribution, a measure of the change in ranking of generations of post intervention income relative to the ranking of pre-intervention income. The progressivity component is valued at 0.02, a slight degree of redistribution from rich to poor generations, while the horizontal redistribution component is -0.01, summing to total redistribution of 0.019. Using a higher discount rate reduces the degree of inequality across generations and in fact reverses the direction of the redistribution, with horizontal redistribution becoming more important than vertical redistribution. As the discount rate tends to 0, the degree of vertical redistribution from rich to poor increases to 0.027, with the degree of horizontal redistribution tending to zero. Therefore as we can see the degree of inter-generational redistribution is quite sensitive to decisions about the discount rate. Nevertheless if we compare the degree of redistribution between generations, we see that the effect is quite small relative to the impact of a tax-benefit system over a cross-section of the population.

11.11. Conclusions

In this chapter we attempted to examine the issue of intergenerational redistribution in Ireland. In addition to public intergenerational transfers, there exist private intergenerational transfers. For example bequests will tend to run in the opposite direction to public transfers, while private transfers will tend to be in the same direction. Seniority rules will tend to result in older workers being paid more relative tot heir marginal productivity than younger workers, resulting in a transfer to young working age to old working age. However with rapidly rising education levels of the young

[77] In order to compare GNP in different years, we need to use a different discounting factor to the growth rate. Here we use the long term growth rate for the economy, 2.5%.

relative to the old and with much of the growth in the Irish economy occurring in high technology sectors where seniority rules tend to be less important, then the impact of seniority on inter-generational transfers will become less important. Other intergenerational transfers include the care of dependants. These include the care of children and elderly relatives, which again move in the same direction as public transfers, but also in child care provision provided by grandparents, where transfers move in the opposite direction.

However looking at transfers between generations at one point in time tells us nothing about true inter-generational redistribution. It simply measures the level of redistribution over the life-course. In order to compare the degree of redistribution between generations it is necessary to look at the government's effect over the lifetime as life-course redistribution may in fact balance out over the lifetime, to result in no net gain. In this chapter, we have tried to generate measures of the net benefit from public expenditure over the lifetimes of different cohorts. Because no cohort has spent an entire lifetime in the Irish State, due to its foundation in 1921, it has been necessary to make projections. Doing this we can compare the net benefit of different generations alive in 1998, noting however, that results for the older generations alive at the time are more accurate due to a lower reliance on projected information. Results are also dependent on our assumptions necessary to allocate aggregated information to individual cohorts. Nevertheless, there appears to be clear gaining generations; those born before the second world war, who gained both from relatively low taxation during their working years, and from a modern welfare state in the latter part of their lives. Subsequent generations will tend to be net losers, with the generation born around 1960 being the generation with the largest net loss. These generations have worked during the period of the highest taxation and may have relatively lower welfare benefits in retirement, depending on the assumption followed. We also notice that periods of recession result in higher net gains from public expenditure. This highlights that positive intergenerational transfers may not necessarily result in gaining generations having higher welfare levels, as presumably an individuals welfare would be higher from being in work and pay taxes and thus than being unemployed and receiving benefits.

In order to examine the long term sustainability of the system, we use a method known as generational accounts. The principle results are that the system is sustainable. This is a result that is different to many other countries. In Auerbach et al's. survey, only 3 of

17 were in a similar position. Much of the change has occurred in the last decade and relates to the medium term positive forecast. A second result is that under most projection assumptions unborn generations gain more that current generations, indicating a degree of intergenerational redistribution from the present to the future. However relative to the degree of redistribution between people in a particular year, relative to the income of entire generations, intergenerational redistribution is relatively small.

One however must be cautious in interpreting these results. In a similar way to other studies of its kind, relatively crude projections were used as a basis for this chapter. Although it seems that public expenditure is sustainable, care needs to be taken if policy changes were introduced as a result of these positive indicators. It may seem that because of the negative generational imbalance, one can loosen the public finances substantially. However such policy changes cannot be examined in isolation. Policy changes will themselves have impacts on the wider economy. For example we can see at present the impact of loose fiscal policy on inflation, with Ireland having amongst the highest inflation rates in Europe and still targeting tax reform on the top of the income distribution. Rising inflation in a single currency area will have detrimental effects on competitiveness and the in turn reduce the ability of the economy to maintain its strong growth. It is important therefore to incorporate a model of the economy into projections of this kind.

Despite these general equilibrium drawbacks and the problems described in earlier in the chapter, it is argued that generational accounts are a useful policy tool for government fiscal policy. Auerbach et al. (1991) highlight that governments traditionally take the budget debt and their deficits as their primary indicators of fiscal policy. For example the EMU convergence criteria included an objective of maintaining budget deficits with 3% of GDP. Similarly the USA has instituted legislation that aims to balance budgets in the medium term. They argue that these objectives are not however concerned about generational balance, that fiscal policy is sustainable in the long term. Therefore, generational accounts should be incorporated, as a measure of fiscal sustainability by governments as is the case in Norway, Italy, Japan and New Zealand (Fehr and Kotlikoff, 1998).

Tables and Figures

Table 11.1. Components of Public Expenditure as a Percentage of GNP 1921-1998

Year	Social Welfare	Education	Health	Capital	Other	Benefits	Costs	Net Benefit
1921	3.9	2.9	0.4	13.1	22.3	42.6	27.5	15.1
1925	3.4	2.7	0.5	12.1	22.4	41.1	25.2	15.8
1930	3.4	2.8	0.9	10.5	19.1	36.6	24.3	12.3
1935	4.2	3.0	1.3	10.9	24.9	44.2	31.4	12.8
1940	5.0	2.6	0.7	12.5	26.6	47.3	29.8	17.5
1945	4.3	2.0	1.1	10.1	23.3	40.7	26.8	13.9
1950	3.9	2.4	1.2	9.7	32.2	49.3	33.8	15.5
1955	5.2	2.1	1.4	7.9	28.1	44.7	31.5	13.2
1960	4.8	2.2	1.2	6.7	24.8	39.6	29.8	9.8
1965	5.4	3.0	1.6	6.0	27.9	43.9	34.2	9.7
1970	6.8	4.1	2.7	5.4	32.4	51.4	37.3	14.1
1975	10.0	4.8	5.6	5.2	36.1	61.7	36.4	25.4
1980	9.4	5.5	7.3	4.7	32.7	59.5	42.0	17.6
1985	14.4	5.5	7.1	4.9	33.7	65.6	57.4	8.2
1990	11.4	4.9	5.7	3.9	22.3	48.2	53.0	-4.7
1995	11.3	5.3	6.7	3.5	24.9	51.8	54.2	-2.4
1998	10.2	4.8	6.1	3.0	28.3	52.3	58.5	-6.2

Source: CSO Statistical Abstract various years and Imputation by Author

Table 11.2. Net Per Capita Gain by Generation (different forecast scenarios)

Year of Birth	DOF	Growth	1 % Tax Cut	Price Indexed SW	Recession
1921	56810	57597	56824	56280	57617
1926	41878	43374	41902	40881	43442
1931	31570	34216	31616	29837	34387
1936	16483	20351	16635	14006	20670
1941	-511	4942	-223	-3689	5488
1946	-19066	-12382	-18597	-22979	-11466
1951	-34858	-26746	-34107	-39914	-24235
1956	-45521	-36562	-44443	-51563	-32459
1961	-51108	-41600	-49693	-57999	-35686
1966	-30853	-21727	-29261	-37855	-14647
1971	-26853	-17378	-25026	-34468	-8655
1976	-28023	-17792	-25978	-36448	-6950
1981	-22975	-11910	-20898	-31818	482
1986	-14202	-3808	-12382	-23037	9553
1991	-6637	1857	-5029	-15481	16366
1996	-6276	2242	-4831	-15130	17369
1998	-7038	2205	-5660	-15833	16674

Source: Author's Calculations

Table 11.3. Generational Balance (Discounted total expenditure per person)

Total in £ million	DOF	Growth	1 % Tax Cut	Price Indexed SW	Recession
Current generations	-154714	-119720	-149597	-181629	-91100
Newly born generations	-378	118	-304	-850	895
Generation born in 1999	125092	89602	119901	152479	60206
Future generations forecast	-26506	-2137	-23344	-50503	35338
Per capita £					
Generations (aged 1-99)	-43907	-33976	-42455	-51545	-25854
Newly born generations)	-7038	2205	-5660	-15833	16674
Generation born in 1999	25651	18373	24587	31267	12346
Future generations forecast	-5435	-438	-4787	-10356	7246

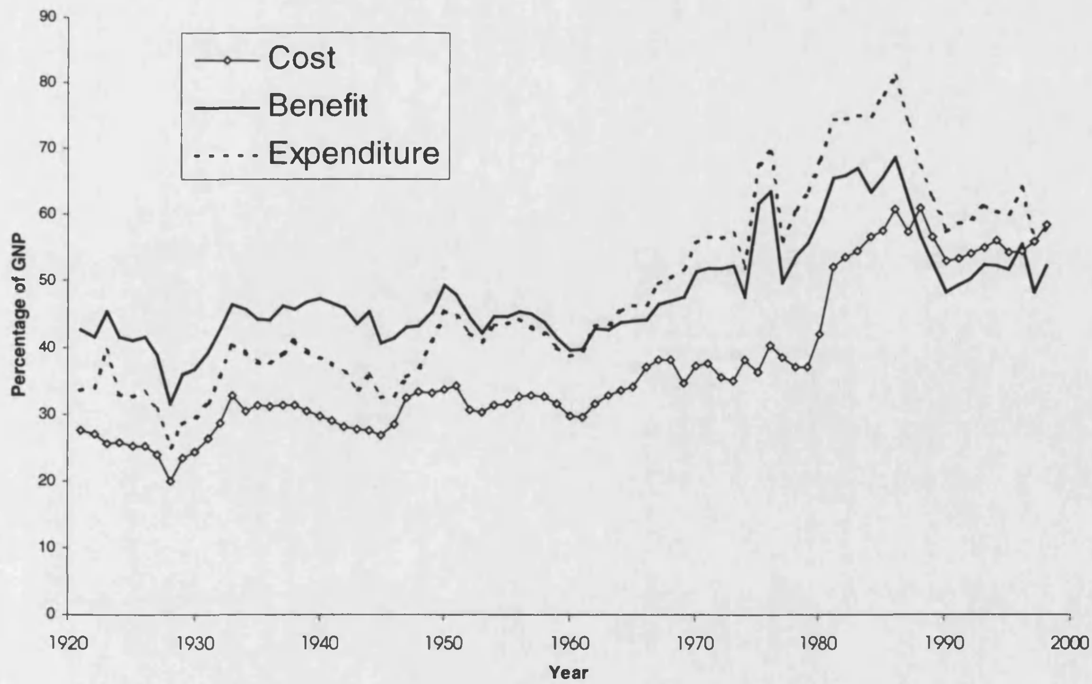
Source: Author's Calculations

Table 11.4. Sensitivity Analysis using DOF forecast (Discounted total expenditure per person)

Total in £ million	GNP +2%	GNP +1%	GNP +3%
Current generations	-154714	-154478	-147073
Newly born generations	-378	-1256	348
Generation born in 1999 (revenue neutral)	125092	125734	116725
Future generations forecast	-26506	-115468	9662
Per capita £'s			
Current generations	-43907	-43840	-41739
Newly born generations	-7038	-23397	6488
Generation born in 1999 (revenue neutral)	25651	25900	23827
Future generations forecast	-5435	-23785	1972

Source: Author's Calculations

Figure 11.1. Costs and Benefits as a percentage of GNP 1921-1998



Source: Author's Calculation and CSO Statistical Abstract various years.

Figure 11.2. Average Education Spending in £'s per Survivor, 1921-1998 (discounted to 1998)

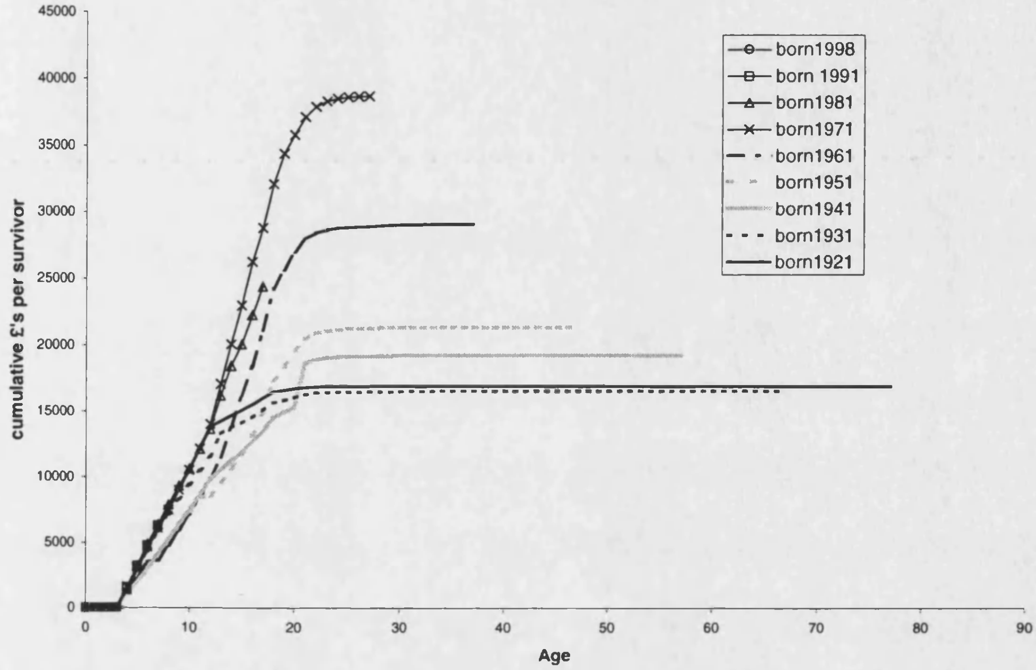


Figure 11.3. Average Social Welfare Spending in £'s discounted to 1998 per Survivor, 1921-1998

