POLICY ANALYSIS USING MICROSIMULATION

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ABSTRACT

Recent changes in the social policy development arena in New Zealand mean that traitional methods of social policy analysis are not now adequate for all analyses. Microsimulation is a technique that can provide another dimension to social policy analysis.

The thesis starts by discussing some of the major social policy developments in New Zealand pointing out some of the weaknesses in the analyses accompaning them. The thesis then goes on to introduce microsimulation as a technique that can help improve the analysis of social policy. However, the main body of the thesis consists of the development of a microsimulation model, a discussion of the database upon which the model is based, and an analysis carried out using the model.

The thesis demonstrates the usefulness of microsimulation models in identifying impacts of social policy changes on small sectors of the population. It does this by simulating the income effects of the increase in the qualification age for National Superannuation on the population sector aged sixty to sixty - five.

Although the thesis demonstrates the effectiveness of microsimulation models, the project uncovered a number of areas where currently available data are not sufficiently adequate for the methodology to be utilised to the full. The thesis finishes by suggesting a number of areas where further development could be productive and assist in improving the quality of social policy analysis.

ACKNOWLEDGEMENTS

Some of the information in this document is Statistics New Zealand data. You are welcome to use it , but please acknowledge the source.

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LIST OF SYNONYMS AND ABBREVIATIONS

ACC	Accident Compensation Corporation payments
ASSET	A Simulation System for Evaluating Taxation - microsimulation model
BERL	Business and Economic Research Ltd
CPI	Consumers Price Index
HEIS	Household Expenditure and Income Survey
HLFS	Household Labour Force Survey
GMFI	Guaranteed Minimum Family Income
NZIER	New Zealand Instituts of Economic Research
POBOC	Payment On Behalf Of Crown
SEBIRD	Study of the Effects of the Budget on Income Distribution and Redistribution - extension of ASSET
TAXMOD	TAX-benefit MODel - microsimulation model

CHAPTER 1: INTRODUCTION

Over recent years there has been considerable discussion about National Superannuation and the public provision of retirement pensions. Some say that taxes National Superannuation is unsustainable because it costs too much making taxes too high. Others state that they have paid taxes all their lives and have paid for the pensions of the previous generation, therefore the state has contracted to pay them a pension. Still others comment that they cannot save for retirement on the wages they are paid, therefore the country owes them a pension when they retire.[1]

Whatever stance is taken, one thing that rapidly becomes clear is the lack of information and tools necessary to make fully informed decisions on the subject. The problem with lack of information and tools is not just confined to the subject of provision of income for the elderly, it applies to much of social policy and the associated government expenditure. As former prime minister of New Zealand Geoffrey Palmer has said:

> Social policy formation in New Zealand generally is beleaguered by an absence of adequate statistical information.[2]

As groups concerned about the size of government expenditure become more vocal, there is increasing pressure to reduce that expenditure.[3] The biggest segment of

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[1] Department of Social Welfare (1988), Task Force on Private Provision (1992a).

[2] Palmer (1977b) page 10.

[3] Boston and Dalziel (1992)

government expenditure goes upon social welfare including public provision for the retired. Therefore, social welfare expenditure is often considered fair game for being cut back. The emphasis then becomes 'target government assistance only to those who need it'.

However, calling for government assistance to be paid only to 'those who need it' raises a number of questions. Who are these people? How do we identify them? What assistance and how much do they need? The more tightly government assistance is targeted, the more detailed and accurate are the forecasts and analyses needed. Answers are required to questions such as :-

> How many people will be eligible for benefits under different definitions of eligibility? Who are they? What are their characteristics?
>
> How much will it cost to pay for the benefits?
>
> How will the costs differ if the income cutoff is modified?
>
> How will behaviour change as eligibility is allowed/disallowed?

While standard methods involving aggregated data can give reasonable answers to the third question, they are inadequate in providing answers to the other questions. There have not been the tools available to provide in-depth analyses in answer to those questions.

Why is it that standard methods are inadequate in identifying some of the important impacts of social policy proposals? Part of the reason is that aggregated methods describe the 'average person' who may in actual fact make up just a small proportion of the population. However, there is more to the problem than that.

While standard aggregated models can produce aggregated cost estimates, there are structural difficulties and inadequacies incorporated in them. If estimates of the effects of programmes are calculated using the aggregated grouped data, every time the groups are changed, models using aggregated data must also be recalculated and rebuilt. However, if models were to use disaggregated data they would only have to have the results retabulated with the new set of input parameters. With the expectation of immediate responses to questions on the effects of programmes, there is often not the

time to recalculate and rebuild aggregated models. This can lead to inadequate analyses and poor forecasts, but the greatest problems are caused by the continuing demand by Parliament and the Government for more and more detail in the expenditure and impact assessments.[4] Aggregated models just cannot adequately handle this detail.

Eligibility and level of benefit are usually based upon an assessment of economic need and/or demographic category and these are becoming more and more narrowly defined. 'Economic need' is commonly defined by income levels, while demographic categories are usually defined by age, handicap, family type and other socio-economic characteristics. Thus potential costs of programmes will depend on the numbers eligible and the kind and amount of benefits for which they qualify. Actual costs will also depend upon behavioral responses to the incentives perceived in relation to the programmes. Analysis models using aggregated data cannot adequately identify the effects and costs at the detail now being required.

Concern about economic need has led to many proposals for alternative social welfare systems, from the private provision - minimalist public backup approach, through compulsory contributory social insurance to the universalist type system such as that used for the National Superannuation programme.[5] However, throughout all this discussion there do not appear to be any publically acknowledged mechanisms for assessing either the full costs and benefits of different types of social welfare systems or for assessing the full and long term impacts of those different social welfare systems on the various sectors of the population. While Government Departments (notably The Treasury) and Government instituted working parties (such as the Task Force on Private Provision for Retirement) have produced cost estimates of policy proposals, there has not been a forum to challenge (or have knowledge of) the assumptions upon which the estimates were based. Neither are there alternative sources of analysis with suitable methodologies able to contest in detail the advice given to the Government.

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[4] State Sector Act (1988), Public Finance Act (1989), Fiscal Responsibility Bill (1993).

[5] See Department of Social Welfare (1988) and Task Force on Private Provision (1992a) for a variety of the methods suggested.

This has meant that income maintenance (the term usually applied to the alleviation of economic need through social security), along with most other social welfare policies, has been discussed in an environment of uncertainty of the actual final outcome arising from the implementation of these policies. Policies appear to have been implemented on the strength of the pressure group and the eloquence of their arguments rather than on the strength of a detailed estimation of the impact of the policies. The arguments usually purport to show how effective the policies have been in other countries such as Australia, UK or more often the USA. However, policies cannot just be transplanted from one society into another. Historical and cultural backgrounds to societies differ and make transplanting policies to a different society something that should be done with care. The outcome has often meant excess or unanticipated costs, unexpected social implications and the most needy persons missing out on the assistance meant to help them. These problems are not restricted to New Zealand for as Citro and Hanushek state for the USA scene:-

> "Despite the widespread use of formal models to provide information to the legislative debate, neither the policy analysis tools employed nor the estimates they produce have been subject to much explicit evaluation of their utility or accuracy."[6]

There are a number of other reasons why little in-depth evaluation of the likely impact of social policy has been carried out in New Zealand. One reason is that it suits some people to make social policy decisions on the basis of ideology rather than non-partizan analysis. Another reason is that the desired analysis would be difficult because the data may not be available or may have been collected for another purpose and may not be totally suitable for the current activity. However, the major reason for the lack of evaluation of social policies remains the lack of suitable data and analytical models at the Department of Social Welfare and other interested parties. Recent discussions about private and public provision of retirement income have further highlighted the lack of capacity in government departments, universities and elsewhere that is capable of contesting policy advice given to the Government by, in particular, The Treasury.

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[6] Citro and Hanushek (1991) page 2.

The small amount of social policy evaluation that has been carried out in New Zealand has usually been historical evaluation of social policy and at an aggregated level. This can make it difficult to identify the impact of social policy on specific groups. But for the most part, social policy remains unevaluated.[7]

The problem of inadequate evaluation of the impacts of policy is not unique to New Zealand and techniques have been developed to enable more widespread evaluation to take place. One of the more recent developments and one developed particularly for the analysis of social policy is the technique of microsimulation or micro-analysis.

Microsimulation is an analysis technique that uses disaggregated information representing individual people and applies policy rules to that information. Thus the effect of the policy rules on the individuals represented can be determined. The adjusted data can also be aggregated to determine the effects of the policy at the aggregated level. As Haveman and Hollenbeck state in their introduction:

> Microsimulation models are designed to simulate the effects of proposed changes in economic policy variables - prices, taxes, subsidies, regulations - on data bases containing observations of disaggregated components of one or more major sectors of the economy.[8]

Merz expands on this when he says:

> Because microsimulation models are concerned with the behaviour of microunits (such as persons within a family/household/firm), they are especially well suited to analyze the distributional impacts of policy changes.[9]

Merz further goes on to say:

> Microsimulation is considered a forecasting instrument because policy effects can be forecasted by a microsimulation model.[10]

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[7] Boston and Dalziel (1992). The lack of evaluation is underlined by the difficulty there is in obtaining substantive evaluations of policy after it has been in place for some time.

[8] Haveman and Hollenbeck (1980), page xxi.

[9] Merz (1991), page 77.

[10] Merz op cit.

While these comments were made in relation to economic policy, they also apply to social policy.

Although microsimulation has been in use in other countries for over twenty years, there has been little literature produced in New Zealand on the topic. Most of the papers published in other countries and those few published in New Zealand relating to microsimulation have discussed the analyses done with the models. According to Hancock and Sutherland:

> Much has been written on the findings and policy recommendations by the users of such models.....Rather less emphasis has been placed on detailing the workings of the models or the process of their design and construction. Yet there is much to be gained by sharing such information. The process of exchanging experiences helps to identify directions for future developments and to suggest new solutions to continuing problems.[11]

The objective of this thesis is to introduce the discussion of the topic of microsimulation to New Zealand, to develop a microsimulation model and to demonstrate the use of such a model in estimating the impacts of a policy change. The change that will be analyzed is the recent increase of the qualification age for National Superannuation from sixty to sixty five. The aspect that will be estimated is the impact on income of those in the age-group 60 - 64. The 60 - 64 age group currently receives National Superannuation, but when the qualification age change is fully implemented, this group will be ineligible for National Superannuation.

Chapter two introduces social policy development and discusses how policy has been developed in the past and methods currently used in policy development. The discussion will draw out some of the strengths and weaknesses of the methods used. Chapter three introduces microsimulation and discusses the development of the technique both in New Zealand and in other countries. The model itself is developed in chapter four while chapter five covers the need for data and what data are currently available in New

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[11] Hancock and Sutherland (1992), pages 1-2.

Zealand. Chapter six shows the use of the model in an analysis of the possible income impact of the increase in the qualification age for National Superannuation. The concluding chapter discusses the effectiveness of the model and includes recommendations for future work.

CHAPTER 2: ANALYTIC TOOLS AND THE DEVELOPMENT OF SOCIAL POLICY IN NEW ZEALAND: SOME HISTORIC EXAMPLES

Introduction

Social Policy in New Zealand has tended to be developed in an piecemeal way.[12] This is particularly the case with income maintenance policy. Those policy developments that are not piecemeal stand out as landmarks. It is interesting to note that the two most comprehensive developments were never fully implemented and never came up to the vision of their original proponents.[13]

A common element in several of the major social policy developments in the income maintenance area has been the provision of retirement income. The 1898 Old Age Pensions Act deals exclusively with retirement incomes while the 1938 Social Security Act includes major elements concerned with retirement income. Perhaps the most significant alteration that has been made to the Social Security Act was the replacement of the Old Age Pension and Universal Superannuation with National Superannuation in 1975.

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[12] A review of amendments to Acts such as the Social Security Act 1964 and the Parliamentary Debates demonstrates this point.

[13] The two development were the Old Age Pensions Act 1898 and the Social Security Act 1938.