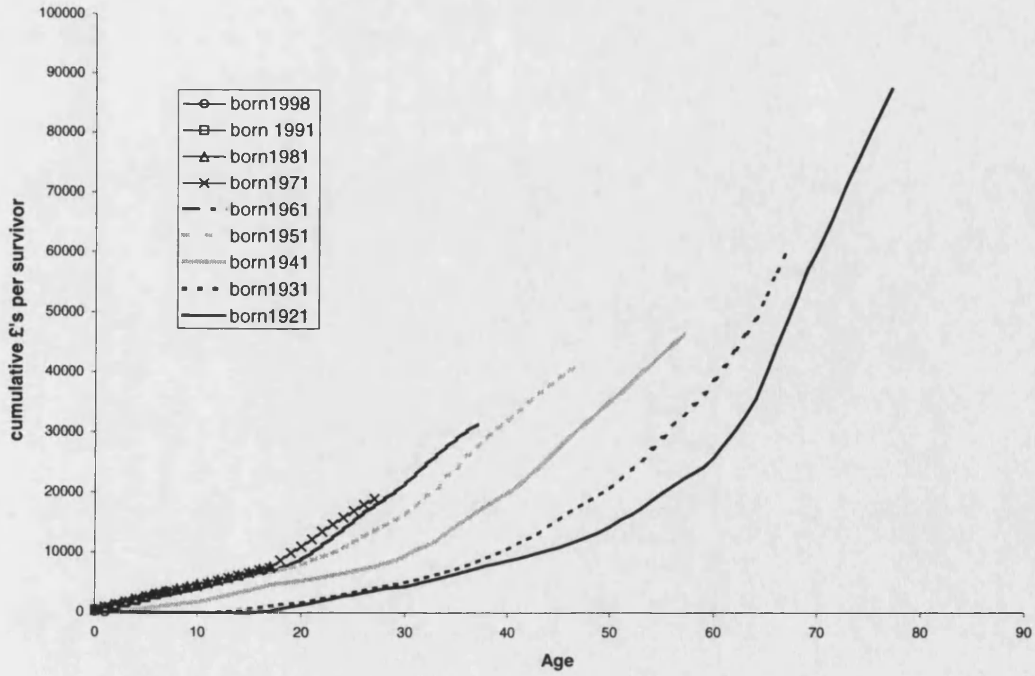


Figure 11.4. Average Health Spending in £'s discounted to 1998 per Survivor, 1921-1998

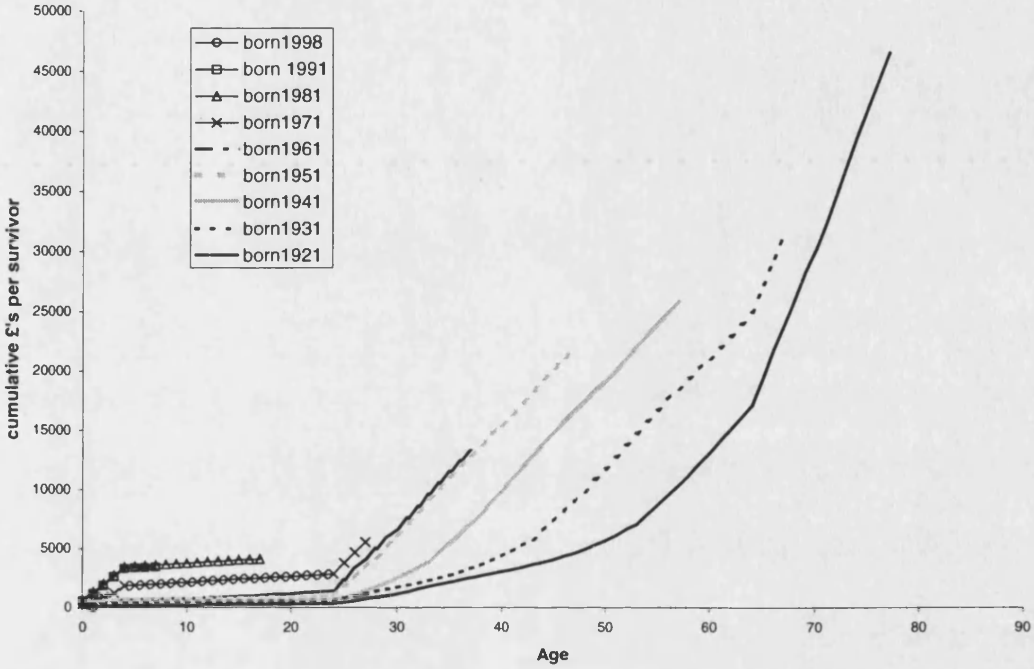
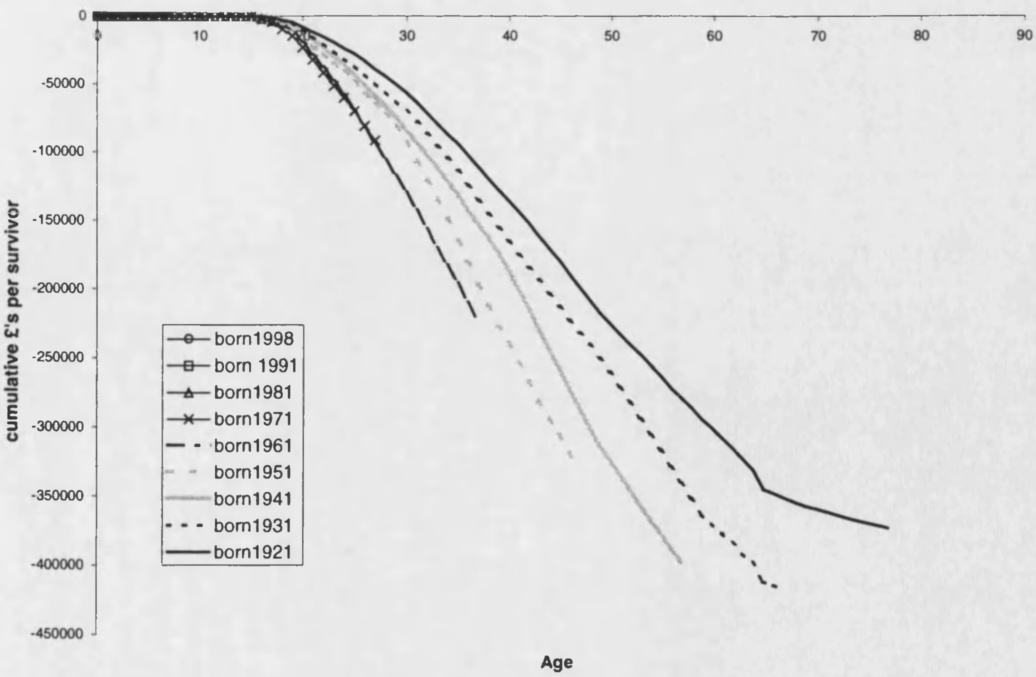
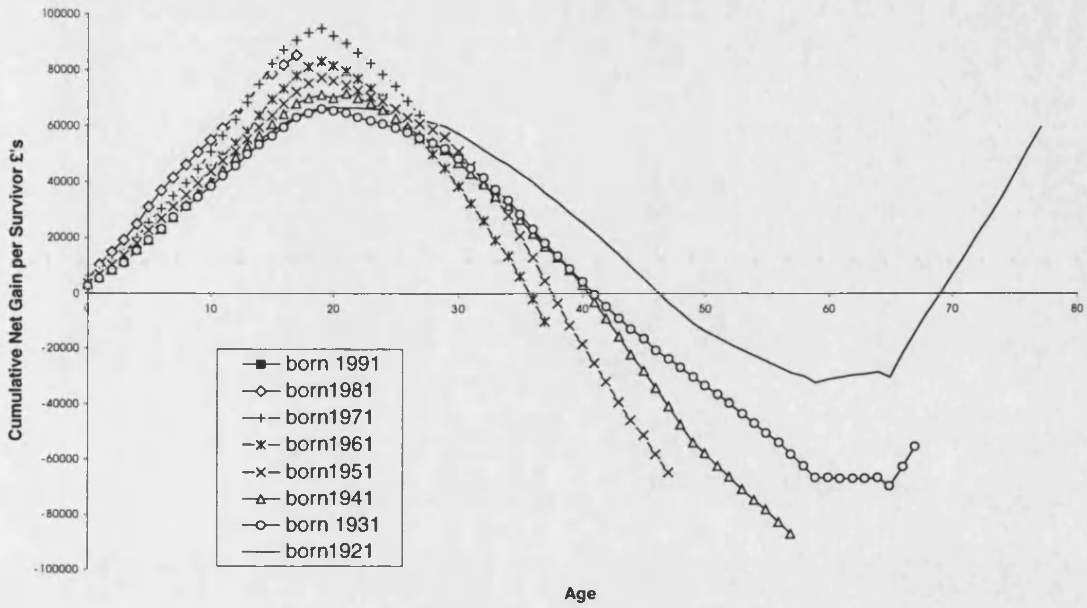


Figure 11.5. Average Taxation in £'s discounted to 1998 per Survivor, 1921-1998



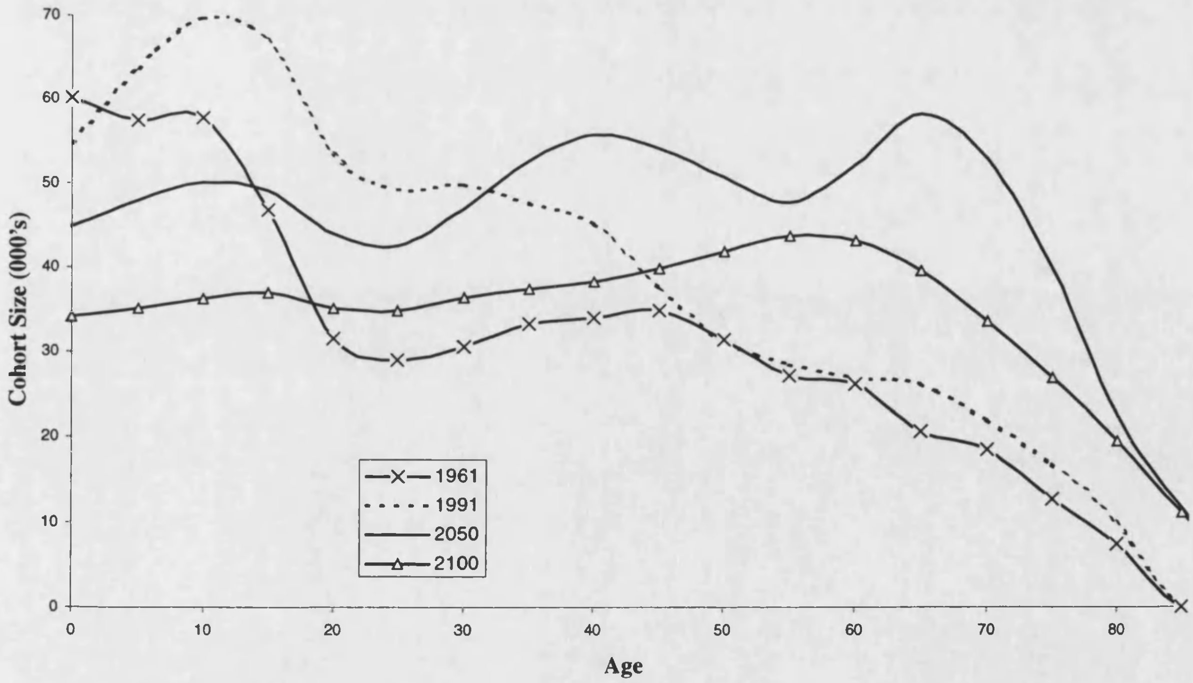
Source: Author's Calculations

Figure 11.6. Net Gain in £'s discounted to 1998 per Survivor, 1921-1998



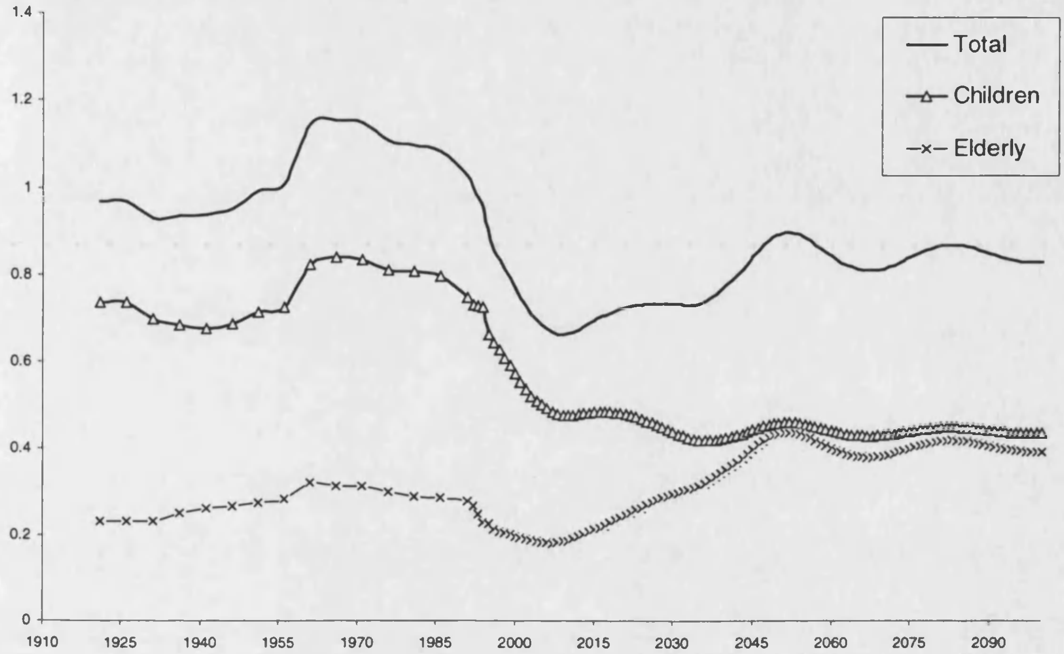
Source: Author's Calculations

Figure 11.7. Age Distribution of Irish Population, 1961, 1991, 2050, 2100



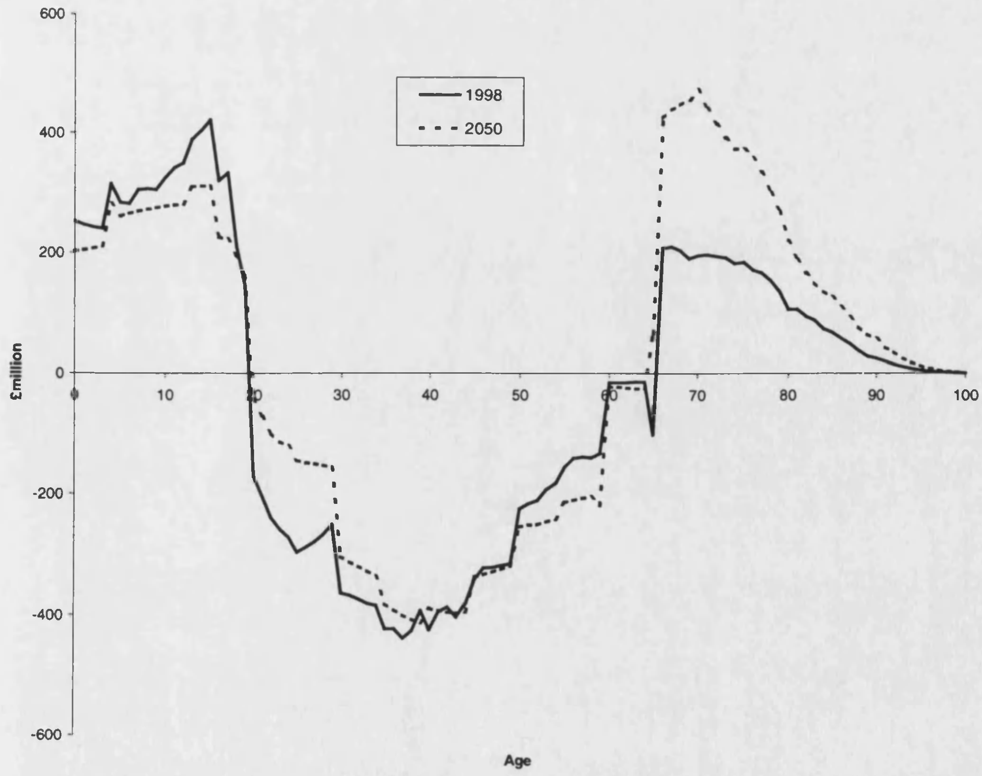
Source: Irish Census (CSO, various years) and Author's Calculations

Figure 11.8. Child, Elderly and Total Dependency Ratios, 1926- 2100.



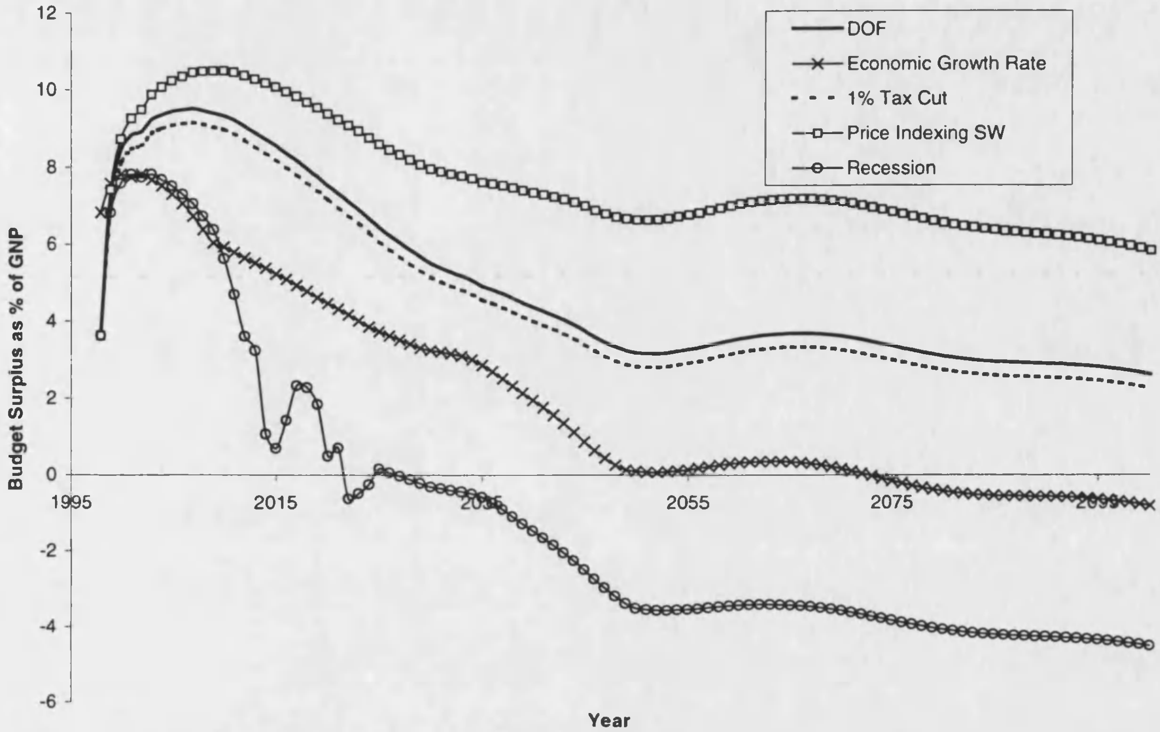
Source: Irish Census (CSO, various years) and Author's Calculations

Figure 11.9. Intergenerational Net Gain (£million) 1998, 2050



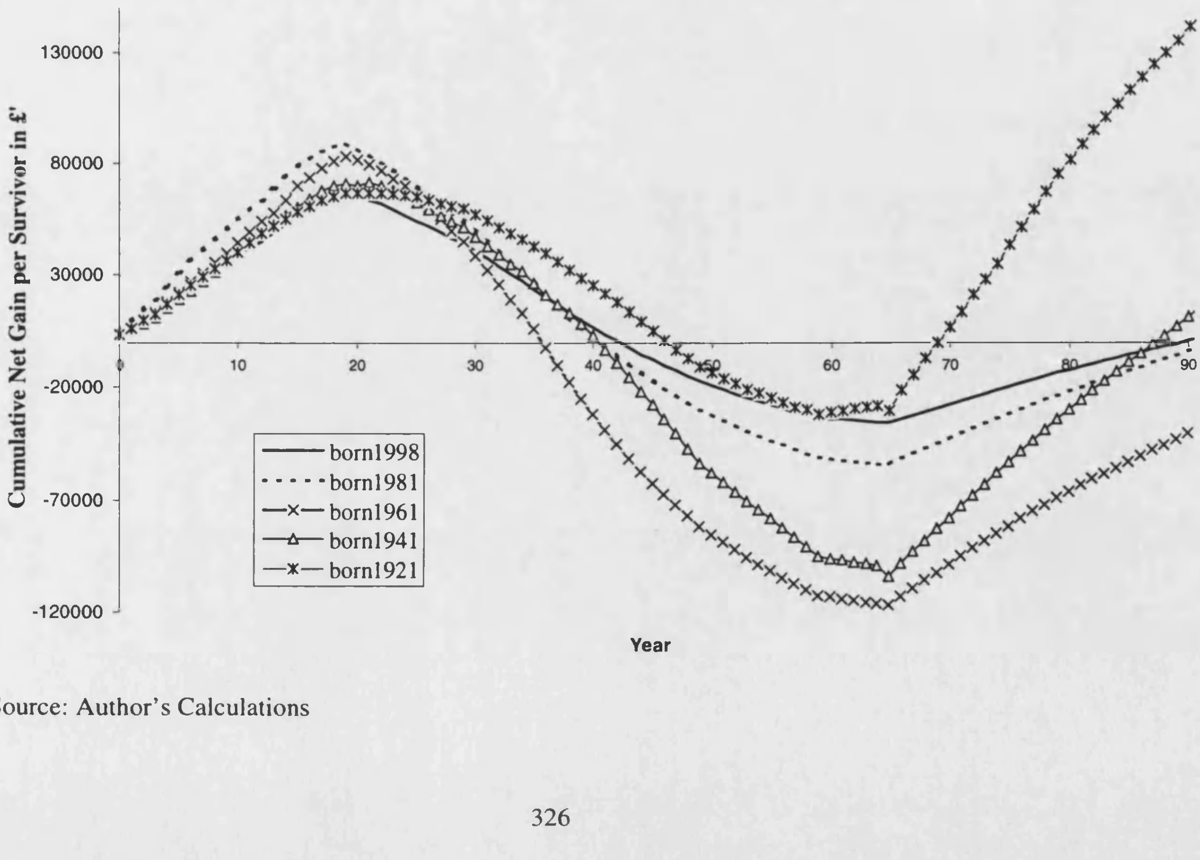
Source: *Living in Ireland Survey* (1994) *and* Author's Calculations

Figure 11.10. Trend in Budget Surplus under different Scenarios 1998-2100



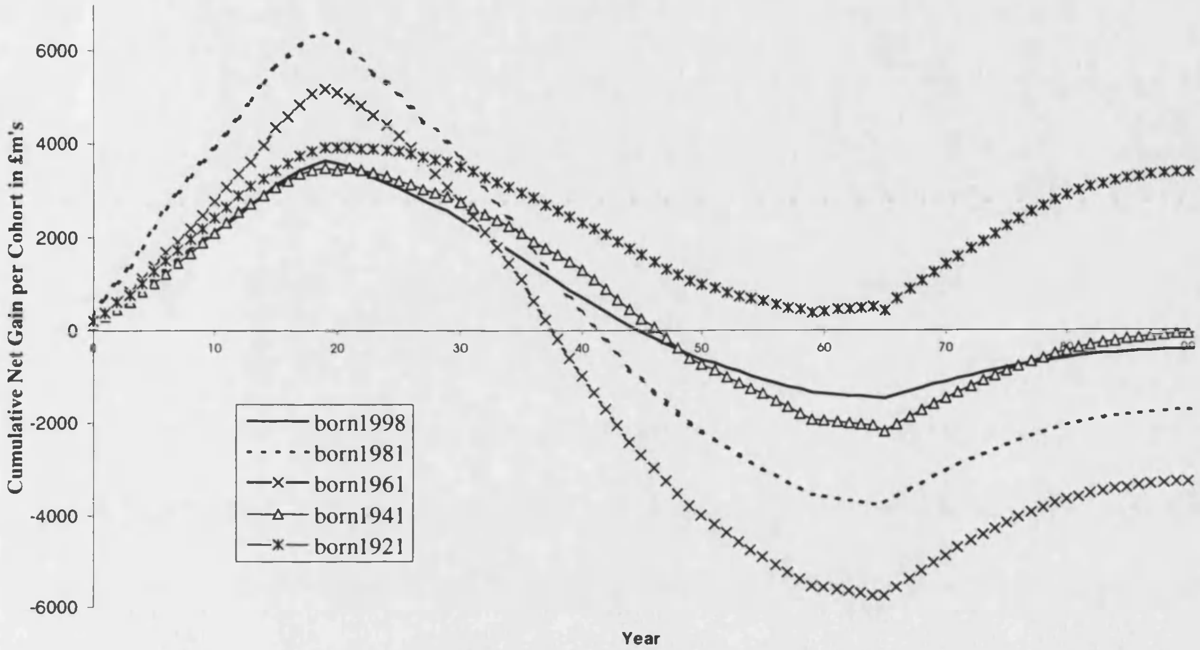
Source: Author's Calculations

Figure 11.11. Net Gain per Survivor in £'s discounted to 1998, 1921-2100



Source: Author's Calculations

Figure 11.12. Cumulative Net Gain per Cohort in £m's discounted to 1998, 1921-2100



Source: Author's Calculations. Note: All figures discounted to 1998 figures using the growth rate of GNP per capita for historical values and with a risk premium of 2% plus the growth rate of GNP for future values.

Chapter 12. Redistribution in the Irish Tax-Benefit System: A Summary of Findings

12.1.Introduction

In chapter 1, we outlined a number of objectives of this thesis. The primary objectives were to fill some of the gaps in knowledge about the redistributive effect of the Irish tax-benefit system.

Although the primary objective of the thesis was to examine the extent of redistribution in the Irish tax-benefit system, in order to do this a dynamic microsimulation model had to be designed to measure the inter-temporal aspects of redistribution. In the next section we summarise some methodological developments made in the construction of a flexible dynamic microsimulation framework. In many respects this is the primary contribution made by this thesis. In section 3, we summarise the principle forces in the Irish Tax-Benefit system. Section 4 discusses the contribution made by the instruments that make up the system to overall redistribution at a point in time. Section 5 considers the redistributive effect of the system with regard to income variability over the life-course. Section 6 is analogous to section 4, considering instead a longer accounting period of the lifetime. The extent of redistribution over the lifetime is compared with redistribution at a point in time. Because of life-course factors, much of the redistribution in the tax-benefit system will be accounted for by redistribution within a persons lifetime. Section 7 compares the extent to which the tax-benefit system redistributes inter-personally (between individuals) or intra-personally (within an individual's lifetime). The final dimension examined looks at redistribution between generations, considering which generations benefited most from the tax-benefit system.

12.2.Methodological Developments

The main methodological development of this thesis has been to conceptualise the key characteristics of dynamic microsimulation models and construct a software framework to implement the model used in this thesis, combined with the flexibility required for other purposes.

The first advance is that framework can be used to simulate both synthetic cohorts and therefore act as a dynamic cohort model, as well as simulating full population cross-sections over time, acting as a dynamic population model. Although the latter feature has not been demonstrated here, it is a feature of the underlying computing framework.

In order to be able to use the model framework for future purposes, it was necessary to use parameterisation. While a certain degree of parameterisation is commonplace in microsimulation models, the degree of parameterisation and the related generalised code employed in this framework is quite extensive. For example it is possible to add new behavioural processes and vary the order in which they are simulated without having to re-program the model. Different units of analysis can be defined without recoding. A general method has been designed for parameterising behavioural processes.

Similarly, as the data structure is defined outside the model, when adding new variables to the model, alterations need only to be made in a parameter file without the need for restructuring the model. It therefore improves the transparency and the robustness of the model, reducing the possibility of error and makes the model easier to change. A final innovation has been in the construction of tabulation program to produce the tables and statistics used by this thesis taking longitudinal information as input.

Another methodological advance is in the ability of the framework to allow behavioural processes to incorporate information about tax-benefits and resulting budget sets on their simulation. In this model, the decision to work, work part-time, become self-employed and seek work if out of work are simulated to depend upon the tax-benefit system in operation. The flexibility in the design of the framework allows the EUROMOD tax-benefit model to be used to simulate the tax-benefit information required by the model. So in these cases, the model can simulate alternative outcomes from the tax-benefit system if different choices were made, so these potential choices can feed in to the actual decision simulated.

Although the dynamic cohort model was the first application of this modelling framework, because of its flexibility, the framework was subsequently used to simulate detailed micro-level consumption patterns for 12 EU countries (See Baldini et al., 2001). These simulations were utilised within the EUROMOD tax-benefit model as an input into the simulation of indirect taxes.