The public provision of retirement income has had a history of inadequate analysis, over-expenditure and policy change (as demonstrated in this chapter).[14] The single largest commitment made - National Superannuation - appears to have been subjected to almost no analysis of likely future cost. As a result, National Superannuation has been subjected to 15 major changes in the 16 years since its introduction. Changes to retirement income entitlements are deeply resented by beneficiaries because they are vulnerable. For the most part they have no other source of income.

In Chapter Two, some of New Zealand's major social policy developments will be discussed. The discussion will be a limited historical review of each of the programmes concentrating on the expenditure forecasts produced and the analysis upon which they were based. The particular policy changes discussed will be the 1898 Old Age Pensions Act, the 1938 Social Security Act and the 1975 National Superannuation Scheme. The Chapter will conclude with a discussion of the changes in social policy introduced since the fourth Labour Government was elected in 1984. The recent social policy changes have been included as they have been very extensive and the outcomes not always what was intended. These changes have also illustrated the need for new methods of policy analysis. Further, several of the policy changes over the past ten years have involved National Superannuation.

1898 Old Age Pensions Act

The election of New Zealand's first 'party' government in 1890 brought in a period of major social policy development. New Zealand was caught up in the longest and most severe depression the country has ever experienced.[15] There was major dissatisfaction with the policies of the Governments and when the Liberal Party formed and presented a manifesto illustrating social concern, they were swept into power. Among the significant social legislation the Liberal Party introduced was: the voting franchise for all women; the Arbitration Act; and the Old Age Pensions Act.

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[14] See also the Task Force on Private Provision for Retirement (1991) and (1992a).

[15] Over twenty years (except for a break of a few years when Vogel borrowed finance for public works) compared with about six years for the 'great' depression.

The introduction of the 1898 Old Age Pension Act appears to have been an interesting mixture of democracy in action and political opportunism. The Old Age Pensions legislation had come about as a result of public pressure, national and international concern about the destitution of the poor and Richard Seddon's political opportunism. In 1882 Sir Harry Atkinson, the Colonial Treasurer and Leader of the House, had introduced into the House a comprehensive social insurance scheme. In Germany, Bismark had introduced a contributory social insurance scheme in 1883. Over the next six years it was gradually extended to become a comprehensive compulsory contribution social insurance scheme for all employees. In Great Britain, the House of Commons in 1885 appointed a Select Committee "to enquire into the best method of National Provident Insurance." This led to a House of Commons conference on destitution in 1891 and then to the establishment of a Royal Commission of the Aged Poor. Other countries were also interested and in 1891, Denmark established the first universal non-contributory old age pension. Austria was apparently another country that had established pension schemes.[16]

While this was going on, considerable interest was also being shown in pension schemes in New Zealand, mainly by the working class. Many schemes were proposed and pamphlets published:

> The Workers' Political Committee set up in 1892 by the Otago Trades and Labour Council included in its programme old age pensions to be financed from the proceeds of a progressive income tax. In that year McGregor, the civil servant in charge of charitable aid, also suggested old age pensions, pointing out what had been done in Germany and Denmark, and saying that there was a strong public sentiment 'in favour of a more sympathetic, discriminating treatment of the aged poor'.[17]

In 1892 Stout proposed a pension scheme of the voluntary contribution variety and other groups also suggested schemes.

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[16] Sutch (1966) page 89.

[17] Sutch op cit pages 88 and 89.

Further to this, there was major social and political change in New Zealand, particularly with the extension, in 1893, of the franchise to women. According to Condliffe, this was important for the Pensions Act:

> It is very significant, therefore, that legislation awaited the advent of woman suffrage.[18]

The first step of the Liberal Government towards the 1898 Act was to set up a Select Committee in 1894. The Committee was to study the question of making provision for old age. Despite the public enthusiasm of a number of members, the Liberal Government was very cautious. It was a big new step and required state expenditure in a time when the overseas debt was causing great concern. The big landowners and other wealthy still had a big say and the Government did not want to arouse them too much by increasing taxes. In the financial statement of 1894 the Government stated:

> The question of Old Age Pensions still remained unsolved. The grant of a State pension to all arrived at a certain age would not only necessitate a greatly increased taxation, but would also add to the burden of those least able to bear such an increase. If the pensions were to be granted to those only who could prove need, it would be difficult to separate the recipients from the non-recipients without injustice, and without discouragement of thrift. Nevertheless, the aims of the friends of the scheme are so high and noble that they must have the warmest sympathy of all human minds. A Select Committee is now sitting to consider the subject, and it is hoped they will be able to make some practical suggestions.[19]

The Select Committee appears to have made quite a thorough study of the few schemes known at the time. The general consensus of the Committee seems to have been that the conditions in the older societies of Europe differed considerably from the conditions in a newly formed colony such as New Zealand and that therefore New Zealand would have to work out its own scheme. According to Sutch, the Committee:

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[18] Condliffe (1930) page 381.

[19] Quoted in Condliffe op. cit. page 383.

...reported that an old age pension of 8s a week should be provided if the finance could be arranged. No means test was suggested, but residence in the colony for 20 years was recommended.....The chairman remarked, 'looking at the precarious nature of the employment of working men in the colony - one week in work and another out of it - only the smallest number of this class could contribute regularly to the establishment of any pension fund'.[20]

The Committee also stated that:

...every year upwards of 1,500 children under 15 years of age were left fatherless - how many without adequate means of support it is not possible to say.

In the end the Committee merely recommended the appointment of a Royal Commission. According to Condliffe:

This time-honoured procedure of escape from a difficult situation aroused Liberal organizations to effective action.[21]

By the mid 1890s the situation regarding the aged was getting much worse. The aged as a proportion of the population had been rapidly increasing. While the overall population grew 10% between 1896 and 1901, the over 65 European population grew by 50%.[22]

It was into this environment that in 1896 Seddon first floated his Old Age Pension Bill. According to Condliffe:

The measure brought down in the session of 1896 was in reality a kite to test the strength of opinion on the subject.[23]

It seems that there must have been a very strong ground swell of support for assistance to the elderly, much stronger than was perhaps realized initially by many of the members of parliament. Once the debate got properly under way, the main arguments seemed to be whether or not the country could afford the scheme, although of course there was a considerable comment about discouragement of self sufficiency, thrift and

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[20] Sutch op. cit. page 89.

[21] Condliffe op. cit. page 383.

[22] New Zealand Official Yearbook (1902).

[23] Condliffe op. cit. page 383.

breakup of families - the same arguments that are used today, one hundred years later, against state provision of income maintenance.[24]

What caused the idea of a pension most problem for a number of years was a principle put forward by G. W. Russell that the pension should be universal. He realized that it would be expensive and special taxes would be required to support it and so suggested a special land tax. Seddon's concern over costs must have been apparent as it appears that those against the scheme must have supported the attempts to make the scheme universal. This is something Seddon did not want and the 1896 Bill lapsed, but a 'Registration of Peoples' Claims Act' was passed. The intention of this Act was to get some indication of the actual interest in and need for state assisted pensions.

The intention of the Act was to set up legislation:

> under which persons aged 65 and up, having had 20 years residence in colony &c (sic) and whose total income from all sources, excluding personal earnings, did not exceed £50 per annum, were permitted, for a limited time, to send in pension claims.[25]

The 8010 persons who registered claims paid a fee of 2s 6d to do so:

> their main occupational groups included labourers, gardeners, shoemakers, nurses and a few professional men.[26]

To the early leaders of the Liberal Party, Balance and Seddon, the way to approach changes in legislation was to move in small steps and to see how effective the legislation was before going on. Thus to Seddon, the 1898 Act was just a start:

> Seddon described the Bill as a start and foreshadowed gradual liberalising amendments as finance allowed and experience suggested. The first change, he predicted, would be to restore the period of continuous residence to twenty years and to reduce the qualifying age to 60.[27]

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[24] Meantime the economy has grown faster than did any economy prior to 1900.

[25] New Zealand Official Yearbook (1897).

[26] Department of Social Security (1950) page 23.

[27] Hamer (1988) page 149.

But three years later the driving force was gone and although many extensions were made over the years it never reached what appeared to be Seddon's vision:

Seddon had also promised that additional legislation would be introduced to cover contributory insurance against the hazards of old age. In this way all classes were to be covered - the better off would have a contributory scheme, the deserving poor would get old age pensions and a means test, the undeserving would remain paupers and receive charitable aid.[28]

Table 2.1   1898 Act - Estimate of Number of Persons 65 and Over

Year	Estimated Number	Actual Number	Year	Estimated Number
1896	20,800	20,756	1906	37,900
1897	21,900		1907	39,750
1898	23,100		1908	41,350
1899	24,500		1909	42,900
1900	25,950		1910	44,250
1901	27,750	31,353	1911	45,600
1902	29,800		1912	46,800
1903	32,000		1913	48,000
1904	34,050		1914	49,000
1905	36,000		1915	49,900

Source: NZPD vol 103 1898 page 537

When introducing the Old Age Pensions Bill in 1898, Seddon had estimated that 5000 people would qualify in the first year with 500 being added each successive year. The expenditure would be £90,000 the first year rising to £126,000 after the fifth year.[29] The Government Actuary (presumably using census data modified by the results of the Registration of People's Claims Act) produced estimates of numbers and expenditure for the first five years of operation of the scheme. As it turned out, the actual numbers were considerably above the estimates and therefore the expenditure required to fund the

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[28] Sutch op. cit. page 92.

[29] New Zealand Parliamentary Debates 1898 vol. 103 pages 537/8.

scheme was very much underestimated. In the first year (the year ended 31/3/1899) it was only in operation for three months and the expenditure was £3,124, but the first full year of operation saw an expenditure of £157,095 instead of around £99,000 and in the fifth year (the year ended 31/3/1903), the expenditure was £212,962 - much greater then the £126,000 estimated in 1898.[30] Table 2.1 shows the original estimates of the sixty five and over population.

The Liberal Party had considered that the pension would reduce charitable aid by one third. It certainly did not reduce it by one third, although payments did go down in 1900 and 1901 and there was no real increase in charitable aid payments between 1898 and 1904. An estimate of likely charitable aid payments based on pre 1898 trends has not been made, but a comparison of the movements in indoor and outdoor relief expenditure does suggest that by 1904 expenditure on outdoor relief may have been over one third lower than they may have been otherwise.[31] However, the savings on charitable aid made in the fifth year of operation of the pension scheme would not have counter-balanced the £90,000 increase in expenditure on pensions for that year.

Table 2.2 1898 Act - Estimated & Actual Numbers and Expenditure

	Estimated expenditure (full year)	Actual expenditure (current £)	Estimated Number Granted	Actual Number Granted
Year 1 (1899)	£90,000	£3,124 (3 mths)	5,000	7487
Year 2		£157,095	500	4,699
Year 3		£199,708	500	2,227
Year 4		£210,045	500	1,694
Year 5	£126,000	£212,962	500	1,391

Total granted = 16,107
    died = 2,574   cancelled = 504   lapsed = 253
    Pensions granted and in force 31/3/1902 = 12,776
Source: New Zealand Official Yearbooks 1899,1900,1901,1902,1903 and NZPDs 1898.

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[30] New Zealand Parliamentary Debates 1905 vol. 132 page 375.

[31] Tennant (1989) page 86 figure 1.

It is uncertain what benefit the Old Age Pension had for Maori. According to Sutch:

> The Pensions Act and its administration weighed against the maoris. First, they found great difficulty in proving age; secondly, most had shares in ancestral land, and were deemed to get income from it, even though it yielded none and could not be sold. After 1900 the staff of the Pensions Department was increased for the specific purpose of finding reasons for striking pensioners (particularly Maoris) off the role.[32]

In looking at the estimates of numbers and costs made by the Government Actuary, one wonders if Maori were actually included in the numbers as at that time it was common to exclude Maori when population numbers were quoted. However, this would not account for the greater than expected numbers as Maori only made up some 8% of those receiving the pension in 1902.[33]

It would appear that the larger numbers than expected arose from two major reasons. The first reason was that the Government of the day did not have an accurate picture of either the number of persons over 65 years of age, or the state of their financial resources. Even though they had tried to get some idea of the picture in 1896 with the Registration of People's Claims Act, it is probable that many of those eligible for the pension did not register because they could not afford the registration cost.

The second reason for the inaccurate estimates is that many elderly in New Zealand at that time had difficulty in proving (or even remembering accurately) their birth date. In the Pensions Department's annual report of 1904 it said:

> Pensioners who have been drawing for years have been found even now to be short of the required age...[34]

The Select Committee of 1894 had estimated that there would be some 10,000 applicants for an old age pension and it appears that their estimate may have been more accurate than a number of others.

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[32] Sutch op. cit. pages 93 & 94.

[33] New Zealand Official Yearbook 1902.

[34] As quoted in Department of Social Security (1950) page 42.

The Social Security Act of 1938

The next major enactment of Social Welfare policy was the 1938 Social Security Act. This Act again arose from a depression and a long period of conservative government. When the country went into depression in the late 1920s, the Government of the time implemented restrictive policies that had their heaviest impact on the lower income groups, particularly so when the depression was biting the hardest. As a result there again arose a strong public demand for the Government to do something to protect the lower income groups.

While the Old Age Pension had greatly assisted low income retired people and schemes were introduced to assist widows and orphans, there were still many who were destitute or lived at subsistence levels. In an environment where usually there was only one income earner in a family, should that income earner be unable to work through sickness or unemployment, the family could be in a desperate situation. The depression of the 1930s highlighted this problem when fathers deserted their families because the miserly amount a deserted family could get from the Government was more than an unemployed person could get.

Around this period a number of proposals had been put forward as Governments sought to alleviate the effects of yet another depression. The first important proposal of the time was one put forward by the Coates Government in 1935. It was a proposal for a comprehensive compulsory insurance scheme to cover both health and superannuation.[35] The report tabled discussed estimated costs based on 'actuarial soundness', but the population numbers upon which the report was based are not included. This proposal went no further as late in 1935 the Coates Government was replaced by the first Labour Government. Although the Coates Government had been looking into compulsory insurance schemes as a way of protecting lower income groups from some of the devastating effects of recessions, its policies earlier in the depression appears to have put it off-side with the majority of the voters as when the Labour Party proposed a

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[35] Report of the Departmental Committee on National Compulsory Superannuation and Health Insurance, 17 August 1935.

comprehensive social security system that assisted the lower socio-economic groups - the majority of the voters - the Labour Party was swept into power.

Some of the planks upon which the Labour Government had been elected included the promise of a pension for all as of right, extensive social security benefits and a comprehensive free health system. As soon as the Government had been installed it started looking at the social welfare area. In early 1936 several committees were set up to review various elements of social welfare (or social security as it was called at the time). Among these committees was a Cabinet Committee on the New Zealand National Superannuation, Health and Unemployment Scheme along with it's interdepartmental officials committee. This committee brought forward a proposal for a comprehensive scheme in October 1936 but concern was expressed over perceived extreme expense of some £30 million. Several investigative committees were set up to provide detailed analysis and proposals for the scheme and 'experts' from the U.K. were brought in to advise on design, costs and implementation. In the end, the health part of the scheme became more or less separate from the rest (and reported on by a special committee set up by the Minister of Health) and in actual fact was sabotaged by the New Zealand branch of the British Medical Association and was never fully implemented.

The Labour Government put substantial effort into developing and estimating the costs of the social security system. It set up several Cabinet and officials committees and brought in an overseas consultant (an option used extensively in recent years) to assist them. In the final stages when the system had been developed a Select Committee was also set up to review the proposals. The proposals were worked on for several years, but the cost estimates that were finally put before Parliament were adjusted estimates prepared by the Minister of Finance (Mr Nash). It is interesting to note that the Minister of Finance seemed to have a better understanding of the economy than G.H. Maddex, the imported consultant who carried out the main analysis for the officials committee and made a special submission to the select committee.[36] The Minister of Finance was more accurate with his estimates of the initial costs of the scheme and was correct in

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[35] National Archives LE 1 1938/10 box 897.

forecasting that the GDP would increase substantially whereas the consultant thought it would not. Tables 2.3 and 2.4 contain estimates of and actual expenditure under the 1938 Social Security Act.[37]

Table 2.3 Social Security Act - Various Expenditure Estimates

Benefit	Int-Dept Com 1/10/36	Int-Dept Com 18/3/37	Caucus Com	Maddex's Est	Actual Cost 1939/40
Old Age	£	£ 0.450 m	£ 0.200 m	£ 0.200 m	£ 0.518 m
Super	15.675 m	2.050 m	6.000 m	6.000 m	5.930 m
Widows	0.970 m	1.009 m	1.000 m	1.080 m	0.786 m
Orphans	0.065 m	0.075 m	0.050 m	0.050 m	0.015 m
Family		0.135 m	0.800 m	0.700 m	0.253 m
Invalids	1.550 m	0.920 m	0.800 m	1.050 m	0.942 m
Miners		0.110 m	0.105 m	0.105 m	0.093 m
Maori War			0.025 m	0.025 m	0.001 m
Umemploy	3.911 m	4.000 m	3.000 m	1.500 m	0.434 m
Sickness	2.000 m	1.000 m		1.000 m	0.209 m
Emerg'cy				0.500 m	0.086 m
Health	4.750 m	2.000 m	3.000 m	3.000 m	1.057 m
Total	28.921 m	15.749 m	14.980 m	15.210 m	10.394 m

Source: Hanson E (1980) pages 156-7.

The evidence suggests that the estimates were quite good until after 1944/45 and then appear to go awry. In the years around 1945/46 there were substantial changes to the Social Security scheme increasing many of the rates and making it more comprehensive. By 1949/50, the rates of the major benefits that contributed over two-thirds of the expenditure, Age and Family, had gone up by more than 150% and the rates of other benefits had increased by amounts ranging from about 60% to over 200%. This increase

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[37] There were two age benefits, an income tested Old Age Pension and a universal Universal Superannuation.

in expenditure could be funded because the National Income had also increased in excess of 100%, much greater than imagined by the politicians and advisors in 1938.

Table 2.4 Social Security Act - Nash's Estimate and Actual Expenditure

Year	Estimate (constant 1938 £)	Actual (current £)	Actual (in constant 1938 £)
1st year (1939/40)	£17,850,000	£10,393,942	£10,393,942
5 years later (44/45)	£20,500,000	£18,768,176	£16,058,116
10 years later (49/50)	£22,000,000	£45,567,985	£33,750,914
30 years later (69/70)	£25,000,000	£161,556,000	£53,761,720

Source: NZPD vol 252 p 255, Official Yearbooks 1940, 1945, 1950, 1970.

Although there had been an improvement in the quality and quantity of data since the 1890s, expenditure restrictions of the depression had meant that some data considered necessary was not available and had to be estimated. World War II and the subsequent immigration policies mean that it is not possible to assess the accuracy of the demographic forecasts and little documentation appears to be available on the methodology used for the forecasts. It appears that the reduced birth rate during World War II may have kept social security expenditure within bounds at that time, while the post war immigration policies and baby boom changed the population base meaning that pre war estimates were not applicable. Table 2.5 shows the demographic estimates compared with the actual outcomes.

National Superannuation Scheme

National Superannuation is the most recent of the major social welfare developments. It can be considered to be an extension of the 1938 Universal Superannuation scheme with a lower qualification age and considerably increased payment rates. National Superannuation (as it is again called) appears to have arisen as the National Party's answer to the Labour Government's introduction of the New Zealand Superannuation

Scheme - a contributory scheme compulsory for all paid workers. As Geoffrey Palmer states:

Table 2.5 Social Security Act - Estimated and Actual Populations

Year	Estimated Total Pop (as at 30 Sept)	Actual Total Pop (as at 31 Dec)	Estimated 60 & over Population	Actual 60 & over Population
1939	1,613,000	1,628,512	185,000	(1/4/39) 179,600
1944	1,664,000	1,655,795	219,000	(census 1945)* 221,760
1949	1,709,000	1,871,748	247,000	(census 1951)* 255,972
1954	1,748,000	2,094,910	265,000	(31/12/54) 269,690
1959	1,777,000	2,334,617	279,000	(31/12/59) 289,405
1964	1,798,000	2,617,000	293,000	(31/12/64) 314,675
1969	1,807,000	2,804,100	313,000	(31/12/69) 347,590
1974	1,808,000	3,079,000	337,000	(31/12/73)* 383,160
1979	1,804,000	3,150,900	358,000	(31/12/79) 429,160

* age distribution data for 1944,1949 and 1974 was not published
Source: Maddex report to the Select Committee (1938) and Official Yearbooks 1940, 1946, 1952, 1955, 1960, 1965, 1970, 1974, 1980.

Whether National would have devised any superannuation policy at all in 1975 had it not been for Labour's legislation must remain a moot point. But as an exercise in how to make policy on the rebound National's effort resembled something approaching an art form.[38]

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[38] Palmer (1977b) page 9.

The Labour Party's New Zealand Superannuation scheme seems to have been a piece of opportunism by an ambitious first term parliamentarian.[39] The parliamentarian, Roger Douglas (later as Finance Minister to introduce the radical changes of 1984), saw the value of introducing a Private Members Bill on a subject that was becoming topical – that of saving for retirement. Although the scheme had support from the Labour Party and later become formal Labour Party policy in the shape of the New Zealand Superannuation scheme, it appears that the scheme was the work of Mr. Douglas alone. The stated aims of the New Zealand Superannuation scheme were to protect the real value of superannuation, to provide adequate retirement incomes, to provide portability between employers and to increase savings. However, it appears that the main reason for the Labour Party being interested in the scheme was the huge fund that would become available for investment and it was this fund that the National Party finance spokesman, Robert Muldoon, focused upon in his criticism of the scheme.[40]

Mr Muldoon made a devastating attack on the Labour Party scheme pointing out the complexity of the scheme, the supposed dangers of the investment fund and the simplicity of the alternative scheme he had developed. The combination of the attacks on the New Zealand Superannuation scheme and the proposal of an alternative scheme was probably a powerful factor in the installation of Mr. Muldoon as National Party leader in 1974 and certainly played a major part in the National Party victory in the 1975 elections. Like the New Zealand Superannuation scheme, the National Superannuation scheme appears to have been mainly the work of one person. In both cases it seems that a major reason for championing the cause of retirement income was seen as a major step for advancement in the political sphere.

The National Superannuation scheme was introduced very soon after the National Party was re-elected. The scheme was brought into legislation with a lot less discussion than that which accompanied the previous scheme. Because the scheme had been fully developed while the party was in opposition, it was in its final shape when introduced to Parliament leaving less room for discussion. Although there were some concerns

[39] Palmer (1977a).

[40] Palmer (1977a).

about the cost of the scheme at the time it was introduced, they were either glossed over or not considered of sufficient importance as the scheme went ahead. However, it is the area of cost that has since surfaced as the main discussion point in relation to National superannuation.

National Superannuation currently takes about 50% of the Social Welfare vote, and is after Debt Servicing the largest single item of government expenditure. As well as being approximately 17% of government expenditure, it is received by about 500,000 people (about 14.3% of the total population) who make up a fairly vocal group of around 20% of the voting population.[41] The scheme has had a very chequered existence (15 significant amendments in the first 16 years) with many decisions regarding it appearing to have been made on political or ideological grounds.[42]

The estimates in table 2.6 below were prepared by a National Party caucus committee while they were still in opposition. These estimates are for the first full year and use 1975 data for both numbers and expenditure and thus are not strictly comparable with the actual data quoted. Because the details of the scheme were worked out by a small opposition caucus committee, there appear to be few papers available on the deliberations that took place. It also seems that officials had little input, as the Department of Social Welfare does not have any files relating to the design of the scheme. However, in constant 1975 dollars, the expenditure on National Superannuation remained within the 1975 estimate until 1982 when there was a substantial increase in the married person rate. This increase was more than the CPI movement and also raised the rate relative to the single person rate. From this time on there have been several changes to the scheme thus making some of the assumptions upon which it was founded not now applicable.