Another application of this framework has been in the construction of a new Pensions Dynamic Microsimulation Model for the UK Department of Work and Pensions, Pensim2. Although the code has not explicitly been used, as it is desired that the model be simulated in different operating system, much of the lessons learnt in the development of this framework are being employed in Pensim2. For example Pensim2 will utilise the method of parameterising as well as the *model engine* algorithms used to implement these parameters.

12.3.Redistributive Forces

Chapter two described the main characteristics of the Irish tax-benefit system and describes the main trends in the components from 1955 to 2000. Over the period examined, income taxes have gradually increased in importance, reaching a peak in the late 1980´s before falling back during the 1990´s. The social insurance and assistance systems have also expanded both in terms of the coverage of the population, the demand for benefits and the value of benefits. Again these trends levelled off in the 1990´s.

One of the main distinguishing features in the Irish Tax-Benefit System relative to other European tax-benefit systems is minor role of insurance in the benefit system. The primary role is one of poverty alleviation. Although the largest benefit instruments are nominally called insurance benefits and depend on the payment of insurance contributions, the objective of these instruments are primarily redistributive rather than income replacement. For longer-term contingencies such as old age, the provision for income replacement is left to the private sector. An example of this is that replacement rates or the ratio of income out of work to in work are relatively low by European standards. However because of the extra payments for dependants even in social insurance benefits, the replacement rates for families are higher. Recently there has been an upward trend in replacement rates due in part to the reduction in income taxation and also in part to bring up the value of shorter term benefits to be similar to the value of longer term benefits.

One of the conclusions of this chapter was policy reform that has taken the form of temporary responses to particular problems in the system has resulted in one of the most complicated benefit systems in Europe. This level of complexity, besides the in built poverty traps, causes itself negative behavioural disincentives. At one extreme the complex benefits system reduces the likelihood that families will claim the benefits they are entitled to. At the other extreme, families will spend so much time claiming the benefits they are entitled to that they will not have time to look for work.

12.4.Redistribution Across the Population

Chapter 3 attempts to investigate the impact of the Irish tax-benefit system on redistribution over a cross-section of the 1994 population at points in time. It tries to assess the importance of different instruments as redistributive mechanisms and assesses the impact of the series of policy reforms instituted over the last 14 years.

As a whole, the Irish tax-benefit system is quite redistributive, transferring resources from rich to poor, however between 1987 and 2000, the primary direction of reforms has been to reduce the redistributive effect of the system as a whole. In fact taking the underlying population as given, disposable income inequality increased by 14% purely on the basis of the policy reforms alone. This trend of these reforms has been in the opposite direction of reforms in other countries. In the future this trend will have to change if the government hopes to achieve its anti poverty targets outlined in its recent National Anti Poverty Strategy.

Focusing on sub-components, we found that changes to income taxes were the primary force in the aggregate impact of the reform. Due to the improved economic position between 1987 and 2000, the system has become more generous with resources transferred in the form of reduced personal taxes and social contributions. Also due to indexation polices benefits have fallen as a proportion of market income, effectively resulting in a transfer of resources from benefits to income tax reduction. Although both income taxes and social contributions have become more progressive over time, the large cut in the value of these instruments has resulted in a lower redistributive effect. The cut in the value of benefits relative to incomes has also seen the redistributive effect of benefits fall.

12.5.Redistribution Over the Life-Course

This chapter examined the degree of redistribution over the life-cycle. As background we considered the position of people at different parts of the life-cycle in 1994. The age incidence of taxes and benefits follows a familiar U-shape pattern, where benefits exceed taxes early in life and in retirement, while taxes exceed benefits in the main working years. Children and elderly were found to live in households with a lower standard of living than working age people. Poverty rates were also found to be higher for these groups.

We also utilised the dynamic microsimulation model to simulate the life-course of a synthetic cohort. We first considered individual demographic and labour market behaviour over the life-cycle. Comparing employment rates of the simulated life-course with individuals with different life-courses in the 1994, we find that total employment rates are higher in the simulated cohort. This is a result of the different education attainment of the simulated cohort and the population. Given the huge social and economic changes that have occurred in Ireland in the last 20 years, a cohort of the population living their lives under mid 1990's behaviour than the population that have lived their lives in the period to 1990. When one decomposes by education level, we find that employment rates across the life-cycle are quite similar to those experienced by the population in 1994.

The pattern of redistribution over the life-course is similar to that of the population, where the points during the life-cycle with the highest market incomes ages 40-60, coincide with the highest benefit-tax rate. The exception is the tax-benefit position of the elderly. While the current elderly have relatively low education levels and low pension entitlement, the simulated cohort will have a much higher education level and much higher accumulated pension rights and savings. As a result income in retirement is much higher. We find also, that because the poorest people die earliest, that the benefit – tax rate falls as the cohort ages through retirement as the oldest are richer on average than younger retired people.

In addition, at every point on the age distribution, especially in retirement, there is redistribution from males to females. This redistribution takes place both through the tax-benefit system as women on average receive more benefits than taxes relative to men and through the family.

Overall we find that tax-benefit system substantially reduces life-course income variability. The most important instruments for reducing life-cycle income variability are social assistance during the early working lives, income tax during the main working years and social insurance in retirement.

Decomposing by education level, we see that the tax-benefit system reduces the variability of incomes across the life-cycle for all education groups. Life-cycle variability is reduced to a greater extent for lower education groups than for University educated. This reflects the progressive nature of the tax-benefit system, where groups with higher average incomes such University educated face higher average net tax rates. Again reflecting the progressive nature of the system, this effect is stronger for females than it is for males.

12.6.Redistribution Over the Lifetime

This chapter assesses the redistributive effect of the Irish tax-benefit system over the lifetime. The principle conclusions are that the tax-benefit system over the lifetime redistributes from men to women. This result is robust to assumptions about sharing between spouses within the household.

Overall the system redistributes from rich to poor, but the overall degree of redistribution is less than that exists from rich to poor when income is based on shorter accounting periods. The principle reason for this is because social insurance benefits are much less redistributive over the lifetime than at particular points in time.

We also decomposed the variability of incomes into the effect of personal income characteristics. The most significant result was the impact of the tax-benefit system in reducing the inequality due to the effect labour market history and human capital have on incomes.

12.7.Intra-Personal Redistribution

This chapter focuses on the degree of redistribution across an individuals life-cycle relative to the amount of redistribution between individuals. The chapter found that the lifetime rich (top quintile) were always on average net contributors to the system, while the poorest in the bottom were net beneficiaries of the system over their entire life-course, confirming that those with higher incomes will tend to have more intra personal redistribution.

Here we reported the high degree of immobility for those at the very top and the bottom of the income distribution. The lifetime can be characterised as permanently poor at the bottom, those in regular well paid employment in top three quintiles, with those in quintile 2 being characterised as being in lower paid marginal employment, moving regularly in and out of work. Most mobility tended to occur in individuals earlier years.

Between person variability was found to be more important than intra-lifetime income variability. It was found that the tax-benefit system as a whole reduces inter person variability more than intra personal variability over the life-course. However Intra-personal redistribution when measured in terms of self-financed benefits over the whole lifetime was found to be more important than inter-personal transfers. The conclusion to be drawn is that in the cohort that has been simulated, intra-person redistribution is similar to inter-person redistribution. Overall intra-personal redistribution was found to be less important than for the UK and Italy, but more important than Australia, highlighting the targeted nature of the Irish tax-benefit system.

12.8.Inter-Generational Redistribution

In the final chapter we examined the issue of intergenerational redistribution in Ireland, trying to generate measures of the net benefit from public expenditure over the lifetimes of different cohorts. There appears to be clear gaining generations; those born before the second world war, who gained both from relatively low taxation during their working years, and from a modern welfare state in the latter part of their lives. Subsequent generations will tend to be net losers, with the generation born around 1960 being the generation with the largest net loss. These generations have worked during the period of the highest taxation and may have relatively lower welfare benefits in retirement, depending on the assumption followed. We also notice that periods of recession result in higher net gains from public expenditure. This highlights that positive intergenerational transfers may not necessarily result in gaining generations having higher welfare levels, as presumably an individuals welfare would be higher from being in work and pay taxes and thus than being unemployed and receiving benefits.

Measuring the extent of redistribution between rich and poor generations, we find that the results are sensitive to assumptions about the discount rate used. We find that there is a slight degree of redistribution from rich to poor generations. Nevertheless if we compare the degree of redistribution between generations, we see that the effect is quite small relative to the impact of a tax-benefit system over a cross-section of the population.

12.9.Final Points and Future Directions

In summing up we must identify some of the caveats in the analyses that have been used and identify some future extensions and directions of work.

Over the course of the thesis we have identified a number of potential further studies and dimensions to be investigated regarding redistribution in the Irish Tax-Benefit System. The analyses have been typically first round incidence studies. Further work could be done to examine issues such as the change in the deadweight losses associated with the different tax-benefit systems over time. We have not examined any political economy motivations for the processes of redistribution in Ireland. This is another potential area of fruitful research. As highlighted in earlier chapters, Ireland in the post-war period, and especially over the past two decades, has lived through periods of enormous social and economic changes. It would be interesting to examine the effect of the changing macro-economic environment on the whole process of redistribution in the Irish Tax-Benefit system.

It must be noted that the results of the cross-section of the population in 1994 used in the study and the simulated cohort are not directly comparable for a number of reasons. Firstly the unit of analysis used is different. In the cross-sectional analyses the household has been used while in the dynamic microsimulation model, unit of analysis is the family. This is as a result of the fact that household formation such as the decision to leave home and the return of elderly parents to live with their children is not captured in the dynamic model. Given the importance of multiple nuclear family households in Ireland, it is important to develop an understanding of the processes involved.

Secondly, in 1994, the social insurance system had not fully matured and therefore many elderly pensioners were recipients of social assistance. Social Assistance therefore plays a more important role than in our simulated population, where the whole cohort is assumed to spend their lives paying contributions for social insurance pensions and then receiving them in retirement. A similar point can be made about the coverage of occupational pensions, where coverage in this cohort is higher than in the population as a whole in 1994. Another important difference is that the average education level in this cohort is much higher than for the population as a whole. This will result in correspondingly higher employment rates. Lastly as a steady state model based on transition rates that applied at the start of an economic boom, it will produce higher stocks of employment than the stock that existed as a result of flows in the pre-boom period. These issues suggest that it may be more appropriate to ether simulate an actual cohort through a particular period of time, allowing for period effects as in the case of Van de Ven (1998) or simulate a number of cohorts or an entire population as in the case of Dynamic Population Models.

On another note of caution however, the degree of intra-personal redistribution found in a tax-benefit system is quite sensitive to the assumptions regarding the degree of mobility within the population as a whole. Because the panel data on which models such as this one used here, have typically been too short in length for reasonable models of labour market career paths, assumptions have to be made about the degree of mobility. These assumptions may have a strong bearing on the results. It would be useful therefore to extend this analysis to measure the sensitivity of the results to different mobility assumptions.

Another area for analysis would be to examine the impact of a policy reform that extended income replacement in retirement, as at present Ireland has no earnings related pension nor any compulsory savings for retirement. This coupled with an increasingly flexible labour market, means that social assistance must be used more extensively in Ireland for retirees than in other countries. Another avenue for research is to improve the econometric models used in the simulations to utilise longer panel data sets in incorporating later waves of the European Community Household Panel and also through the use of more sophisticated behavioural modelling.

Another area for an analysis is in comparative redistribution studies. Because the model links a dynamic model that generates a synthetic panel to a tax-benefit microsimulation model, EUROMOD that contains the rules for each tax-benefit system in the European Union, it would be possible to examine the inter and intra-personal redistribution in different European countries.

Throughout the thesis the phrase *this is beyond the current study…* has been used. In many cases we have had to make severe approximations and compromises in the methods that have been used and in the processes that have been included. For example, the modelling of savings processes is a current gap, one that could be usefully incorporated in a dynamic microsimulation model. This however is an area where no work has been done in Ireland. Similarly further work could be done to model economic influences on demographic behaviour, again an area of limited research so far. Microsimulation models can therefore as Burtless (1996) points out *provide an organising framework* to identify knowledge and data gaps and for creating an agenda to fill them.

References

Aaron, H.J., 1971. "Demographic effects of social security benefits. In: Feldstein, M.S. and Inman, R.P. (Eds.), The Economics of Public Services, pp 151-173. New York: Macmillan.

Amiel, Y. and Cowell, F. A. 1992. "Measurement of Income Inequality: Experimental test by Questionnaire" *Journal of Public Economics*, **47**, 3-26.

Ando A., 1996. Microsimulation Analysis of Aggregate Savings Behaviour in Japan: Effects of Ageing Population on Aggregate Savings and Design of Policies on Savings in Japan, Tokyo: National Institute for Research Advancement.

Ando, A. A. Moro, 1995. "Demographic Dynamics, Labor Force Participation and Household Asset Accumulation: Case of Japan", NBER Working Paper 5261. Cambridge MA: National Bureau of Economic Research.

Ando, A. and S. Nicoletti Altimari, 1999. "A Micro Simulation Model of the Italian Household Sector", Mimeo, University of Pennsylvania, Department of Economics.

Ando, A., A. Brandolini, G. Bruno, L. Cannari, P. Cipollone, G. D'Alessio, I., Faiella, L. Forni, M.R. Marino and S. Nicoletti Altimari, 200. "The Bank of Italy's DYNAMITE: Recent Developments". Mimeo, Rome: Bank of Italy.

Andreassen L., and I. Solli, 2000. "Incorporating overlapping-generations modelling in a dynamic microsimulation framework", Paper Presented to the 6th Nordic Workshop on Microsimulation, Copenhagen, June.

Andreassen L., D. Fredriksen and O. Ljones, 1996. "The Future Burden of Public Pension Benefits: A Microsimulation Study", in Harding A. (ed.) Microsimulation and Public Policy, Amsterdam: Elsevier.

Antcliff S., M. Bracher, A. Gruskin, A. Hardin, C. Kapuscinski, 1996. "Development of DYNAMOD 1993 and 1994", NATSEM, Canberra: DYNAMOD Working Paper No. 1.

Antcliff, S., 1993. "An introduction to DYNAMOD: A Dynamic microsimulation Model", NATSEM, Canberra: DYNAMOD Technical Paper No. 1.

Antcliff, S., M. Bracher, A. Gruslin, A. Hardin and C. Kapuscinski, 1996. "The Development of DYNAMOD 1993 and 1994". Dynamic Modelling Working Paper, No. 1. Canberra: NATSEM.