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[41] An indication of the activities of those receiving national Superannuation can be gauged by the number of submissions received from this group by the Task Force on Private Provision for Retirement. Task Force on Private Provision for Retirement (1992b).

[42] Palmer (1977a).

Table 2.6 National Superannuation - Estimated and Actual Expenditure

Year	Est Numbers	Actual Numbers	Est Expend (1975 $)	Actual Expend (current $)	Actual Expend (constant 1975 $)
1977	355,900	371,697	690.479 m	114.980 m	86.235 m
1978		387,439		926.507 m	632.519 m
1979		397,010		1162.89 m	680.057 m
1980		405,834		1334.12 m	671.788 m
1981		418,901		1556.82 m	678.123 m
1982		430,175		1895.85 m	715.984 m
1983		441,789		2418.93 m	882.247 m
1984		451,128		2526.03 m	845.982 m
1985		459,813		2743.51 m	792.901 m
1986		465,079		3341.21 m	817.081 m

Sources: Department of Social Welfare Annual Reports; Palmer G (ed) (1977a).

The universality of the scheme and the nature of the over sixty population is such that in 1975 - 77 when the scheme was designed, the estimates of the eligible population were fairly accurate and continue to be so today. This means that the costs of the scheme were (and still are) very predictable, unless the ground rules are changed. Behavioural changes should not have been a problem in the original proposal as the scheme was universal and non-income tested. Thus the costs that have worried the politicians for the past ten or more years could have been known when the scheme was implemented, but obviously it was not considered to be a major problem by the Government that implemented the scheme. The lack of background information on demographic assumptions coupled with the published forecast being for the first full year of the operation of the scheme only, make it impossible to compare long term forecasts with actual outcomes.

The Treasury Briefing Papers of 1984, 1987 and 1990

The 1980s introduced a period where policy appeared to have been produced in a way somewhat different than had been usual in the past in New Zealand. It appeared that ideologues had captured government departments, particularly The Treasury, and were driving the development of policy. At the same time there was, apparently, a move towards greater executive government. This has meant that more and more decisions are being made by Cabinet and fewer are being fully discussed in public, in parliament or in select committees.[43]

The philosophy that appeared was one of economic growth along with efficiency, equity and liberty (or freedom) and these are, according to The Treasury, "generally accepted ends or goals".[44] It is this philosophy that is apparent in many of the policy changes that have taken place since 1984, while prior to 1984 the underlying philosophy for social policy development was that which has been summed up by the Royal Commission on Social Security in New Zealand in the following words:

> *The aims* of the system, should be
>
> (i) First, to enable everyone to *sustain life and health;*
>
> (ii) Second, to ensure, within limitations which may be imposed by physical or other disabilities, that everyone is able to enjoy a standard of living much like that of the rest of the community, and thus is able to feel a sense of *participation in and belonging* to the community;
>
> (iii) Third, where income maintenance alone is insufficient (for example, for a physically disabled person), to improve by other means, as far as possible, the quality of life available.[45]

The change of philosophy has not been well debated in public and is in conflict with the philosophy espoused in "The April Report".[46]

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[43] Boston and Dalziel (1992), Boston et al (1991).

[44] The Treasury (1987) page 9.

[45] Report of the Royal Commission of Inquiry into Social Security in New Zealand (1972) page 65. Emphasis as in original.

[46] The Royal Commission on Social Policy (1988).

From the philosophy of economic growth arises the conclusion that the main tool the government can use for social policy, particularly income maintenance, is economic management. This tool promotes economic growth and, by implication and assumption, creates employment. Also arising from the same standpoint is the principle that government expenditure removes economic resources that can be more useful for economic growth in other hands. This assumption has led to a strong emphasis on the reduction of government expenditure, particularly in the social policy area (with special attention on National Superannuation). As an extension of this view, social welfare policy as part of social policy is peripheral to economic policy.[47]

The Treasury's major efforts in the economic/social policy area since 1984 have been directed towards economic growth by restraining Government expenditure and encouraging cut backs in inflation. The result (as shown in table 2.7) was that the rate of growth of the economy dropped to zero, substantially increasing the numbers of those needing state assistance. This was a good example of the policies implemented not having the desired outcomes.

After more than eight years of implementation, the policies proposed by The Treasury have still not achieved their purpose. Those few forecasts that were provided have in many cases proved wildly inaccurate and the desired outcomes are still being awaited in most cases.[48] As it became apparent that many of the recent policy changes were not having the desired effects, more and more 'fine tuning', particularly in the social policy area, has been attempted. This has meant a vastly increased workload for the policy analysts usually with insufficient time to carry out in-depth analyses. As much of the 'fine tuning' has been aimed at small sectors of the population, few of the traditional tools of analysis have been able to predict the full impact of each of the changes.

In this context, it is extremely interesting that a government department (The Treasury) should publish a series of briefing papers prepared for incoming Governments that were very critical of the existing social and economic policies without publishing adequate

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[47] The Treasury (1987) page 401.

[48] The Dominion 29/4/92; 30/4/92; Easton 1991; Morrison (1993) and many other newspaper and periodical articles.

forecasts to back up their criticisms. Not only were the current policies criticised without quantitative forecasts, but neither did those policies proposed as alternatives have adequate supporting forecasts published at the time.

Table 2.7 GDP and Employment Movements

Year Ended 31/3	GDP Index		Unemployed		Employed		CPI	
	Actual	Treasury Forecast	Actual (000s)	Treasury Forecast (000s)	Actual (000s)	Treasury Forecast (000s)	Actual	Treasury Forecast
1984	103							
1985	108							
1986	109							
1987	112		67		1,558			
1988	113	112	81	91	1,529	1,552	8.97	8.9
1989	112	114	116	97	1,499	1,562	4.01	6.9
1990	113		116		1,471			
1991	112		135		1,470			
1992	110		181		1,460			
1993	113		168		1,475			

Note: Base year for GDP Index March 1983 (=100)

Source: *Department of Statistics - various publications, The Treasury (1987).*

Many of the efforts to more tightly target social welfare benefits have not achieved the expenditure reductions expected or have produced unexpected results.[49] A number of the inaccurate results can be blamed upon inadequate time for detailed analyses, inadequate data and inadequate tools of analysis. Targeting benefits requires knowledge of, and tools able to identify impacts on, small sectors of the population. However, most tools and data currently available were designed and implemented with universal benefits in mind, and are thus not totally suitable for analysing small groups of the population.

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[49] This thesis will not discuss the the principle of targetting. This subject is well covered in publications such as Boston and Dalziel (1992).

Conclusion

Until the 1880s, social policy development in New Zealand seemed to have been driven by ideological forces. The first social welfare policy development that appeared to have been driven on humanitarian grounds was the reconstruction of the hospitals and charitable aid in 1885. For the next one hundred years social welfare policy was driven by humanitarian philosophies,[50] but in the early 1980s there was a swing back to the ideological basis for developing social policy. However, one thing stands out whatever the philosophy used to justify social policy, that is that many of the proposals arose because of personally held viewpoints and had little or no reliable data to back them up.

There are some very interesting conclusions to be drawn out of this review of the effectiveness of social policy forecasting measures. The first is the willingness of earlier politicians and forecasters to produce longer term forecasts. The forecasts of both numbers and expenditures presented by Seddon were for five years, while those produced for the 1938 Social Security Act included estimates for over forty years ahead. However, all the later policy proposals seem to have been accompanied by forecasts for one year only, usually for the first full year if it was a new proposal.

A second striking conclusion is that subsequent changes to a piece of social policy often have a significant impact on actual expenditure and alter the scheme in such a way as to make the assumptions used for the original forecasts obsolete. Unless this effect is fully understood, commentators may be led to consider the original forecasts inaccurate or inadequate.

The quality of the forecasts themselves have differed over the years. The forecasts for the 1898 Old Age Pension Act suffered very greatly by the lack of good data on the eligible population - particularly in the area of financial data. The effort put into preparing estimates for the various schemes of the 1930s would appear to have produced reasonably good forecasts. Those carrying out the work seem to have been given more

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[50] Condliffe (1959b). Royal Commission on Social Security in New Zealand (1972).

time for the task than has happened in recent years. The result was a reasonably accurate and very detailed set of forecasts despite the complicating effects of the Second World War. In contrast, it is not possible to determine how accurate the forecasts for National Superannuation were as the available information on the forecasts is very limited.

In recent years forecasts have become much less extensive and the information upon which the forecasts were based much less available. These more recent forecasts appear to have been produced in a hurry and as a result seem to be less accurate and less detailed. Added to this successive Governments have been much more restrictive in the provision of resources to officials and government departments for the carrying out of the tasks. On the other side should be placed the knowledge that policies have been implemented much more quickly giving those officials preparing the background information and forecasts much less time to prepare them and putting those officials under greater stress.

At the same time as officials are under pressure to produce numerous analyses for social policy changes, there is an increasing movement away from universal schemes towards income-tested schemes. Social welfare impact forecasts, particularly expenditure forecasts, are much harder to prepare and are much less accurate for income-tested schemes than for universal schemes. This is because most of the data available and the tools used are at the aggregate level, which suits universal scheme analyses as they deal with the 'average' person. Targeted schemes require disaggregated data, that is detailed information relating to small groups of people, usually groups that do not respond well to public surveys.

The demand by the Government for more policy development and more accurate analyses will not reduce in the short term and will probably increase. Therefore the need for better quality data and analytic tools will get more critical. The following chapters discuss an analytic tool that can help provide more detailed and accurate social policy analyses more quickly.

The past and current policy development scene has been discussed in Chapter Two, drawing out some of the shortcomings that have occurred. Chapter Three introduces a technique, microsimulation, that can assist in addressing some of those shortcomings.

CHAPTER 3: MICROSIMULATION AND ITS USES

Introduction

Simulation is a technique whereby the actions and interactions of the components of a situation of interest are portrayed. By varying the input parameters, different scenarios can be depicted and the outputs analyzed. Simulation models are widely used in the physical sciences to demonstrate certain types of activities, particularly where it is impractical to actually carry out the experiment in a realistic situation. In this case a substitute is analyzed instead. Simulation models are also widely used in the training of aircraft pilots and astronauts. Most children of today know of and/or have used personal computer programs for flying aircraft or driving cars. These are just simulation models.

As Orcutt et al state:

> Simulation, a general approach to the study and use of models, furnishes an alternative approach to that offered by analytic mathematical techniques. In using analytical mathematical techniques to solve a model, the objective is to determine, deductively and with generality, the way in which the model relates endogenous variables to initial conditions and time paths of exogenous variables. By contrast, in any single simulation run the solution obtained is highly specific and consists of only a single set of time paths of endogenous variables. To determine how behaviour of the endogenous variables is more generally dependent on initial conditions, parameters and exogenous variables may require

many simulation runs; and even then induction from specific results to general solutions will be required.[51]

One can look on a specific simulation run as being an experiment using a certain type of model. This experiment will require specifying a set of initial conditions suitable for the model, then specifying values for the set of parameters used in setting up the relationships built into the model and finally specifying the time paths of those exogenous variables used by the model. One can then carry out other experiments by specifying different sets of initial conditions, parameters and perhaps the exogenous variables.

In social policy and economics, simulation models are used to track national economies, sectors, firms and/or individuals through time. In the words of Barbara Bergmann:

> They can illuminate a wide variety of issues that are difficult to analyze with an economist's conventional tool-kit and are especially useful in studying dynamic processes. Microsimulation models allow the analyst to produce simulated aggregate time series that are rigorously consistent with the assumptions made about behavor on the micro level. Thus, simulations provide a means of bridging the micro-macro split in economic analysis.[52]

Simulation has a particular relevance in the area of information and expectations. As the entities being modelled move along the time path, they gather information and their expectations change as they react to the information they have gathered. The builders of simulation models are able to include this type of feature in the models.