Arrow K.J., 1980. Microdata Simulation: Current Status, Problems, Prospects, in Microeconomic Simulation Models for Public Policy Analysis, vol. 1, (eds.) R.H. Haveman and K. Hollenbeck), Academic Press, New York, pp. 91-106.

Atkinson, A.B., 1970. "On the Measurement of Inequality", Journal of Economic Theory, Vol. 2, pp 244-63.

Atkinson, A.B., 1987. "Income Maintenance and Social Security", in Auerbach and Feldstein.

Atkinson A.B., 1994. "State Pensions for Today and Tomorrow", LSE/STICERD, WSP/104.

Atkinson A.B. 1995, "The Welfare State and Economic Performance", LSE/STICERD: Welfare State Programme Working Paper No. 109.

Atkinson, A.B., 2000. "Is rising income inequality inevitable? A critique of the transatlantic consensus". *WIDER Annual Lectures 3*. Helsinki: WIDER.

Atkinson, A.B., J. Gomulka and H. Sutherland, 1988. *"Grossing-Up FES Data for Tax-Benefit Models"*, in Atkinson and Sutherland (eds.) Tax Benefit Models, London: London School of Economics, STICERD Occasional Paper.

Atkinson, A.B. and J. Micklewright, 1985, Unemployment benefits and unemployment duration, STICERD Occasional Paper, No. 5, London: London School of Economics.

Atkinson, A.B. and J., Micklewright, 1991. "Unemployment Compensation and Labour Market Transition: A Critical Review", Journal of Economic Literature, Vol. XXIX, pp. 1679-1727.

Atkinson, M.E., J. Creedy and D.M. Knox, 1999. "Alternative Retirement Income Arrangements and Lifetime Income Inequality: Lessons From Australia" International Tax and Public Finance, 6, pp. 103-117

Atkinson, A.B. and J.E. Stiglitz, 1980. Lectures on Public Economics. London and New York: McGraw-Hill.

Attanasio, O.P. and J.W. Banks, 1998. "Household saving: Analysing the saving behaviour of different generations", Economic Policy, vol. 27, October, pp. 549-583.

Auerbach, A.J., J. Gokhale and L.J. Kotlikoff, 1991. "Generational accounts: A meaningful alternative to deficit accounting. In Tax policy and the economy, vol. 5 ed. D. Bradford, 55-110. Cambridge, Mass.: MIT Press.

Baekgaard, H., 1998. Simulating the Distribution of Household Wealth in Australia: New Estimates for 1986 and 1993. Technical Paper No. 14 – June, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia..

Baldini M, D Mantovani, C O'Donoghue, 2001, "Expenditure imputation and indirect tax simulation", EUROMOD working paper EM7/01, Department of Applied Economics, University of Cambridge.

Baldini M., 1997. Diseguaglianza e Redistribuzione nel Ciclo di Vita, Bologna: Il Mulino.

Banks, J., R. Disney and Z. Smith, 1999. "What can we learn about pension reform from Generational Accounts for the UK?", IFS Working Paper Series, No. W99/16. London: Institute for Fiscal Studies.

Barr N., 1993. The Economics of the Welfare State 2nd Edition. London: Weidenfeld and Nicolson.

Becker G., 1981. A Treatise on the Family, Cambridge, Ma.: Harvard University Press.

Becker, G., 1960, "An Economic Analysis of Fertility," Demographic and Economic Change in Developed Countries, New York: NBER.

Beckerman, W., 1979. "The Impact of Income Maintenance Payments on Poverty in Britain", Economic Journal, Vol. 86, June.

Berger M., 1985. "The Effect of Cohort Size on Earnings Growth: A Reexamination of the Evidence," Journal of Political Economy, Vol. 93, pp. 561-573.

Björklund A. and Palme M., 1997. "Income redistribution within the life cycle versus between individuals: Empirical evidence using Swedish panel data". Working Paper Series in Economics and Finance No. 197, Stockholm: Stockholm School of Economics.

Björklund, A., 1993. "A comparison between Actual Distributions of Annual and Lifetime Income: Sweden 1951-89". Review of Income and Wealth, Vol. 39, No. 4, pp. 377-386.

Blomquist, S., 1981. "A Comparison of Distributions of Annual and Lifetime Income: Sweden Around 1970., The Review of Income and Wealth, Vol. 22, pp. 243-264.

Blondal S. and M. Pearson, 1995. "Unemployment and Other Non-Employment Benefits", *Oxford Review of Economic Policy*, Vol. 11 No. 1., pp. 136-69.

Boadway, R. And M. Keen, 1999. "Redistribution" in Atkinson, A.B. and F. Bourguignon (eds.) Handbook of Income Distribution, Elsevier.

Bonnet, C. and R. Mahieu, 2000. "Public pensions in a dynamic microanalytic framework: the case of France", in Mitton et al. (eds.) Microsimulation in the New Millennium, Cambridge: Cambridge University Press.

Bracher M., 1996. "Preliminary Demographic Parameters for the DYNAMOD Micro-Simulation Model", in Antcliff et al. (eds.) "Development of DYNAMOD 1993 and 1994", NATSEM, Canberra: DYNAMOD Working Paper No. 1.

Brandolini, A., G. Bruno and L. Guiso, 1993, "MOSED, Simulation Model of Distributive Effects: A First Report", Mimeo, Rome: Bank of Italy.

Breen, R..J., D.F. Hannan, D.B. Rottman and C.T. Whelan, 1990. The Transformation of Irish Society: State, Class and Development in Contemporary Ireland, London: Macmillan.

Breen. R., 1991. "Education, Employment and Training in the Youth Labour Market", SRI, General Research Series Paper No. 152.

Bristow, J., 1980. "Economics in The Economic and Social Review: A tenth Anniversary Issue", The Economic and Social Review, Special Tenth Anniversary Issue, January, pp. 3-10.

Brown, R.J., S.B. Caldwell and S.A. Eklund 1992, “Microsimulation of dental conditions and dental service utilisation” in J.G. Anderson (ed.), Proceedings of the Simulation in Health Care and Social Services Conference, Society for Computer Simulation, San Diego.

Brown, R.J., S.B. Caldwell and S.A. Eklund 1995, "How fee and insurance changes could affect dentistry: Results from a microsimulation model" Journal of American Dental Association, Vol. 126.

Buiter, W.H., 1995, "Generational Accounts, Aggregate Saving and Intergenerational Distribution", NBER Working Paper No. 5087. Cambridge M.A.: National Bureau of Economic Research.

Burtless, G., 1996. “A framework for analysing future retirement income security”. Pp 244-272 in E.A. Hanushek and N.L. Maritato eds. Assessing Knowledge of Retirement Behaviour. Panel on Retirement Income Modelling. National Research Council. Washington D.C.: National Academy Press.

Caldwell S. and R. Morrison, 2000. “Validation of longitudinal microsimulation models: experience with CORSIM and DYNACAN”, in Mitton et al. (eds.) Microsimulation in the New Millennium, Cambridge: Cambridge University Press.

Caldwell S.B., 1990, “Static, dynamic and mixed microsimulation”, Dept. of Sociology, Cornell, University, Ithaca, New York, July.

Caldwell S.B., 1996, “Health, Wealth, Pensions and Life Paths: The CORSIM Dynamic Microsimulation Model”, in Harding A. (ed.) Microsimulation and Public Policy, Amsterdam: Elsevier.

Caldwell, S., M. Favreault, A Gantman, J. Gokhale, T. Johnson and L.J. Kotlikoff, 1998. “Social Security’s Treatment of Postwar Americans”. Working Paper, No. 6603. Cambridge, M.A.: National Bureau of Economic Research.

Caldwell, S.B., 1987, "Microsimulation: The next thirty years", Paper presented for Conference on Income Transfer Policy, Carnegie -Mellon University and Urban Institute, Washington D.C.

Caldwell, S.B., 1988a. " Small findings, large questions: synthesis in policy research", Paper presented to Thematic Session on Sociology and Social Policy, American Sociological Association Annual Meetings, Atlanta.

Caldwell, S.B., 1988b. "A large-scale modelling strategy for regional science", Paper presented for the 17th Annual Meeting of the Northeast Regional Science Association.

Caldwell, S.B., 1988c. "The Cornell model: Portable software for dynamic microsimulation", Paper presented to Conference on Public Data, International Association of Social Science Information Services and Technologies, Washington D.C.

Caldwell, Steven B., Melissa M. Favreault, Alla Gantman, Jagadeesh Gokhale, Thomas Johnson, and Laurence J. Kotlikoff. 1999. "Social Security's Treatment of Postwar Americans." In James M. Poterba, ed., Tax Policy and the Economy, 13. Cambridge, MA: National Bureau of Economic Research, MIT Press.

Callan T., 1991. Income Tax and Welfare Reforms: Microsimulation Modelling and Analysis, Dublin : ESRI General Research Series Paper No. 154.

Callan T. 1997. Income Support and Work Incentives: Ireland and the UK. Dublin: ESRI Policy Research Series Paper No. 30.

Callan T., S. Dex, N. Smith and J.D. Vlasblom, 1999, "Taxation of Spouses: Across-Country Study of the Effects on Married Women's Labour Supply", Centre for Labour Market and Social Research, Working Paper No. 99-02, Aarhus: School of Business, University of Aarhus.

Callan, T. and A. Doris, 1999. "Labour Supply Responses", in Nolan (ed.) Assessment of the Impact to Introducing a Minimum Wage. Dublin: ESRI.

Callan, T. and B. Farrell, 1992 Women's Participation in the Irish Labour Market, Report No. 91, Dublin National Economic and Social Council.

Callan T. and R. Nestor, 2000. Housing Benefits & Employer PRSI in Ireland. Mimeo. Dublin: The Economic and Social Research Institute.

Callan T., and B. Nolan, 1989, "Evaluating Social Welfare Expenditures: How well does the System Perform in Reducing Poverty?". The Economic and Social Review, Vol. 20, No. 4, pp –329-352.

Callan T., and B. Nolan, 1990, "Income distribution and Redistribution: Ireland in Comparative Perspective", Working Paper Series No. 17. Dublin Economic and Social Research Institute.

Callan T., and B. Nolan 1993, "Income Inequality in Ireland in the 1970's and 1980's," Working Paper Series No. 43, Dublin: Economic and Social Research Institute.

Callan, T. and B. Nolan, 1993b. "Income Distribution and Redistribution: Ireland in Comparative Perspective", in J.H. Goldthorpe & C.T. Whelan (eds.) The Development of Industrial Society in Ireland. Oxford: Oxford University Press.

Callan, T and B. Nolan 1999, "Income Inequality in Ireland in the 1980's and 1990's," in Barry F. (ed.) *Understanding Ireland's Economic Growth*, London: Macmillan Press.

Callan, T., and B. Nolan, 1999b. Tax and Welfare Changes, Poverty and Work Incentives in Ireland, 1987-1994, Dublin: ESRI Policy Research Series Paper No. 34.

Callan T., B. Nolan and B.J. Whelan, D.F. Hannan with S. Creighton, 1989, Poverty Income and Welfare in Ireland, General Research Series Paper No. 146, Dublin: The Economic and Social Research Institute.

Callan T., B. Nolan, B.J. Whelan, C.T. Whelan and J. Williams, 1996, Poverty in the 1990's: Evidence from the Living in Ireland Survey. Dublin: Oak Tree Press.

Callan T., B. Nolan, D. O'Neill and O. Sweetman, 1998, Female Labour Supply and Income Inequality in Ireland, Maynooth: Department of Economics Working Paper.

Callan, T., B. Nolan and C. Whelan, 1996. A Review of the Commission on Social Welfare's Minimum Adequate Income, Dublin: ESRI Policy Research Series Paper No. 29.

Callan T., C. O'Donoghue and C. O'Neill, 1996. Simulating Welfare and Income Tax Changes: The ESRI Tax-Benefit Model, Dublin: The Economic and Social Research Institute.

Callan T., C. O'Neill and C. O'Donoghue, 1995. Supplementing Family Income, Dublin: The Economic and Social Research Institute, Policy Research Series Paper No. 23.

Callan T., C. O'Donoghue and C. O'Neill, 1996, Simulating Welfare and Income Tax Changes: The ESRI Tax-Benefit Model. Dublin: The Economic and Social Research Institute.

Callan T., C. O'Donoghue and C.O'Neill, 1994. Analysis of Basic Income Schemes for Ireland, Dublin : ESRI Policy Research Series Paper No. 21.

Callan T., C. O'Donoghue and C.O'Neill, 1994. 'Evaluating Basic Income Options', in Reynolds B. and S. Healy (Eds.) Towards an Adequate Income for All. Dublin Conference of Religious of Ireland.

Callan T. and A. van Soest, 1993, "Female Labour Supply in farm households: farm and off- farm participation", Economics and Social Review, Vol. 24 No. 4, pp 313-334.

Callan T. and A. Van Soest, 1996. Family Labour Supply and Taxes in Ireland, ESRI Working Paper No. 78. Dublin: Economic and Social Research Institute.

Cantillon, S & Nolan, B 1998, "Are Married Women More Deprived than their Husbands?", Journal of Social Policy, Vol. 27, No. 2.

Central Statistics Office Ireland, 1980, Redistributive Effects of State Taxes and Benefits on Household Incomes in 1973, Dublin: Stationery Office.

Chénard D. 2000a. "Individual alignment and group processing: an application to migration processes in DYNACAN", in Mitton et al. (eds.) Microsimulation in the New Millennium, Cambridge: Cambridge University Press.

Chénard D. 2000b. "Earnings in DYNACAN: distribution alignment methodology", Paper Presented to the 6th Nordic Workshop on Microsimulation, Copenhagen, June.

Citro C.F. and E.A. Hanushek (eds.), 1991a. The uses of Microsimulation Modelling, Volume 1, Review and Recommendations. Washington National Academy Press.

Citro C.F. and E.A. Hanushek (eds.), 1991a. The uses of Microsimulation Modelling, Volume 2, Technical Papers. Washington National Academy Press.

Citro, C., and E. Hanushek, 1997. Assessing Policies for Retirement Income: Needs for Data, Research, and Models. Washington D.C.: National Academy Press.

Clancy, P., 1984, "Demographic Changes and the Irish Family", The Changing Family, Dublin: University College.

Coleman, D.A., 1992, "The Demographic Transition in Ireland in International Context" in Goldthorpe, J. and C. Whelan (eds.), The Development of Industrial Society in Ireland, Proceedings of the British Academy, Vol. 79. London: British Academy.