Simulation at the macro level is quite widely used in the economic and social policy sectors in New Zealand. For instance, the Reserve Bank model of the New Zealand economy is a very sophisticated macrosimulation model and is used to estimate the impacts on the economy of different economic policy options. Most economic commentators and financial institutions also have models, of greater or lessor

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[51] Orcutt et al (1980), page 88.

[52] Bergmann (1990) page 99.

complexity, of the New Zealand economy or sectors of it. These macro models use aggregated data, that is, data that is the sum of the data relating to all those micro-units that make up that part of the economy or society being studied.

However, simulation at the micro level is much less common. Microsimulation rather than acting on the aggregated sum of the micro-units, acts on the individual micro-units themselves. Because microsimulation models are concerned with the behaviour of the micro-units, they are particularly suited for the analysis of the distributional impacts of policy changes:

> Models based on microsimulation techniques are conceptually highly attractive because they operate at the appropriate decision level and take into account the diverse circumstances and characteristics of the relevant population.[53]

Although microsimulation modelling was proposed in 1957, the use of it for the analysis of social welfare policy only began in the mid 1960s.[54] In the USA expenditure on welfare programmes had expanded significantly and systems were required to be put in place to analyze the costs and benefits of these programmes. However this created difficulties:

> There were many ideas and legislative proposals, but there were few established tools available anywhere in government to answer the kinds of questions asked by the policymaker.

and:

> Many of the analyses conducted led to the administration's submitting poor cost and impact estimates to the Congress in support of its legislative agenda. Most of the changes in public welfare programs actually carried out during the flurry of Great Society enactments were based on quite inappropriate data and little analysis.[55]

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[53] Citro and Hanushek (1991) page 9.

[54] Orcutt et al (1980) page 81.

[55] Orcutt et al (1980) pages 81 - 82.

It was also found that many of the questions asked about the Federal social welfare programmes and sectors of the population could not be answered adequately because of unsuitable data and inadequate tools. Other questions just were not able to be answered at all. However, numbers were provided and these were then taken seriously. These comments, although addressing the scene in the USA in the 1960s, are applicable to the New Zealand policy development environment today.

Microsimulation models can be applied to a number of social policy areas, but it is in the area of income redistribution that they have been used most often. Microsimulation models are very useful in this area because they can expose complicated linkages. A Government's redistribution objective is rarely very clear and to further confuse matters, the Government's objectives and policies in other areas also have a substantial impact on income redistribution. In addition, income redistribution is a contentious issue as redistribution takes from some and gives to others. Microsimulation models can help clarify the extent of policy interaction. They can also demonstrate how sections of the population are affected by redistribution. The OECD states that:

> Tools are needed to analyze the way social benefit systems have and should change in the light of changing circumstances. Microsimulation models have been found to be essential for this.[56]

According to Hoschka, there are three main advantages leading to the acceptance of microsimulation models.[57] These are:

> that, intuitively, it would seem easier to explain human behaviour using hypotheses based on the individual rather than those relying on aggregated variables;
>
> that micro-models have the capacity to model complicated policies to a great degree of detail; and
>
> that micro-models can provide data on specific groups of people rather than just the 'average' person.

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[56] OECD (1992) page 3.

[57] Hoschka (1986).

In a similar vein, Haveman and Hollenbeck suggest that:

> These models have emerged as an important analytical tool for two reasons. First, they reflect the basic tenet of micro economics that a complex entity composed of many components can best be explained and predicted through an analysis of its component parts. Second, national decision making in policy formation requires information about benefits and costs of proposed policies and the gainers and losers experiencing those impacts. Microeconomic simulation provides policy makers with the capability of examining the entire distribution of effects, not just an aggregate or a mean.[58]

And according to Citro and Hanushek:

> Yet, when flexible, fine-grained analysis of proposed policy changes is called for, no other type of model can match microsimulation in its potential to respond.[59]

Other potential advantages of microsimulation are:

1. available detailed survey and other information on micro-units can be fully utilised;

2. regulation, tax and benefit effects can be realistically represented;

3. assumptions and hypotheses about micro-units can be introduced when desired;

4. micro-unit outputs can be used to generate univariate and multivariate distributions and can be aggregated as required;

5. interactions at the micro-level can be explicitly stated;

6. models can be set up to represent the recursive aspect of life.

The major benefits of microsimulation hinge on the explicitness with which interactions at the micro level can be depicted. While conventional methods of economic analysis will often provide good explanations of individuals' contingency plans, they are not so good when it comes to describing the processes that allow the contingency plans to interlock. It is not uncommon to find complicated mathematical descriptions of

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[58] Haveman and Hollenbeck (1980) pages xxi - xxii.

[59] Citro and Hanushek (1991) page 9.

individuals' behavioural rules followed by unclear written descriptions of the interactions between the individuals.

A major disadvantage is brought about by the lack of high level mathematics. This means that one cannot use formal deductive methods and must rely on the inductive analysis of the numerical results, which according to Bergmann:

> ..may be less certain and certainly less entertaining.[60]

Bergmann goes on to say:

> Drawing qualitative generalizations from numerical results is fraught with the possibility of error. The very ease with which new detail can be added to simulation models poses a danger. When the models grow more complex, the job of checking their cogency, of rooting out bugs, and interpreting and generalizing from their results becomes more problematic.[61]

The crux of the problem here is the hypothesis on which the model is based. The quality of the results depends upon the quality of the hypothesis and the quality of the data used. Because it is only in recent years that computers have made it possible to process very large quantities of micro-unit data adequately, there is not the same strong proven theoretical basis as there is at the macro level. To quote Hoschka again:

> Accordingly, the development of micromodels is a rather challenging task for economics and social sciences: micromodels provide a tool to make microtheories operational and testable. In the course of time, this may result in a collection of empirically tested and compatible microtheories in various fields. Micromodels may thereby become a reservoir and a test tool for the development of microanalytically founded theories.[62]

Microsimulation analysis uses as a basis disaggregated unit record data usually collected through sample surveys or censuses. Microsimulation models process this disaggregated

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[60] Bergmann (1990) page 101.

[61] Bergmann (1990) page 101.

[62] Hoschka (1986) page 47.

data by simple recursive methods and then apply relatively uncomplicated analytic methods to produce the final results. Although it is more difficult to process disaggregated than aggregated data because of the quantities of data that are required to be held, analyses can be more flexible and can more easily identify the effects of policy on specific groups in society. However, for this type of analysis to be carried out, suitable data must exist and for the forecasting of future impacts, suitable mechanisms must exist for 'aging' the data.

Types of Microsimulation Models

According to Harding, there are three types of microsimulation (or micro-analytic) models. These are static models, dynamic population models and dynamic cohort models.[63]

A static model assumes that the individuals within a household will not change their behaviour in response to policy changes or to other events. Dynamic models attempt to capture at least some of these behavioral reactions.

A static microsimulation model is called 'static' because there is little adjustment made to the data over the time period covered. Apart from upgrading the financial data from the time of the survey to the time of the simulation run, the only other adjustments done are minor changes to the population grossing-up weights. As the population only changes slowly and behavioural changes take a while to work through, static models work well in the short term. However they tend to fall down for longer term analyses and forecasts.[64]

Static microsimulation models are the most common model in use currently. This is because they are usually based on sample surveys (a source of data that is usually available when the models are built), and they can be of a wide range of sophistication. Thus they can be set up relatively easily. The sample surveys usually gather information

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[a] Harding (1990a).

[b] Shackleton et al (1992).

on the characteristics of a small unit such as an individual, family or household. The model applies elements of Government taxes and social security benefits or similar redistribution policies. Analyses are then carried out to determine the impact on the population. These analyses are usually done in the historical perspective, but there are techniques of 'aging' the database that will project the sample into the future. This allows the forecasting of the effects of social policy for some future point in time.

The second major type of microsimulation model is the dynamic population model. This type of model starts with the same population samples as the static models, but uses more complex 'aging' techniques to age the micro-units. The micro-units can be aged one year at a time and projected forward for up to fifty years. As the aging is done a year at a time for the whole database, it is possible to analyze the effects of social policy on a year by year basis. More complex population models also build in behavioral effects. With this type of model it is possible to analyze short, medium and long term effects of policy. However, as each micro-unit has to be processed for each year in the period being analyzed, dynamic population models require large computing resources and complex computer programs.

Dynamic cohort models use the same type of aging processes as do the dynamic population models, but instead of using a population sample that contains the full range of diversity of a normal population, these models analyze the effects of policy on only one age cohort of the population. This age cohort is usually a simulated 'typical' cohort. A year will be selected in which the cohort will be 'born' and the model will then simulate a typical lifecycle for that group. The lifecycle may cover some ninety to one hundred years, a time frame that would be too difficult for the more complex population models to handle. Thus the dynamic cohort technique is particularly good for longitudinal analyses illustrating the lifecycle effects of policy.

The range of applications of dynamic models is much wider than that of static models. This is because of the inherent flexibility of dynamic models. They have been used for the usual social policy modelling of tax and benefits, but have also been used for

lifetime income studies including social insurance and pension requirements, as well as such things as energy use studies.

At this stage of the development of microsimulation models all models, both static and dynamic, still have an area where major development is required. This is in the area of behavioral responses to policy changes. Currently all models assume that the micro-units do not change their behaviour in response to the Government's changes in policy. It is an area that is receiving considerable attention internationally, but as yet no clear picture has arisen.[65] Econometric studies designed to assess the magnitude of behavioral change have produced inconsistent estimates for the relevant elasticities.[66] However, it is precisely this area which is often of major concern in policy analyses and is of concern in the analysis to be carried out in this project.

Historical Development of Microsimulation

Microsimulation modelling had its origins in an article by G. H. Orcutt that appeared in 1957.[67] Over the next 4 years, he developed a model called SUSSEX, but the first real application did not take place until 1965. While the principles put forward by Orcutt and the SUSSEX model were primarily dynamic, it was not until the mid 1970s when Orcutt and others at the Urban Institute developed DYNASIM that dynamic microsimulation modelling actually arrived on the scene. Orcutt has continued to be in the forefront of microsimulation development particularly in the area of dynamic modelling. He worked with the Urban Institute for some time and this organisation has produced considerable literature on the subject, especially about those models it operates.[68]

The earliest applications run were what has been called 'calculator' models. This type of model is a simple easily programmed model that calculates the estimated expenditure

[65] Harding (1990b).

[66] Hagenaars as quoted in Harding (1990a), page 30.

[67] Orcutt G M. (1957) pages 116 - 123.

[68] Orcutt et al (1980), Lewis and Michel (1990).

of the implementation of a policy change. Calculator models were usually used for calculating tax receipts or social welfare benefit expenditure. Even today calculator models are often the initial step into quantitative analysis for social policy and lead towards full implementation of microsimulation models. However, not everyone considers calculator models to be true microsimulation models.

In the 1970s there was a movement towards more sophisticated models and static microsimulation models started to appear in applications. Some of these static models also had aging capabilities. It was also about this time that countries other than the USA started to become active in building microsimulation models.[69]

Static models have been used extensively in the USA for tax and social welfare benefit analysis, the most well-known being the TRIM, TRIM2, MATH and STATS models. The Federal Republic of Germany (FRG), the UK and Canada also make extensive use of static models for activities such as tax, social insurance and welfare benefit modelling. The FRG models that are the most widely known are BAFPLAN, BASYS and APF, while the major UK models are TAXMOD (a name also used in New Zealand and Australia), TRAP, IFS and PSM. The Canadian static model is SPSD/M developed in 1988. In Australia static models started to appear in 1986 when interest in the study of poverty in that country increased.

Dynamic models are now in operation in a number of countries. As mentioned above the first dynamic model was DYNASIM developed in the USA in the mid 1970s. Development of dynamic models in the FRG followed soon after and now Germany may have overtaken the USA in the sophistication and extent of use of these models. One FRG model, DPMS, developed in 1985 has been exported to other European and East European countries. Other countries to have dynamic models include the Netherlands (NEDYMAS, 1988) and Canada (DEMOGEN, 1989). Australia has only recently moved into the dynamic area with the development of the Harding and NIEIR models.

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[69] Hellwig (1990).

Initially most of the models required large scale computers and good experienced programmers to run them. This is part of the reason for the initial development of the simpler calculator models and the much later development of the much more complex dynamic models. Now that the methodology has matured somewhat coupled with the increased power and 'user friendliness' of computers micro-simulation models are much more available and simple to use. Some models, for instance the Canadian SPSD/M model and CORSIM (a version of DYNASIM), will even run comfortably on a personal computer. There has been a considerable movement between employers among the core group of developers of micro-simulation models and a number of very similar models are in operation in different organisations and even in different countries.[70]

The best sources of information about all the aspects of microsimulation modelling and analysis are the proceedings of the various national and international conferences and workshops that have taken place in recent years. Topics covered at these conferences range from the broad theoretical bases to practical applications of models along with the detailed analyses that resulted. These conferences have tended to draw papers from the major developers of microsimulation models from within a country (if a national conference) or from Europe and North America if an international conference. (The proceedings of a number of conferences are mentioned in the bibliography appended.[71])

The Use of Databases in Microsimulation Models

Despite the refined stage of development of microsimulation models, they are still restrained by the data they use for their analyses. For instance the models will incorporate any sampling and coding errors present in the original survey. No matter how sophisticated the mathematical and statistical techniques used, if the data is incomplete, inaccurate or unsuitable, the results will be unreliable. Thus the first stage in the development of microsimulation models is the obtaining and validation of the data which the models will use.

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[70] Hellwig (1990).

[71] See Haveman & Hollenbeck (1980); Orcutt et al (1986); Bradbury (1990).

Every microsimulation model requires an initial database that must satisfy certain minimum requirements. On the one hand data must be available as single observations of decision making units. On the other hand, the most important relevant socio-economic characteristics must be present. A large sample size is also necessary for the stratification of the population by a substantial number of variables. Finally, several data sets representing different periods in time should be available so that the model can be tested.

McClung has an interesting viewpoint on the importance of the base data when stating:

> Within the last half decade, it has become evident that the potential for creative modelling has been about mined out. Continued improvement in microsimulation depends mainly upon having better data. I do not want to discourage research on technique, but I suggest that research be more willing to conclude with specifications for a desirable data collection and less willing to press on to imaginative alternatives to better data.[72]

Most models rely on survey data although there are now models based on synthesised data, that is data built up from several sources rather than data representing a specific person. (eg DEMOGEN, the Harding model). There are a number of well known weaknesses with survey data such as under reporting, missing data, inadequate survey design, old or incompatible survey dates. Although a number of methods have been developed to overcome some of these problems, there have not been any rigorous analyses of the statistical properties of microsimulation estimates. Further, most models involve some ad hoc manipulation of data in order to achieve results:

> Provision of the required data involves great difficulties in the development of micromodels. This includes two problems: quality of data and accessibility of data. There is presumably no micromodel which is provided with exactly the data that is required.[73]

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[72] McClung (1986).

[73] Hoschka (1986) page 49.

In most countries there is not just one comprehensive survey that covers all of the elements required for policy analysis using microsimulation models. There are instead a number of surveys each having some of the elements needed. Statistical matching techniques are then used to merge the relevant databases to provide a single data source suitable for microsimulation modelling. Because adequate data in every area covered by a model are not usually available, microsimulation models tend to use whatever pieces of data are available and able to be used. This will reduce the accuracy of the model, but the models are usually constructed so that they can be adjusted when more accurate data becomes available.[74]

The need for synthesis on survey databases arises because this raw material is frequently inadequate to test the broad effects of a policy change or to examine the distribution of existing benefits. This is most noticeable with income from government programmes to low-income families which is consistently under reported in surveys when compared with actual programme data.

Totally synthetic databases have been developed to solve some of the problems mentioned above. In the former Federal Republic of Germany, synthetic databases have been developed to produce a short term improvement in the available data. The data is not genuine in that they are average cases calculated from aggregated statistics.

Even with synthesised data, there is the problem of reliability of data and the difficulty of interpreting results. At least survey data does actually depict part of the real world, synthetic data does not. It is usually possible to create a complete set of synthetic elements for a synthetic unit-record, whereas this may not be possible with survey data. Another benefit of synthetic data is that it can overcome the restrictions due to confidentiality that are often placed on survey data.

[74] Harding (1990a).

Microsimulation in New Zealand

In New Zealand microsimulation models have been used only to assess the effects of the Government's redistribution policies. It is of concern that currently in New Zealand it appears that there are only two major microsimulation models in existence, ASSET and TAXMOD. ASSET (A Simulation System for Evaluating Taxation) and its derivative the SEBIRD (Study of the Effects of the Budget on Income Distribution and Redistribution) is a model developed and operated by the Department of Statistics. TAXMOD is a model developed in Australia and used by the Treasury Department.

Since this thesis was begun, another microsimulation model has been developed and used in New Zealand. The new model is a dynamic longitudinal cohort model developed by Business and Economic Research Ltd (BERL). The model was developed for the Task Force on Private Provision for Retirement and was used to "explore the likely impact on saving behaviour of changes in various influences".[75] Public knowledge of this model is sketchy as the only published reference to it is a small section in the Task Force paper.[76]

New Zealand sourced literature on the subject of microsimulation for social policy analysis is almost non-existent. The very few papers in existence describe ASSET and SEBIRD. Most of the papers that refer to ASSET have only a brief description of what the model does and then go on to analyze the output of the model. Papers of this type have been written by Snively, the NZ Planning Council and the Department of Statistics.[77] A paper by Broad [78] appears to be the only paper published that provides a detailed description of the main model along with its assumptions. Unfortunately the paper was written in 1983 and the model has undergone a number of refinements since then. Snively has produced papers mentioning the model in some of its later forms.[79]

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[75] Task Force on Private Provision for Retirement (1992b) page 18.

[76] Task Force on Private Provision for Retirement (1992b).

[77] New Zealand Planning Council (1989a), (1989b); Snively (1986), (1987).

[78] Broad (1983).

[79] Snively (1988).

There does not seem to be any published documentation describing the SEBIRD elements of the model.

ASSET is a static cross-sectional model used for tax/benefit analysis. The model uses the HEIS database and allocates direct taxes and Government transfers across households.[80] The ASSET model has been used by a number of government departments and the New Zealand Planning Council (now disbanded) to carry out several detailed analyses of income and wealth distribution in New Zealand. In 1988 ASSET was further developed to enable indirect taxes to be allocated across the households.[81] These extra modules (known as SEBIRD) were constructed to provide information for the Royal Commission on Social Policy.[82] However, by its nature ASSET is not particularly suitable for forecasting the future impact of Government policies although it does have some aging capabilities. ASSET is also limited in that it is written in SAS and will only run on a mainframe computer. ASSET was originally used by the Treasury, who had some input into the development of it.

The Treasury TAXMOD model is also solely used for tax/benefit analysis. The model, which has been developed from the Monash University TAXMOD model, is mentioned in passing in only one or two New Zealand sourced papers.[83] This is unfortunate as the original Monash version of TAXMOD was a static model with some aging capability, but apparently the Treasury has added elements to provide a dynamic capability. The Treasury has extensively changed the model which was originally designed for the Australian tax/benefit system. The base assumptions and design of the Monash version of TAXMOD are described in a paper by Bascand and Trengrove.[84] TAXMOD is what is known as a tax-benefit model and has been designed specifically to run on personal computers (PC). The model is used by the Treasury to forecast the fiscal impacts of changes in taxes and benefits and to identify the effects on different sections of the

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[80] Snively (1988).

[81] Brood and Bacica (1985), Snively (1987)

[82] Private discussion with some of those involved in the development.

[83] see Brashares and Smith (1989) for reference to this model.

[84] Bascand and Trengrove (1987).

population. A recent publication has included more detailed descriptions of TAXMOD and how it can be used.[85]

Chapter three has introduced the concepts of microsimulation. Chapter four will build upon those concepts and describe a microsimulation model that has been designed for the New Zealand social policy environment.

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[85] Prebble and Rebstock (1992).

CHAPTER 4: THE MODEL

Introduction

The objective of a microsimulation model is to take a database of unit records representing a population at a certain time and to modify that database and the records on it to represent a different period in time and/or policy environment. The modification of the database and records is done according to some stated rules. An analysis is then done to ascertain the effect of the rules on the population. For example, in the realm of social policy, one could determine the effect in three years time of a change in benefit eligibility status. This would require the demographic and economic variables on the database to be aged three years, that is, to be adjusted to the expected values three years hence. Each record's eligibility would then be assessed against first the current policy regime, and second the proposed changes. An analysis would then be done to calculate expenditure changes and to determine those population categories that would be winners and losers.

Thus there are three sections to the modelling part of a microsimulation model: the aging section, the policy application section and the analysis section. While the analysis section can be considered to be a separate module, the aging and policy application sections are often inextricably entwined. This is particularly the case with a static model of the type developed for this thesis. Policy changes will often have effects that will require altering the exogenous parameters that are used for the aging action. Simple examples of this occur if the Government changes the base social welfare benefit rates. These rates are standard exogenous parameters to the economic aging module. Another example would be a change in the qualification age for the universal pension - National Superannuation. This would require adjustments to demographic aging parameters.

The basic essence of a microsimulation model is that there are a large number of dimensions for each observation (or to put it in another way, there are 'x' variables for each record). What is wanted is for these dimensions to be adjusted to simulate changes over a period of time. The model takes each dimension one by one and applies an adjustment mechanism tailored to that particular dimension. A major difference between micro and macro models shows up here in that the micro model has large numbers of simple equations, while the macro model will usually have fewer but more complicated equations, such as simultaneous equations. What is done in the model developed here is to model simple changes to single variables. However although the model could be extended to more complex relationships between adjusted variables as in macro models, the model would lose the benefit of the simplicity of the equations. The main adjustment mechanisms are described by the generic title 'aging'.

Chapter four will begin by discussing the different forms of database aging used in microsimulation. The basic model will then be described with the algorithms included in the various modules being discussed. The discussion of the modules will include discussions on variables included and sources of data for these variables. The model described in chapter four is a general model suitable for policy analysis in New Zealand. Chapter six will discuss the specific analysis carried out for this thesis.

Income Unit

The term income unit refers to the base unit around which income maintenance calculations are based. The income unit can cause major problems for policy analysis models as different elements of the income tax/benefit systems can have different income units. For instance, the taxation system in New Zealand is based around the individual as the income unit, but, in some cases exemptions can be shared between married couples.

It gets even more complex in the benefit system. While an individual qualifies for a benefit in his/her own right, the rate of payment is related to the number of dependents that person has and the marital status of the person. If that individual is married or

living in a de facto relationship, then the income used to determine the abatement level is the combined couple income. To further complicate matters, for the couple half of the benefit is paid to each person and is taxed individually (usually resulting in a lower marginal tax rate than if it were all paid to the one person). In other situations, where an allowance is paid to a student, the income unit can include the student's parents. In these cases the income unit could be the individual, the couple, the household, or the family.

Because of this complexity, one must be very clear which regulations apply to the income units being analyzed in a particular microsimulation model. As the model developed here is a general model, it may need to have adjustments made to the income units when used for the analysis of certain types of social and economic policy.

The HEIS database, the database to be used in this model, is basically a file of data relating to individuals. These individuals are linked together to give an indication of household groups. The head of household record contains some additional data relating to the operation of the household. While the database contains data on individuals, married couple households tend to act as units, particularly when it comes to income. Also, the taxation system treats married couples as a unit when allowing the transfer of income and tax credits for such things as the superannuation surcharge. This means that a married couple must be able to be treated both as a unit and as two individuals. In relation to this, National Superannuation incorporates a living alone allowance; therefore, the benefit imputation algorithm must be able to identify single adults sharing a household with other adults.

This thesis will use the individual as the income unit and rely on other variables on the record to enable the individual records to be linked together when household data is required.

Aging

A survey database such as the HEIS database is a snapshot of a representative sample of the population taken at a certain point in time. Often an analyst needs to know how the population would look at a different point in time. The process of changing the data on the database from representing one point in time to representing another is known as 'aging' the database.