Creedy, J., 1997. "Lifetime Inequality and Tax Progressivity with Alternative Income Concepts", Review of Income and Wealth, Vol. 43, No. 3, pp. 283-295.

Creedy, J., 19991. "Lifetime Earnings and Inequality", Economic Record, March, pp 46-58.

Creedy, J., R. Disney and E. Whitehouse, 1993. "The Earnings-Related State Pension, Indexation and Lifetime Redistribution in the UK". Review of Income and Wealth, Vol. 39, No. 3, pp 257-278.

Csicsman, N. and N. Pappne, 1987. "The Software Developed for the Hungarian Micro-simulation System", Proceedings of International Workshop for Demographic Microsimulation, International Institute for Applied Systems Analysis, Budapest, Hungary, November.

Cubeddu, L. M., 1996. "The Intra-Generational Redistributive Effects of Social Security", Department of Business and Economics Working Paper No. 168. Barcelona: Universitat Pompeu Fabra.

Curry C. 1996. "PENSIM: A Dynamic Simulation Model of Pensioners' Incomes". London: Department of Social Security.

Curtin C., 1986. "Marriage and Family", in Ireland: A Sociological Profile, Dublin: Institute of Public Administration.

Daly, M.E., 1981, Social and Economic History of Ireland Since 1800, Dublin: The Educational Company.

Davies H. and Joshi H., 199. *Measuring the costs of children: estimates for Britain*

Davies J. St-Hilaire, F., Whalley, J., 1984. Some calculations of lifetime tax incidence". American Economic Review, Vol. 74, 633-649.

Decoster, A., I. Standaert, C. Valenduc and G. Van Camp. 2000. "What Makes Personal Income Taxes Progressive? The case of Belgium", Paper Presented to the 6th Nordic Workshop on Microsimulation, Copenhagen, June.

Dekkers, G.J.M., Nelissen, J.H.M. & Verbon, H.A.A., 1996. Intergenerational equity and pension reform: The case of the Netherlands. Public Finance, 50 (2), 224-245.

Department of Social Welfare, 1976. *A National Income Related Pension Scheme: A Discussion Paper*, Dublin: Stationery Office.

Department of Social Welfare, 1994. Guide to Social Welfare Services, Dublin: Department of Social Welfare.

Department of Social Welfare, 1995. Report of the Review Group on the Role of Supplementary Welfare Allowance in Relation to Housing, Dublin: Department of Social Welfare.

Department of Finance, Ireland, 1998. "Long term Issues Group Paper – December 1998", mimeo.

Department of Finance, Ireland, 1999. "Report of The Budget Strategy for Ageing Group", mimeo.

Dex S., S. Gustafsson, N. Smith and T. Callan, 1995, "Cross National Comparisons of the Labour Force Participation of Women Married to Unemployed Men", Oxford Economic Papers, Vol. 47, pp. 611-635.

Di Tommaso, M.L., S. Dex, and B. Rowthorne, 2000. "Women's labour supply decisions in the light of possible fiscal reforms", paper presented to the Conference of the European Society for Population Economics 2000, Berlin. Bonn ?
is this the ref on p152

Dobson A., 1990. Generalised Linear Models. London: Chapman and Hall.

Duncan A. and M. Weeks, 2000. Simulating Transitions Using Discrete Choice Models, in Mitton, L., H. Sutherland and M. Weeks (eds.), Microsimulation Modelling for Policy Analysis: Challenges and Innovations. Cambridge: Cambridge University Press.

Eardley, T., J. Bradshaw, J. Ditch, I. Gough and P. Whiteford, 1996. *Social Assistance in OECD Countries, Vol. 1 and 2*. London HMSO.

Easterlin R. 1980. Population and Economic Change in Developing Countries. Conference Series No. 30. Chicago University of Chicago Press.

Eklind B., I. Eriksson, J. Hussénius and M. Müller, 1996. "Pension Analysis in A static Model with Lifetime Income Distribution: Initial Results", in Harding A. (Ed.), Microsimulation and Public Policy, Amsterdam: North-Holland.

Eliasson G., 1986. "The Swedish Micro-to-Macro Model: Idea, Design and Application", in Orcutt G.H., J. Merz and H. Quinke, Microanalytic Simulation Models to support Social and Financial Policy Amsterdam: North-Holland.

Ericson, P. and J. Hussenius, 1998. "A note about SESIM – a dynamic microsimulation model", mimeo, Stockholm: Swedish Ministry of Finance.

Ericson, P. and J. Hussenius, 1999. "Distributional Effects of Public Student Grants in Sweden – a Presentation and an Application of the Dynamic Microsimulation Model SESIM", paper presented to the APPAM seminar Public Policy Analysis and Management: Global and Comparative Perspectives", Washington D.C., November.

Esping-Andersen G., 1996. The Three Worlds of Welfare Capitalism, London: Chapman Hall.

Evans M., and C. O'Donoghue, 1999. "Cross-National Microsimulation Modelling: Reforming Social Assistance in Three European Countries", *Brazilian Electronic Journal of Economics*, No. 2.

Evans M., C. O'Donoghue and P. Vizard 2000, "Means Testing and Poverty in 5 European Countries" in Atella V. (ed.) Le Politiche Sociali in Italia ed in Europa Coerenza e Convergenza nelle Azioni 1997-1999. Bologna: il Mulino.

Evans, M. and J. Falkingham, 1997. "Minimum Pensions and Safety Nets in Old Age: A Comparative Analysis", Welfare State Program Discussion Paper, No. WSP/131, London: London School of Economics: STICERD.

Fahey T., 1995. Health and Social Care Implications of population Ageing in Ireland, 1991-2011. Dublin: The National Council for the Elderly, Report No. 42.

Falkingham J. and A. Harding. 1996. "Poverty Alleviation Versus Social Insurance Systems: A Comparison of Lifetime Redistribution", Discussion Paper No. 12, National

Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

Falkingham J. and C. Lessof, 1991. "LIFEMOD: The Formative Years". London: Research Note No. 24. London School of Economics.

Falkingham J. and J. Hills, 1995. The Dynamic of Welfare: The Welfare State and the Life Cycle. New York: Prentice-Hall.

Falkingham J. and P. Johnson, 1995. "A Unified Funded Pension Scheme (UFPS) for Britain", in Falkingham and Hills (eds.) The Dynamic of Welfare: The Welfare State and the Life Cycle. New York: Prentice-Hall.

Falkingham J., J. Hills and C. Lessoff, 1993. "William Beveridge versus Robin Hood: Social Security and Redistribution over the Lifecycle", Discussion Paper WSP/88. London School of Economics.

Falkingham, J. and J. Hills, 1995. The Dynamic of Welfare. Hemel Hempstead: Prentice Hall/Harvester Wheatsheaf.

Favreault, M.M. and S.B. Caldwell. 2000. "Assessing Distributional Impacts of Social Security Using Dynamic Microsimulation." In Anil Gupta and Vishnu Kapur, eds., Microsimulation in Government Policy and Forecasting. North Holland Press, Contributions to Economic Analysis Series.

Feldstein, M. 1997. "Transition to a Fully Funded Pension System: Five Economic Issues", NBER Working Paper Series No. 6149. Cambridge, MA: NBER

Ferrera, M., 1996. "The Southern Model of Welfare in Social Europe", *Journal of European Social Policy*, no. 1, pp. 17-37.

Ferrera M. (1998) *Targeting welfare in a "soft" state: Italy's winding road to selectivity*. European Forum Conference Paper WS/13. Florence: European University Institute.

Fitzpatrick, D., 1987. "Divorce and Separation in Modern Irish History", Past and Present, Vol. 114, pp. 172-196.

Fölster, S., 1997. "Social Insurance Based on Personal Savings Accounts: A Possible Reform Strategy for Overburdened Welfare States?" European Economy – The Future of the Welfare State. Brussels: Commission of the European Communities.

Friedman, M., 1957. *A theory of he Consumption Function,* New Jersey: Princeton University Press.

Fredriksen D., 1998. Projections of Population, Education, Labour Supply and Public Pension Benefits: Analyses with the Dynamic Microsimulation Model MOSART. Social and Economic Studies. Oslo: Statistics Norway

Fukushige, M. 1996. , Annual redistribution and lifetime redistribution. Economics Letters, Vol: 52, Issue: 3, September 199, pp. 269-273 ,

Fukushige, M., 1996. , Annual redistribution and lifetime redistribution. Economics Letters, Vol. 52, Issue: 3, September 199, pp. 269-273,

Fullerton, D. and L. Rogers, 1993. Who Bears the Lifetime Tax Burden. Washington D.C.: Brookings Institution.

Fullerton, D. and L. Rogers, 1994. "Distributional Effects on an Lifetime Basis". NBER Working Paper Series No. 4862. Cambridge, MA: NBER

Galler H., 1997. Discrete-time and Continuous-time Approaches to Dynamic Microsimulation Reconsidered'- NATSEM Technical Paper No. 13, -October. Canberra: National Centre for Social and Economic Modelling, University of Canberra, Australia.

Galler H.P. and G. Wagner, 1986. "The microsimulation model of the Sfb3 for the analysis of Economic and Social Policies", in Orcutt G.H., J. Merz and H. Quinke, Microanalytic Simulation Models to support Social and Financial Policy Amsterdam: North-Holland.

Galler H.P., G. Wagner, 1986. 'The microsimulation model of the Sfb3 for the analysis of Economic and Social Policies', in Orcutt G.H., J. Merz and H. Quinke 'Microanalytic Simulation Models to support Social and Financial Policy'.

Glennerster H., 1995. "The Life Cycle: Pubic or Private Concern?" in Falkingham J. and J. Hills, (eds.), The Dynamic of Welfare: The Welfare State and the Life Cycle. New York: Prentice-Hall.

Glennerster H., J. Falkingham and N. Barr, 1995. 'Education Funding, Equity and the Life Cycle', in Falkingham J. and J. Hills, (eds.), The Dynamic of Welfare: The Welfare State and the Life Cycle. New York: Prentice-Hall.

Hain W. and C. Helberger, 1986. 'Longitudinal Simulation of Lifetime Income', in Orcutt G., J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to support Social and Financial Policy. New York: North-Holland.

Hain W. and C. Helberger, 1986. "Longitudinal Simulation of Lifetime Income", in Orcutt G., J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to support Social and Financial Policy. New York: North-Holland.

Hammel, E.A., 1990. "SOCSIM II", Working Paper No. 29, Graduate Group in Demography, Berkeley: University of California at Berkeley.

Hancock R. and H. Sutherland, 1992. Microsimulation Models for Public Policy Analysis: New Frontiers. London: LSE\STICERD Occasional Paper 17.

Hancock R., 2000. "Charging for Care in later life: an exercise in dynamic microsimulation" in Mitton et al. (eds.) Microsimulation in the New Millennium, Cambridge: Cambridge University Press.

Hancock R., J. Mallender and S. Pudney, 1992, 'Constructing a Computer model for Simulating the Future Distribution of Pensioner's Incomes for Great Britain', in Hancock R and H. Sutherland (eds.) 'Microsimulation Models for Public Policy Analysis: New Frontiers.

Hannan, D.F. and S. Ó Riain, 1993. Pathways to Adulthood in Ireland: Causes and Consequences of Success and Failure in Transitions Amongst Irish Youth, General Research Series Paper No. 161, Dublin: The Economic and Social Research Institute.

Hannan, D.F., 1970., Rural Exodus, A Study of the Forces Influencing the Large Scale Migration of Irish Rural Youth, London: Chapman.

Hannan D. F., B. McCabe and S. McCoy, 1998. *Trading Qualifications for Jobs: Overeducation in the Irish Youth Labour Market*, Dublin: Oak Tree Press.

Hanushek E.A. and N.L. Maritato, 1996. Assessing Knowledge of Retirement Behaviour, Washington D.C.: National Academy Press.

Harding A., 1990, 'Dynamic Microsimulation Models: Problems and Prospects', Welfare State Program discussion paper no. 48, London School of Economics.

Harding A. 1993. Lifetime Income Distribution and Redistribution: applications of a microsimulation model, Contributions to Economic Analysis, Vol 221, Amsterdam: North Holland.

Harding, A. 1993b. "Lifetime Repayment Patterns for HECS and AUSTUDY Loans". Discussion Paper No. 1, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

Harding A. 1995. Microsimulation and Public Policy, Contributions to Economic Analysis, Vol 221, Amsterdam: North Holland.

Harding, A., R. Percival, D. Schofield and A. Walker, 2000. "The Lifetime Distributional Impact of Government Outlays". Discussion Paper No. 47, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

Hausman J., 1981. "Labour Supply". In Aaron, H.J. and J.A. Pechman (eds.) How Taxes affect Economic Behaviour, Washington: Brookings Institution.

Heike, H.D., O. Hellwig and A. Kaufmann, 1987. "Experiences with the Darmstadt microsimulation model (DPMS)", Proceedings of International Workshop for Demographic Microsimulation, International Institute for Applied Systems Analysis, Budapest, Hungary, November.

Hellwig O., 1988a. "Modelling and Software Aspects of Demographic Microsimulation", Darmstadt University, Darmstadt.

Hellwig O., 1988b. "Modelling and Software Aspects of Demographic Microsimulation", Augsburg University, Augsburg.

Hellwig O., 1989. "Programming a microanalytic simulation model using software engineering", Fourth International Symposium on Computer Simulation in the Social Sciences, Nuremberg, June.

Hendricks G. and R. Holden, 1976a. A Report on the Variance in Simulated Earnings Histories produced by DYNASIM. Urban Institute, Washington D.C.

Hendricks G. and R. Holden, 1976b. "The role of microanalytic simulation models in projecting OASDI costs", Proceedings of the Business and Economic Statistics Section. Washington D.C.: American Statistical Association.

Henry E.W., 1989. The Capital Stock of Ireland, 1950-1984. General Research Series Paper No. 145. Dublin: Economic and Social Research Institute.

Hills J. 1995. "The Welfare State and Redistribution Between Generations" in Falkingham J. and J. Hills (eds.), The Dynamics of Welfare. Hemel Hempstead: Prentice Hall/Harvester Wheatsheaf.

Holmer M.R., 2000. Validating Earnings Histories, mimeo. Washington D.C.: Policy Simulation Group. http://www.polsim.com/ehvalid.pdf

Holmer, M. and A. Janney and B. Cohen, 2001. Overview of PENSIM/2, mimeo. Washington D.C.: Policy Simulation Group. www.radix.net/~holmer/overview.pdf

Horowitz, J., 1990. "The Marginal Cost of Redistribution: Lifetime and Annual Perspectives," Southern Economic Journal, January.

Horowitz, J., 1993. "Distributional Implications of the Social Security Spouse Benefit," (with Marilyn R. Flowers), Southern Economic Journal, 60(2).

Horowitz, J., 1993. "Lifetime and Annual Marginal Costs of Redistribution in England, Sweden, and the United States, "Review of Economics and Statistics, Vol. LXXV, No. 1, pp. 143-147.

Hoshka, P., 1986. "Requisite research on methods and tools for microanalytic simulation models" in G. Orcutt, J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to Support Social and Financial Policy. Amsterdam: North-Holland.

Houle C., B.P. Will, J.M. Berthelot, W.K. Evans, 1997. "Use of POHEM to Estimate Direct Medical Costs of Current Practice and New Treatments Associated with Lung Cancer in Canada"

Hughes, G., 1985. Payroll Tax Incidence, The Direct Tax Burden and the Rate of Return on State Pension Contributions in Ireland. General Research Series Paper No. 120, Dublin: The Economic and Social Research Institute.

Hurd, M. 1990, "Research in the Elderly: Economic Status, Retirement, and Consumption and Saving", Journal of Economic Literature, Vol. XXVIII, pp. 565-637.

Immervoll, H. and C. O'Donoghue, 2001, "Towards a Multi-Purpose Framework for Tax-Benefit Microsimulation: A Discussion by Reference to EUROMOD, a European Tax-Benefit Model", EUROMOD Working Paper no. 2/01, Department of Applied Economics, University of Cambridge.

INSEE, 1999. "La modèle de microsimulation dynamique, DESTINIE", Documents de Travail de la Direction des Etudes et Synthèses Économiques", No. G9913. Paris: Institut National de la Staistique et des Études Économiques.

Jarvis S. and S. Jenkins 1998. "How Much Income Mobility is There in Britain? " *Economic Journal,* Vol. 108, No. 447.

Jenkins, S., 1995. "Accounting for Inequality Trends: Decomposition Analyses for the UK, 1971-86". Economica, Vol. 62, pp. 26-63.

Johnson P., Conrad and Thomson, 1989. Workers versus Pensioners: Intergenerational justice in an ageing world, Manchester: Manchester University Press.

Joyeux, C., R. Plasman and B. Scholtus, 1996. "A Model of the Evolution of Pensions Expenditures in Belgium", paper presented to a meeting of the European HCM Network on Socio-Economic Modelling, June, 1996, Cambridge.

Kakwani, N.C. 1984, "On the Measurement of Tax Progressivity and Redistributive Effect of Taxes with Application to Horizontal and Vertical Equity". In R.L. Basmann and G.F. Rhodes (ed), *Economic Inequality: Measurement and Policy,* Advances in Econometrics, Vol. 3. Greenwich CT: JAI Press.

Kaplow, L. 1989 "Horizontal Equity: Measures in Search of a Principle, National Tax Journal, Vol. 42: pp 139-154.

Keister, L. 2000. Wealth in America: Trends in Wealth Inequality. Cambridge: Cambridge University Press.

Kennedy, F., 1988. Family, Economy and Government in Ireland, Dublin: The Economic and Social Research Institute, General Research Series Paper No. 143.

Kennell D.L. and J.F. Sheils, 1990. "PRISM: Dynamic Simulation of Pension and Retirement Income", in Lewis G. H. and R.C. Michel (eds.) Microsimulation Techniques for Tax and Transfer Analysis. Washington D.C.: The Urban Institute Press.

Kessler D., 1996. "Preventing Conflicts Between Generations, For an Active Management of the Allocation of Resources between Generations", 20th Annual Lecture of the Geneva Association.

Killingsworth, M.R., J. Heckman, 1986. Female Labor Supply: A Survey. In: O. Ashenfelter and R. Layard (eds.), Handbook of Labor Economics I. Amsterdam: Elsevier Science Publishers.

King A., H. Baekgaard and M. Robinson, 1999a. "DYNAMOD-2: An Overview". Technical Paper No. 19, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

King A., H. Baekgaard and M. Robinson, 1999a. "The Base Data for DYNAMOD-2". Technical Paper No. 20, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

Klevmarken A. And P. Olovsson, 1996, Direct and Behavioural Effects of Income Tax Changes- Simulations in the Swedish Model MICROHUS, in Harding A. (ed.) Microsimulation and Public Policy, Amsterdam: Elsevier.

Klevmarken N.A., 1980. "On estimation and other problems of statistical inference in the micro simulation approach", in R.H. Haveman and K. Hollenbeck, (eds.) Microeconomic Simulation Models for Public Policy Analysis, vol. 1, Academic Press, New York, pp. 91-106.

Klevmarken N.A., 1994. "The impact of demographic changes on the income distribution: Experiments in microsimulation" paper presented at the ESPE-meeting in Tilburg, The Netherlands.

Klevmarken N.A., 1996. "Behavioural Modelling in Micro Simulation Models", Paper presented to EUROMOD Meeting, Cambridge, May.

Klevmarken N.A., 1997. "Modelling behavioural response in EUROMOD", Paper presented to Conference of European Microsimulation, Brussels, April 18th.

Klevmarken, N.A, 1983. "Pooling incomplete datasets" Statistical Review, Vol. 5, pp69-88.

Klevmarken, N.A. & Olovsson, P., 1996, "Direct and behavioural effects of income tax changes - simulations with the Swedish model MICROHUS", in Microsimulation and Public Policy, ed. by Ann Harding, Elsevier Science Publishers, Amsterdam.

Klevmarken, N.A., 1997. " Modelling Work Incentives in MSM", Invited Lecture in the 5th Nordic Seminar on Microsimulation Models in Stockholm, June 9-10.

Knight, S., 1997. Payroll Taxes and the Redistribution of Income: A Joint Economic Committee Study. Paper prepared for J. Saxton, Chairman, Joint Economic Committee Washington D.C.: United States Congress.

Kotlikoff L.J. and W. Leibfritz, 1998. "An International Comparison of Generational Accounts", NBER Working Paper No. 6447. Cambridge M.A.: National Bureau of Economic Research.

Krupp, H.J., 1986. "Potential and Limitations of Microsimulation Models", in Orcutt G., J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to support Social and Financial Policy. Amsterdam: North-Holland.

Lambert, P.J., 1993, The Distribution and Redistribution of Income: a Mathematical Analysis (2nd ed.). Manchester: Manchester University Press.

Landt, J., A. Harding, R. Percival and K. Sadkowsky 1994, Reweighting a Base Population for a Microsimulation Model', Discussion Paper 3: National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia.

Layard, R., 1977. "On measuring the redistribution of lifetime income", in M. S. Feldstein and R.P. (eds.) *The Economics of the Public Sector*. London: Macmillan.

Lee J., 1989. Ireland 1912-85: politics and society. Cambridge: CUP.

Leimer D.R., 1999. "Lifetime Redistribution Under the Social Security Program: A Literature Synopsis", Social Security Bulletin, Vol. 62, No.2.

Lewis G.H. and R.C. Michel, 1990. Microsimulation Techniques for Tax and Transfer Analysis, Washington D.C.: The Urban Institute Press.

Lutz W., 1997. FAMSIM Austria: Feasibility Study for A Dynamic Microsimulation Model for Projections and the Evaluation of Family Policies Based on the European Family and Fertility Survey. Vienna: Austrian Institute for Family Studies.

Meenan, J., 1970. The Irish Economy since 1922: Liverpool: Liverpool University Press.

Merz, J. 1986. "Structural Adjustment in Static and Dynamic Microsimulation Models" in Orcutt G., J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to support Social and Financial Policy. New York: North-Holland.

Merz, J., 1991. "Microsimulation- a survey of principles, developments and applications", *International Journal of Forecasting*, Vol. 7 No. 1.

Miles, D. and A. Timmermann, 1999. "Risk sharing and transition costs in the reform of pension systems in Europe". Economic Policy, October.

Moffitt, R., 1984. "The Estimation of a Joint Wage Hours Labour Supply Model", Journal of Labour Economics, Vol. 2, No. 4, pp. 550-566.

Morduch J. and T. Sicular, 1998, Rethinking Inequality Decomposition, with Evidence from Rural China. Cambridge: Harvard Institute for International Development Discussion Paper No. 636

Morrison R. 2000. "Assessing the Quality of DYNACAN's Synthetically-Generated Earnings Histories", Paper Presented to the 6th Nordic Workshop on Microsimulation, Copenhagen, June.

Mot E. S. , 1992, Survey of Microsimulation Models, Social Security Research Committee, The Hague: VUGA.

Murphy D., 1984, "The Impact of State Taxes and Benefits on Irish Household Income", Journal of the Statistical and Social Inquiry of Ireland, Vol. XXV, Part 1, pp. 55-120.

Murphy D., 1985, "Calculation of Gini and Theil Inequality Coefficients for Irish Household Income in 1973 and 1980", The Economic and Social Review, Vol. 16, No. 3, pp. 225-249.

Narendranathan, W. and M.B. Stewart, 1993. "How does the Benefit Effect Vary as Unemployment Spells Length?", Journal of Applied Econometrics, Vol. 8., pp. 361-381.

Narendranathan, W., S. Nickell and J. Stern, 1985, "Unemployment Benefits Revisited", The Economic Journal, Vol. 95, pp. 307-329.

National Pensions Board, Ireland, 1988. *Report on the Tax Treatment of Occupational Pension Schemes*. Dublin: The Stationery Office.

National Pensions Board, Ireland, 1993. *Developing the National Pension System,* Final Report of the National Pensions Board. Dublin: The Stationery Office.

Nelissen J.H.M., 1994. Income Redistribution and Social Security: An application of microsimulation. London: Chapman and Hall.

Nelissen, J.H.M. 1995c. The Interaction of Household and Labour Market Modules in Microsimulation Models. In: Van Imhoff, E., A.C. Kuijsten, P. Hooimeijer & L.J.G. Van Wissen (Eds.), Household Demography and Household Modelling (pp. 319-341). Plenum Press, New York.

Nelissen, J.H.M. Demographic projections by means of microsimulation. The NEDYMAS model, part A+B, Tilburg University Press, Tilburg, 1995a, 424 p.

Nelissen, J.H.M., 1993a. The redistributive impact of social security schemes on lifetime labour income, KUB, Tilburg, 1993, 287 p.

Nelissen, J.H.M., 1993b. Labour market, income formation and social security in the microsimulation model NEDYMAS. Economic Modelling, 10 (3) 225-272.

Nelissen, J.H.M., 1995b. Annual versus lifetime income redistribution by social security, Tilburg University Press, Tilburg, 31 p.

Nelissen, J.H.M., 1995d. Lifetime income redistribution by the old-age state pension in The Netherlands. Journal of Public Economics, 58 429-451.

Nelissen, J.H.M., 1995e. Lifetime income distribution: households versus individuals. Applied Economics Letters, 2 122-125.

Nelissen, J.H.M., 1995f. Lifetime income redistribution by social security. Journal of Population Economics, 8 (1) 89-105.

Nelissen, J.H.M., 1996a. The modelling of institutional households by means of microsimulation., Tilburg University Press, Tilburg, 166 p.

Nelissen, J.H.M., 1996b. Social security and lifetime income redistribution: A microsimulation approach. In A. Harding (Ed.) Microsimulation and public policy (pp. 267-292). Amsterdam: North-Holland.

Nelissen, J.H.M., 1996c. Annualized versus non-annualized lifetime income redistribution. Applied Economics Letters, 3 533-536.

Nelissen, J.H.M., 1997a. Vertical and horizontal lifetime redistribution by the Dutch social security system. In Zandvakili, S. (Ed.) Taxation and Inequality (pp. 291-326). Research on Economic Inequality, vol. 7, Greenwich: JAI Press Inc.

Nelissen, J.H.M., 1997b. Modelling and forecasting of institutional households using microsimulation. Zeitschrift für Bevölkerungswissenschaft, 22 (1), 111-130.

Nelissen, J.H.M., 1998. "Annual versus lifetime income redistribution by social security", Journal of Public Economics Vol. 68, pp 223-249.

Nelissen, J.H.M., 1998. Annual versus lifetime income redistribution by social security. Journal of Public Economics, 68(2) 223-249.

Nelissen, J.H.M., 1999a. Mortality differences related to socioeconomic status and the progressivity of old-age pensions and health insurance: The Netherlands. European Journal of Population, 15, 77-97.

Nelissen, J.H.M., 1999b. A payable alternative for the Dutch old-age pension system. Journal of Policy Modelling, 21 (2), 275-282.

Nelissen, J.H.M., 2000. The costs and the lifetime redistributive impact of capital funded Dutch supplementary pensions. Geneva Papers on Risk and Insurance, 25, 407-423.

Neufeld C., 2000. "Alignment and Variance Reduction in DYNACAN" in Anil Gupta and Vishnu Kapur, eds., Microsimulation in Government Policy and Forecasting. North Holland Press, Contributions to Economic Analysis Series.

Nickell, S. 1979. "The Effect of Unemployment and Related Benefits on the Duration of Unemployment", *Economic Journal*, Vol. 89, No. 353, pp. 34-49.

Nickell, S., 1982, "The Determinants of Occupational Success in Britain", Review of Economic Studies, Vol. XLIX, pp. 43-53.

Nolan B, 1999, "Targeting Poverty", New Economy, Vol. 6, No. 1 pp. 44-49.

Nolan B., 1978, "The Personal Distribution of Income in the Republic of Ireland", Journal of the Statistical and Social Inquiry of Ireland, , pp. 91-139.

Nolan B., 1981, "Redistribution of Household Income in Ireland by Taxes and Benefits", The Economic and Social Review, Vol. 13, No. 1, pp. 59-88.

Nolan B., 1989. 'Socio-Economic Mortality Differentials in Ireland', ESRI Working Paper 13.

Nolan B., 1991. The Utilisation and Financing of Health Services in Ireland, Dublin: ESRI General Research Series Paper No.155.

O'Cinneide S., 1972, "The Extent of Poverty in Ireland", Social Studies, Vol. 1., No. 4. Pp 381-400.

O'Connell P., 1982, "The Distribution and Redistribution of Income in the Republic of Ireland", The Economic and Social Review, Vol. 13, No. 4, pp. 251-278.