However good the efforts of the conductors of detailed surveys, the data when available are always still out of date. Structural and institutional changes are constantly taking place that are not reflected in an historic database. This means that methods have to be designed that will update the data to reflect present conditions, and for forecasting purposes, to portray probable future conditions. Simple methods such as using the CPI to adjust money variables are inadequate as microsimulation models use individual variables such as wage/salary income, rental income, interest income, social welfare income etc. whereas indexes such as the CPI measure the movements of a basket of variables. As well as this, a person's income can be obtained from a number of different sources, each of which may respond in a different way to changes in economic conditions. Apart from this, the CPI is a measure of expenditure rather than a measure of income.

There are many complex interactions to be born in mind when updating a database, and one must be clear about what one is attempting to do. As King states:

> While there exists a general framework for the techniques of static aging, the level of detail which is included in any microanalytic simulation 'model' is obviously highly flexible. A number of considerations bear on the decision concerning the level of detail to be incorporated in an updating technique and these include purposes of the proposed simulations, data availability and ease of understanding. First, attention should be focused on those aspects of the data base which are important for the proposed simulations. Second, the availability of data, or the confidence in assumptions or forecasts, all constrain the level of detail possible. Third, for the results of simulations based on an updated data

base to be assessed, there has to be confidence in the updating technique or, at least, a clear statement of the assumptions used. To this end, a crude yet clearly stated assumption regarding some aspect may be better than an intricate and barely comprehensible technique.[86]

The value of an aged database therefore depends on how well identified and how appropriate are the data used for reweighting the demographic variables and re-estimating the economic variables. Also included with this should be estimates of the reliability of the updated data, for as Kenneth Arrow has stated:

.. there is still a statistical inference of some kind to arrive at the estimate of a parameter. ... Unfortunately, as far as I can see, in all uses of models for policy purposes ... there is no confidence or error band.[87]

There are two major methods of aging, static aging and dynamic aging. With static aging, the economic and demographic variables are adjusted to reflect the desired situation, but the underlying structure is not changed. That is, changes are not made to variables such as marital or employment status. In contrast, when dynamic aging is used these states are allowed to change from period to period to represent how people respond to changing social and economic influences.

The main aging technique used in this model will be that of 'static aging', although in the labour market module elements of 'dynamic aging' will be incorporated. Static aging will be suitable for the analysis undertaken for this thesis as the forecast period is short and many of the demographic relationships can be considered to be constant over the period. As mentioned earlier, there is widespread acceptance of the suitability of using static adjustment aging for short-term simulations of up to around five years which is the period covered in the analysis done in this research.

In the model being developed for this thesis, the aging mechanism is implemented in several steps. Static methods are used for the basic demographic and economic

[86] King (1987), page 2.

[87] Arrow (1980) page 260.

variables, dynamic methods for those elements associated with labour force participation. The demographic variables are aged as a matrix because the demographic variables are interrelated and this interrelationship was used in selecting the survey sample and thus becomes an integral part in determining the value of the weight variable. The other variables that are aged (mostly the economic variables), are adjusted separately. In doing this it is assumed that each variable is independent of the others. There is a possible weakness in this assumption if there is a relationship, because adjusting related variables independently may lead to an internal inconsistency. However, the increased simplicity resulting from the independence assumption may offset the possible inconsistency caused by an omitted relationship.

The first aging step in the model is the demographic aging where the individual records have their weight variable adjusted to reflect projected demographic changes. It is also at this point that household records are adjusted to take account of the changing household composition. Following this the economic aging is carried out where multipliers obtained from aggregate national series are applied to the various elements of private income. Once the demographic and economic aging has been done, labour force participation can be simulated using dynamic aging methods and the transfers (government social welfare benefits) and income taxes can be imputed. This step will enable disposable income of income units to be determined and thence analyzed. It is also at this point that a much more extensive model (such as the SEBIRD part of ASSET) would impute the indirect transfers and taxes.

Static Aging

There are two elements to static aging. As King again states:

> Static aging involves two components. These are 'demographic aging', whereby the weights attached to each unit in the sample are altered to make the sample representative of the population at a later date, and 'economic aging', whereby the record data is adjusted to reflect changes in, typically, the income attributes of units in the sample. Demographic aging usually includes reweighting for the changes in both demographic and labour market structure according to external

data or forecasts. Economic aging is undertaken through the application of economic multipliers to the data.[88]

King has a further interesting comment about the aging of a database:

> The purpose of updating is neither to produce a completely accurate representation of the population, nor to attempt to remove the need to conduct income surveys. The purpose is to produce (using acceptable and understandable techniques) a database which more closely resembles the situation at a later date, ... particularly in those areas deemed important for the simulation purposes in question.[89]

There are two sets of activities to be undertaken in preparation for aging a database. The first set of activities is to determine those elements of the database that are 'demographic' in character and to carry out the necessary reweighting. This group of elements is held on the database along with 'weights' that indicate the statistical incidence in the total population of those particular elements. It is these weights that may change from year to year and thus need adjustment. The difficulty here is to find a matrix of time series that will enable these parameters to be predicted into the future. It may mean obtaining data from other data series and then matching and merging with all the associated problems to produce parameters directly applicable to the database.

The 'weight' of a record on a sample database is a variable held on the database record that indicates how many people there are in the population with the similar characteristics to those of the person in the sample. The characteristics used usually include demographic variables such as age, gender, ethnicity, marital status and household type along with income related variables. While the sample weights can be calculated for an extensive matrix of characteristics, usually it is not possible to obtain a similar matrix of forecasted populations. Therefore to reweight the database, the model creates and uses a matrix containing fewer characteristics.

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[88] King (1987), page 1.

[89] King (1987) page 2.

The second set of activities is to determine those elements on the database that have 'economic' characteristics and to directly age them by applying indices of some type or other. This is a quite different activity in that the aging activity is directly applied to the data variable and not to the weight variable. Again the difficulty here is to identify a suitable time series or index that can be applied directly to the element on the database. An example of this is with income data. In recent years in New Zealand the higher income deciles have had annual increases in income of 10% and more while the lower deciles have had zero or even negative increases. However, the common tables of movement in income use average income. Thus if these tables were used to update the income data, the lower income deciles would have their updated income overstated. This would tend to hide the true effects of redistribution policies, the information that the analysis is trying to uncover. While the index for each decile is still an average and the same comments would apply, the range of income to which the index applies is much narrower, with a corresponding lower distortionary effect.

Dynamic Aging

Much of the policy analysis for which microsimulation is suitable involves varying just the exogenous parameters that are used for static aging purposes. Microsimulation has been used extensively for tax-benefit analysis, particularly for determining the 'winners and losers', both numbers and descriptions. However, the research carried out for this thesis requires an analysis of the behavioral changes brought about as a result of legislation changes relating to the qualification age for national Superannuation. This type of analysis will require an additional module, one that will allow for changing assumptions about labour force participation. A function of a well structured simulation model is demonstrated here, that is, the ability to have added modules to simulate specific policy changes as distinct from the standard analyses. While the demographic, and in particular, economic aging modules have specific policy rules built into them along with the ability to change them by parameter, behaviour-related assumptions require a different methodology and thus a separate module for their simulation. The behavioral changes associated with the policy to be analyzed in this paper will be simulated in the labour force participation module. As part of the labour force

participation simulation, income variables will have to be further adjusted to reflect the impact of these behavioral changes.

Dynamic aging is a technique whereby characteristics of an individual are adjusted period by period simulating how that individual might react in an actual situation. Dynamic aging is usually based upon transitional probabilities. A transitional probability is the probability that an object will be in a particular state in the next period and is determined from the state in which the object is, in the current period. For instance, if a currently employed person has a 90% probability of still being employed in the next period, a 7% probability of being unemployed and a 3% probability of being out of the labour force, the transitional probabilities are .90, .07, and .03 respectively.

To determine which new state the record will move to, a technique known as 'Monte Carlo' is usually used. In this situation a random number between 0 and 1 is allocated to the record. In the case mentioned above, if the random number were less than or equal to .90, the record would be given the first state. If the random number were greater than .90, but less than or equal to .97, then the record would be given the second state. If the random number were greater than .97, the record would be given the third state. In dynamic aging the Monte Carlo technique would be applied to all those variables that were to be 'aged' to a new state and for which transitional probabilities were available. The Monte Carlo technique relies upon the randomness of the distribution of the sample on the base file used and the randomness of the distribution to be obtained. The technique breaks down if either distribution is not random.

A major problem with using the Monte Carlo technique in New Zealand is the obtaining of transitional probabilities. While carrying out the research for this thesis, the author was only able to find one published series of transitional probabilities relating to the variables used in social policy analysis. That series was the quarterly transitional probability series for employment/unemployment states published by the Department of Statistics from their Household Labour Force Survey.[90] There is one other relevant set

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[90] In their quarterly publication Labour Force.

of transitional probabilities available. That set is for transition between income quintiles.[91]

A major reason for there being so few transitional probability series is that while New Zealand has some good cross-sectional surveys, there are very few of the longitudinal surveys that are necessary for determining transition between states. This situation puts doubt on the accuracy of the analyses that have used transition between states. What is usually used as a proxy for transitional probabilities is the expected future distribution. In this case there is an implicit assumption that the transition is random. However in something like unemployment, there is a greater probability that an unemployed person will be unemployed in the next period than for an employed person to be unemployed.

Reweighting

When using a sample database such as HEIS, it is necessary to include a factor (known as the 'weight') to enable the sample to be 'grossed-up' to obtain figures covering the whole population. However, it is often found that grossed-up statistics do not agree with aggregated totals of known accuracy obtained from other sources. Therefore, the weights have to be adjusted, or reweighted, to provide more accurate results. The term reweighting also covers the adjustment of the weight variables required when aging a database to represent a different period in time.

The terms used for the process of reweighting can be a bit confusing at times as different terms are used in different countries. King, from Australia, uses the term reweighting[92], while in the UK, the term used is grossing-up[93]. The term used in this thesis is reweighting.[94]

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[91] Smith and Templeton (1990).

[92] King (1987).

[93] Atkinson and Sutherland (1988), Hancock and Sutherland (1992).

[94] The two terms are sometimes used interchangeably and one needs to be aware of the context in which they are used. The terms can sometimes mean the numbers of persons in the population a record represents and sometimes a multiplier applied to other variables so that they can match data from other sources.

Reweighting can appear to be a relatively simple task, but unless carried out carefully can lead to incorrect outcomes. The weight factor indicates how many people there are in the population with the same characteristics as the person in the sample. The characteristics used to categorise groups of people of interest include demographic variables such as age, gender, ethnicity, marital status, household type along with income related variables. While the sample weights are calculated for an extensive matrix of characteristics, it is not possible to obtain a similar matrix of forecasted populations.

The decision on how to obtain the revised weights requires some thought. As King states:

> The choice of how to reweight the original sample, in terms of which variables to use and to what degree of detail, is determined by the judgements about what characteristics have changed significantly over the period in question and data availability.[95]

This point of data availability is important, but is also a problem. The characteristics that need to be concentrated on depend upon the analysis to be carried out. Most social policy analyses involve income adequacy and so analyses of social policy changes need to investigate the effects on those characteristics that either describe income or are related to the obtaining of income. It has been shown that income levels are directly or indirectly related to labour force participation, previous employment status, age, gender, ethnicity, occupation, industrial sector in which employed, education, marital status, invalidity/disability status, number of dependents, assets, social class and others.[96] However, it is also important when reweighting, that the data be available in a single matrix. Having it this way will ensure internal consistency. If the weights are adjusted, first using one set of parameters and then using another set, it is possible that the second reweighting will distort the effects of the first reweighting.

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[95] King (1987) page 9.

[96] Brosnan (1982), (1984), (1987), Brosnan and Hill (1983b), Pool and Brosnan (1982), Fargher and Maani (1992) and others.