O'Connell P. and D. Rottman, 1992. The Irish Welfare State in Comparative Perspective pp.205-240 in Goldthorpe J. and Whelan C. (eds.) *The Development of Industrial Society in Ireland.* Oxford: Oxford University Press

O'Donoghue C., 1997, "Carbon Dioxide, Energy Taxes and Household Income', *ESRI Working Paper*, No. 90

O'Donoghue, C., 1998. A Technical Description of the Irish module of Eur6, *Microsimulation Unit Research Note*, R26, University of Cambridge, Department of Applied Economics.

O'Donoghue C., 2000. "A Dynamic Microsimulation Model for Ireland: A Study of a Flexible Dynamic Modelling Framework" Paper Presented to the 6th Nordic Workshop on Microsimulation, Copenhagen, June.

O'Donoghue, C., forthcoming. "Dynamic Microsimulation: A Methodological Survey", *Brazilian Electronic Journal of Economics*, Special Issue on Dynamic Microsimulation.

O'Muircheartaigh, F.S., 1977. "The Changing Burden of Personal Income Tax in Ireland and the Social Valuation of Income 1946-76", Journal of the Statistical and Social Inquiry Society of Ireland, Vol. XXIII, Part IV.

O'Shea, E. 1999. "Measuring Trends in Male Mortality by Socio-Economic Group in Ireland: A Note on the Quality of Data", Department of Economics Working Paper No. 39., Galway: National University of Ireland.

O'Donnell, R. and C. O'Reardon 1996. "Irish Experiment: Social Partnership Has Yielded Economic Growth and Social Progress," New Economy, Vol. 4, No. 1

O'Donoghue C. 2001. Redistribution in the Irish Tax-Benefit System, unpublished PhD, London School of Economics.

O'Donoghue C. and M. Evans, 1999, Cross-National Microsimulation Modelling: Reforming Social Assistance in 3 European Countries, Brazilian Electronic Journal of Economics Vol. 2.

O'Donoghue C., 1997, "Carbon Dioxide, Energy Taxes and Household Income", Dublin: ESRI Working Paper, No. 90.

O'Donoghue, C. and F. Utili, 2000. "Micro-Level Impacts of Low Wage Policies in Europe", Salverda W., B. Nolan and C. Lucifora (eds.), Policy Measures for Low-Wage Employment in Europe. London: Macmillan.

O'Donoghue, C. and H. Sutherland, 1999, "For richer, for poorer?: The treatment of marriage and the family in European income tax systems", Cambridge Journal of Economics. Vol. 23, No. 5.

O'Donoghue, C., 1998. A Technical Description of the Irish module of Eur6, Microsimulation Unit Research Note, R26.

O'Donoghue, C., 2000. "The Irish Tax-Benefit System and the Population Structure", Chapter in PhD These, London School of Economics.

O'Neill D. and O. Sweetman, 1999, Poverty and Inequality in Ireland 1987-1994: A Comparison using measures of Income and Consumption, Maynooth: Department of Economics Working Paper 1999-??.

Orcutt G. and J.D. Smith, 1979. "Towards a theory of wealth accumulation and distribution: A model of US household wealth accumulation" Annales de L'INSEE, No. 33-34, pp5-57.

Orcutt G., 1957, "A new type of socio-economic system" Review of Economics and Statistics, Vol. 58, pp 773-797.

Orcutt G., A. Glazer A., R. Harris and R. Wertheimer II 1980. Microanalytic modelling and the analysis of public transfer policies, in R.H. Haveman and K. Hollenbeck, (eds.) Microeconomic Simulation Models for Public Policy Analysis, vol. 1, Academic Press, New York, pp. 91-106.

Orcutt G., A. Glazer, 1980. Microanalytic modelling and simulation, in Micro Simulation- Models, Methods and Applications, (eds. B. Bergmann, G. Eliasson and G. Orcutt), IUI Conference Reports 1980:1, Industrial Institute for Economic and Social Research, Stockholm, pp. 81-106.

Orcutt G., A. Glazer, H. Jamarillo and P. Nelson, 19767b. "Microanalytic Simulation", Working Paper 9/21/76, New Haven: The institution for Social and Policy Studies, Yale University.

Orcutt G., J. Merz and H. Quinke, 1986. Microanalytic Simulation Models to Support Social and Financial Policy, Amsterdam: North-Holland.

Orcutt G., M. Greenberg, J. Korbel and A. Rivlin, 1961, Microanalysis of Socio-economic Systems: A Simulation Study, New York: Harper and Row.

Orcutt G., S. Caldwell and R. Wertheimer 1976. 'Policy Exploration through microanalytic simulation, Washington DC: The Urban Instate.

Osberg, Lars and Lethbridge, Lynn, 1996. "Labour Market Modeling in DYNACAN – Final Report.", DYNCAN Project Consulting Report, May.

Palme, M., 1996, “Income Distribution Effects of the Swedish 1991 Tax reform: An Analysis of a Microsimulation Using Generalised Kakwani decomposition”, Journal of Policy Modelling, Vol. 18, No. 4, pp. 419-443.

Panis C. and L. Lillard, 1999. Near Term Model Part II, Final Report. Santa Monica: Rand Corp.

Percival R., 1994. 'Modelling Austudy', Canberra: NATSEM, STINMOD, Technical Paper No. 5.

Pfähler, W., 1990, “Redistributive effect of income taxation: decomposing tax base and tax rates effects. Bulletin of Economic Research, Vol. 42, pp. 121-129.

Panel on Retirement Income Modelling 1997. Assessing Policies for Retirement Income: Needs for Data, Research, and Models. Washington DC: National Research Council.

Pudney S and H. Sutherland, 1996. “Statistical reliability in microsimulation models with econometrically-estimated behavioural responses” in A Harding (ed.) Microsimulation and public policy, Elsevier, Amsterdam, 473-504.

Pudney S.E., 1992. “Dynamic Simulation of Pensioner’s incomes: methodological issues and a model design for Great Britain.”, Dept. of Applied Economics Discussion paper no MSPMU 9201, University of Cambridge.

Pudney, S. and Sutherland, H. 1994, “The statistical reliability of micro-simulation estimates: Results for a UK tax-benefit model”, Journal of Public Economics, 53, 327-365.

Pylkkanen, E. 2000. “Modelling Wags and Hours of Work”, paper presented to the Nordic Workshop on Microsimulation, Copenhagen, June.

Rake, K., 2000. "Can we do better comparative research using microsimulation models? Lessons from the Micro Analysis of Pension Systems" in Mitton L., H. Sutherland and M. Weeks Microsimulation in the New Millennium, London: Cambridge University Press.

Roche, J. 1984, Poverty and Income Maintenance Policies in Ireland, Dublin: Institute for Public Administration.

Rottman, D. and M. Reidy, 1988, Redistribution Through State social Expenditure in the Republic of Ireland: 1973-1980. National Economic and Social Council.

Rottman, D.B., D. Hannan and N. Hardiman, M.H. Wiley, 1982, The Distribution of Income in the Republic of Ireland: A Study in Social Class and Family-Cycle Inequalities, General Research Series Paper No. 109, Dublin: The Economic and Social Research Institute.

Rowe, G. and M. Wolfson, 2000. "Public Pensions – Canadian Analyses Based on the LifePaths Generational Accounting Framework", paper prepared for the Nordic Microsimulation Workshop, Copenhagen.

Rowntree, B.S., 1902., Poverty: A study of town life.. London: Nelson.

Samuelson P.A., 1958. 'An exact Consumption-Loan Model of interest with or without the Social Contrivance of Money', Journal of Political Economy, Vol. 66, No.6.

Sandford, C. and O. Morrissey, 1985. The Irish Wealth Tax: A Case Study in Economics and Politics. Dublin: ESRI General Research Series Paper 123.

Schulz J. 1979, 'The economic impact of Private Pensions on Retirement Income' Final Report to the National Science Foundation, Washington D.C.

Schulz J. 1982, 'Problems of American Pensions: Microsimulation Policy Analysis'. Journal of Institutional and Theoretical Economics no 138.

Shorrocks, A.F., 1982a. "Inequality decomposition by factor components". Econometrica, volume 50, pp 193-212.

Shorrocks, A.F., 1982b. "The impact of income components on the distribution of family incomes". Quarterly Journal of Economics. Vol. 98, pp. 311-326.

Ståhlberg, A.C., 1988. "Lifetime Redistribution of Social Insurance in Sweden: Intra- and intergenerational effects." Working Paper 3/88, Swedish Institute for Social Research .

Ståhlberg, A.C., 1988. "Lifetime Redistribution of Social Insurance in Sweden: Intra- and intergenerational effects." Working Paper 3/88, Swedish Institute for Social Research.

Stroombergen A., D. Rose and J. Miller, 1995. Wealth Accumulation and Distribution: Analysis with a Dynamic Microsimulation Model. Wellington: Business and Economic Research Ltd.

Sutherland H., 1995. Static Microsimulation Models in Europe: A Survey *Microsimulation Unit Discussion Paper*, MU9503, University of Cambridge, Department of Applied Economics.

Tanner, S., 1998., "The Dynamics of Male Retirement Behaviour", Fiscal Studies, Vol. 19, No. 2, pp. 175-197.

Tanner, S., 1998., "The Dynamics of Male Retirement Behaviour", Fiscal Studies, Vol. 19, No. 2, pp. 175-197.

Taylor, M.P., 1996. "Earnings, Independence or Unemployment: Why Become Self-Employed?" Oxford Bulletin of Economics and Statistics, Vol. , pp. 253-265.

Taylor, M.P., 1996. "Earnings, Independence or Unemployment: Why Become Self-Employed?" Oxford Bulletin of Economics and Statistics, Vol. , pp. 253-265.

ter Rele H., 1997. Generational Accounts for the Dutch Public Sector. Research Memorandum No. 135. The Hague: CPB Netherlands Bureau for Economic Analysis.

Third Millennium, 1999. "Third Millennium Declaration" in Williamson, J.B>, D.M. Watts-Roy and E.R. Kingston (eds.), The Intergenerational Equity Debate. New York: Columbia University Press.

Toder E., C. Uccelllo, J. O'Hare, M. Favreault, C. Ratcliffe, K. Smith, G. Burtless and B. Bosworth. 1999. Modeling Income in the Near Term – Projections of Retirement Income Through 2020 for the 1931-60 Birth Cohorts. Final Report. Washington DC: Urban Institute.

Townsend, P. and N., Davidson, 1982, Inequalities in Health: The Black Report. London: Penguin Books.

van de Ven, J., 1998. "A Dynamic Cohort Microsimulation Model". Department of Economics Research Paper, No. 637. Melbourne: University of Melbourne.

van Soest A., 1995. Structural models of family labor supply: a discrete choice approach, Journal of Human Resources, 30(1), 63-88.

Van Soest A., I. Woittiez and A. Kapteyn, 1990. Labour supply, income taxes and hours restrictions in the Netherlands, *Journal of Human Resources,* 25, 517-558.

Vencatasawmy, C.P., E. Holm, T. Rephann, J. Esko, N Swan, M. Ohman, M. Astrom, E. Alfredsson, K. Holme and J. Siikavaara, 1999. "Building a spatial microsimulation model", SMC Internal Discussion Paper. Kiruna: Spatial Modelling Centre.

Walker, A., 2000. "Modelling Immigrants to Australia: to Enter a Dynamic Microsimulation Model", in Anil Gupta and Vishnu Kapur, eds., Microsimulation in Government Policy and Forecasting. North Holland Press, Contributions to Economic Analysis Series.

Walsh B., 1970, "A Study of Irish County Marriage Rates, 1961-1966", Population Studies, Vol. XXIV, No.2.

Walsh B., 1972. "Ireland's Demographic Transformation 1958-1970", The Economic and Social Review, Vol. 3, No. 2.

Walsh B.M., 1974, "Income Maintenance Payments in Ireland". Economic and Social Review, Vol. 5, No.2.

Walsh, B., and B.J., Whelan, 1973. "Determinants of Female Labour Force Participation: An Econometric Analysis of Survey Data", Journal of Statistical and Social Inquiry Society of Ireland, Vol. XXIII, Part I.

Wertheimer, R., S.R. Zedlewski, J. Anderson and K. Moore, 1986, 'DYNASIM in comparison with other microsimulation models' in G. Orcutt, J. Merz and H. Quinke (eds.)

Wertheimer, R., S.R. Zedlewski, J. Anderson and K. Moore, 1986, "DYNASIM in comparison with other microsimulation models" in G. Orcutt, J. Merz and H. Quinke (eds.) Microanalytic Simulation Models to Support Social and Financial Policy. Amsterdam: North-Holland.

Whelan C.T. and B.J. Whelan, 1988. The Transition to Retirement, General Research Series Paper No. 138, Dublin: The Economic and Social Research Institute.

Whelan C.T. and B.J. Whelan, 1988. The Transition to Retirement, General Research Series Paper No. 138, Dublin: The Economic and Social Research Institute.

Winder, N. and Y Zhou, 1999. "Predicting the annual income of Swedish individuals", SMC Internal Discussion Paper. Kiruna: Spatial Modelling Centre.

Wolfson M. and G. Rowe, 1998. "Public Pension Reforms- Canadian Analyses Based on the LifePaths Generational Accounting Framework", paper presented to the International Association for Research in Income and Wealth, Cambridge.

Wolfson M. and G. Rowe, 1998a. "Public Pension Reforms – Analyses Based on the LifePaths Generation Accounting Framework", paper presented to the 26th General Conference of the International Association for Research in Income and Wealth, Cambridge, UK.

Wolfson M. and G. Rowe, 1998b. "LifePaths – Toward an Integrated Microanalytic Framework for Socio-Economic Statistics", paper presented to the 26th General Conference of the International Association for Research in Income and Wealth, Cambridge, UK.

Wolfson M. 1990, 'Divorce, homemaker pensions and lifecycle analysis', Population Policy and Review, Vol. 8 25-54.

Wolfson M., 1988. "Homemaker Pensions and lifetime redistribution", Review of Income and Wealth, Vol. 34, No. 3, pp. 221-250.

Wolfson M., 1989b. "Divorce, homemaker pensions and lifecycle analysis", Population Policy and Review, Vol. 8 25-54.

Wolfson, M. 1989a. The CEPHID Project: Canada's Elderly Projecting Health, Income and Demography, mimeo, Statistics Canada, February.

Wolfson, M. 1989a. The CEPHID Project: Canada's Elderly Projecting Health, Income and Demography, mimeo, Statistics Canada, February.

Yitzhaki, S., 1983. "On an extension of the Gini index", International Economic Review, Vol. 24, pp. 614-28.

Zafir, M., 1987. "Aims and Structure of the Hungarian Microsimulation System based on Household Statistical Data", Mimeo, Budapest.