While it is desirable to reweight (or gross-up) a sample using a complex matrix of the same degree as that of the initial sample, it is usually not possible to do so. To create a matrix of that degree would entail producing a set of detailed forecasts incorporating the whole range of characteristics used in selecting the original sample, a very time consuming and complex task. The complexity of the initial sample selection matrix also makes it impossible to project the sample into the future with any degree of confidence. Thus it is usual to produce a reweighting matrix consisting of just a few of the most important variables. The problems with reweighting and the need for statistical significance have been deemed to be of such importance that they have spawned an important sub-stream of interest in the world of microsimulation, one often known as 'Grossing-Up'.[97] An aspect that seems to be of particular interest in this area is the reweighting with data from different sources without the data becoming internally inconsistent. However, the more diverse the data sets used for reweighting, the less one is able to obtain a composite measure of the reliability of the forecasts. Much of the literature regarding reweighting (or grossing up) relates to reweighting an older database to a more current period, rather than to projecting it into the future. In this case there is usually accurate aggregate data available that can be used to update and to validate the reweighting exercise.[98]

Basic Model

The model developed for this thesis is a simple static aging model with a dynamic aging module incorporated to simulate expected labour force changes. The model is a basic one as it has only been designed as a prototype to explore the concept of microsimulation and to demonstrate a practical application of the technique. The model has not had user-friendly interfaces incorporated and has been written in SAS which (apart from BASIC) was the only language available on the computer system used for the development. This has meant that the model is somewhat less flexible than it would have been otherwise.

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[97] Atkinson and Sutherland (1988). Hancock and Sutherland (1992).

[98] More detailed discussions about 'grossing up' can be found in Atkinson and Sutherland (1988) and Hancock and Sutherland (1992).

Figure 4.1 Structure Diagram of Model

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│           Initialise            │
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│        Set up Exogenous         │
│           Parameters            │
└─────────────────────────────────┘
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┌─────────────────────────────────┐
│        Demographic Aging        │
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┌─────────────────────────────────┐
│         Economic Aging          │
└─────────────────────────────────┘
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┌─────────────────────────────────┐
│    Labour Force Participation   │
└─────────────────────────────────┘
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┌─────────────────────────────────┐
│       Benefit Calculations      │
│    (& National Superannuation   │
│         for Base Run)           │
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│         Tax Calculation         │
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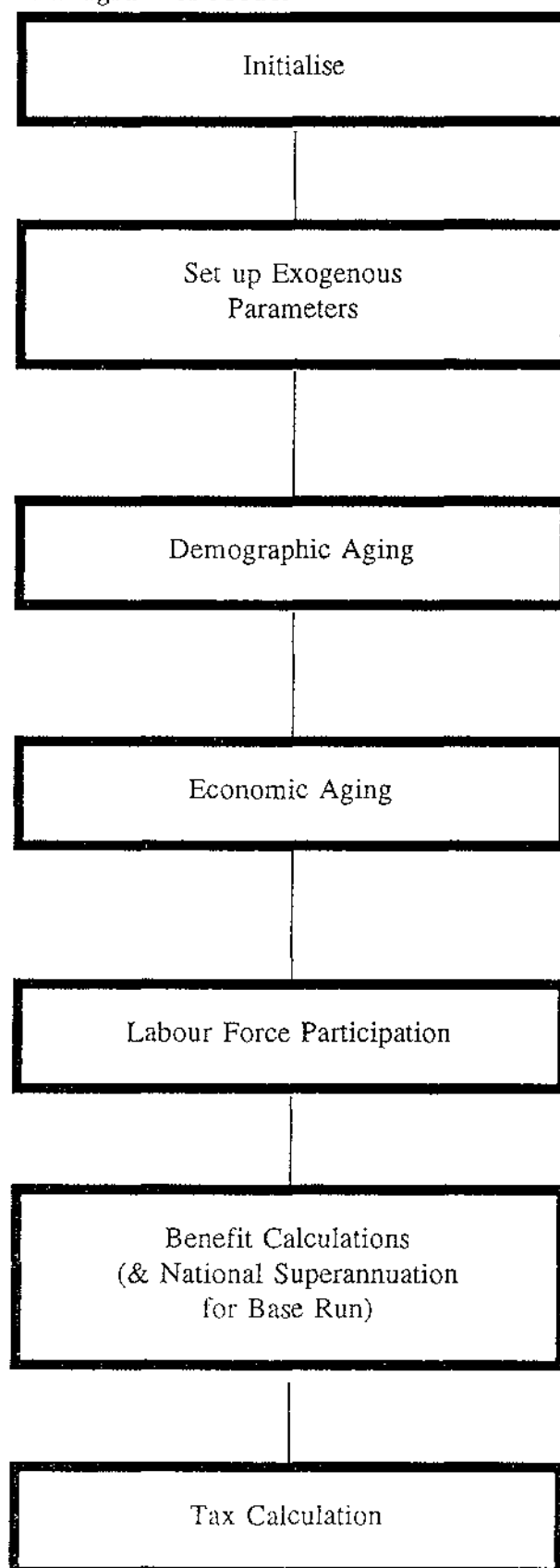
The model is also constrained by the lack of data series suitable for the aging of many of the variables. The lack of suitable exogenous parameters has meant that a few variables have not been aged and some possible behavioural changes have not been explicitly defined. However, the model does incorporate elements of most of the important modules required in any microsimulation. The structure of the model is shown in figure 4.1 and the main modules are discussed below.

Initialisation Module

The Initialisation Module is the module in which the modules required to define the tasks to be carried out are selected. In the model as used for this thesis, the Initialisation Module is in a very minimal state. In a more developed microsimulation model, the Initialisation Module would be an interactive module and would be used to define the specific tasks to be carried out and to select those modules required for those specific tasks. To be able to select only those modules necessary for the particular task in hand can substantially reduce processing time and demand on computer resources.

For the model in its current state, the Initialisation Module is used to set up some static parameters and to set some system variables. The first action of the initialisation module is to set up age and income groups. The age groups are five year groups up to age eighty five. The rest are included in the one group. Both age and income groups can be varied for specific analyses.

Exogenous Parameters Module

The setting up of the exogenous parameters is the crux of the aging elements of the model. In the basic form of the model as used here, the parameters have been set up in the source program, but designed in such a way as to be suitable for interactive input. There is a large number of parameters, most of which are economic indicators that are used to age the economic variables. However, the main parameter is the table of expected population numbers that is used to reweight the demographic weight variable.

The majority of parameters are input directly into the model, but there are a few that need to be calculated as they are not in a form suitable for direct use in the model. In the current version of the model, the parameters that fall in this category are the economic aging parameters for the wage/salary quintiles. The wage forecasts were only available as index movements referring to a different base date than that used for the wage/salary data of the database. The formula used for calculating the wage adjustment parameter is

$$wageind_{it+j} = wageind_{t+j} \times \left[\frac{WI_{it}/WI_{it-j}}{WI_t/WI_{t-j}} \right]$$

where $wageind_{t+j}$ $\equiv$ overall expected level of wages/salaries at time t+j
      $wageind_{it+j}$ $\equiv$ expected level of wages/salaries quintile i at time t+j
      WI_{it} $\equiv$ wage index quintile i at time t
      WI_t $\equiv$ overall wage index at time t
      WI_{it-j} $\equiv$ wage index quintile i at time t-j
      WI_{t-j} $\equiv$ overall wage index at time t-j.

This formula was used as wage levels have become increasingly divergent in recent years and it was considered that this might continue over the next few years. While average wage levels may go up or down, recent experience has been towards increasing divergence between quintiles. It was thought reasonable that the recent movement rates would continue over the analysis period.

The ability to input the exogenous parameters interactively is important when running a number of different scenarios and comparing the results. A microsimulation model is usually a very large computer program and large computer programs usually run very much more efficiently in a 'compiled' language. However, this means that every time the source program is altered an additional time consuming computer run is needed to 'compile' the more efficient 'object' program. Therefore, to be able to run a variety of scenarios without having to recompile the computer program all the time, interactive input of the parameters that will be varied is required.

To become much more simple to use, the model described here should have a clearly laid out interactive screen format that guides the user through the input of all the required parameters. This refinement has not been included in the model as used here as the module would add a large design component to the task of developing the model, without adding to the concept of microsimulation itself. Therefore in the interests of time and simplicity, the interactive user interface was omitted.

Demographic Aging Module

Demographic aging is the name given to the activity of adjusting the descriptive characteristics included in the individual records held on the database. In a static aging module, this process is carried out as part of the reweighting process.

The large number of variables that are effected by a social policy change can cause major problems for microsimulation analyses. First it is often difficult to obtain accurate tables for all of the variables one wishes to use. Second, if the tables are available, it is rare that one can obtain reliable forecasts for the variables. Often in this case, the modeller has to develop forecasting models to produce the required forecasts. This adds considerably to the time and effort needed for the building of the microsimulation model. There is a third major problem that effects static models to a much greater extent than dynamic models. This is the need, mentioned above, to have the changes in the demographic variables reflected in a single matrix. It is difficult to find a set of forecasts incorporating age, gender and ethnicity, let alone other variables as well. This means that until more complex forecasts are produced, and dynamic models are built, analyses will be incomplete in that certain characteristics will be considered to be unchanging over time.

It is very difficult to establish what variables are important in determining the reactions of the target population to policy proposals. This is because there are few New Zealand based research studies available attempting to analyze the determinants of why persons are in the situation that they are. The majority of studies that do attempt to describe the social and economic position of the population of New Zealand are descriptive studies.

That is they describe the situation pointing out common characteristics of people in similar situations, but not analysing what might have caused them to be in that situation. Very little research appears to have been done into the determinants of labour force participation and income differentials which are the elements that have the most impact on income adequacy. Brosnan over a decade or more has been involved in a number of studies in this area that seem to be the main sources of substantive research in New Zealand.[99]

It is usually taken as a 'given' that age, gender and often ethnicity have a major impact on income, wealth and labour force participation. Therefore, it is possible to find forecasts of these variables. However, studies as to why these are so important are not so common.

The next sections of this chapter will discuss those demographic variables that are part of the core model.

Mortality

Apart from the birth rate, the main characteristic that affects numbers in the labour force is the size of the population. Mortality is the term used for the death rate and once an age cohort has been born, is the most important determinant of how many people are alive at each age.

The term mortality relates to the probability of death and of course, the probability of death and its converse the probability of life has a major impact on social needs. In the context of income maintenance, mortality has a major impact on likely future income adequacy for a person, their family and dependents.

It has been well established for many years that the likelihood of dying is effected by age and gender. Over recent years, there has been a substantial amount of New Zealand

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[99] Brosnan (1985), Brosnan (1987), Brosnan and Hill (1983b), Brosnan and Wilson (1989a), Poot and Brosnan (1982).

based research that shows that mortality is also effected by ethnicity, socio-economic class, occupation, education etc. [100] Reinken et al include geographic locations and mention housing tenure as variables that are correlated with mortality.[101]

Pearce from the Wellington School of Medicine (formerly the Wellington Clinical School) along with a number of his colleagues (particularly Smith) and students has done substantial research into mortality and morbidity data.[102] Their main source of data has been the death registration records compiled by the National Health Statistics Centre. Using this data they have concentrated on social class differences in mortality. The social classes are defined using both the British Registrar-General's classification and the New Zealand specific Elley-Irving classification Both classifications give similar results.[103] These classification systems group occupations into six broad classes.

The social class classifications used by Pearce et al were:-

I   higher professional, managerial, administrative;

II   lower professional, managerial, administrative;

IIIN   remaining non-manual occupations;

IIIM   skilled manual;

IV   semi-skilled manual;

V   unskilled manual. [104]

The data analyzed was for males sixteen - sixty four, as the occupational data was more complete for this group. The findings of Pearce et al indicate that the lower social class groupings had mortality rates significantly higher than those of the higher classes and that the mortality rate for the lowest class was approximately twice that of the highest class on the six category scale.[105] This is similar to that found in the UK studies. They

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[100] Davis (1984), Pearce et al (1984), Pearce et al (1985), Smith et al (1984), Pearce et al (1991).

[101] Reinken et al (1985).

[102] Pearce et al (1983), Pearce et al (1984), Pearce et al (1985).

[103] Pearce et al (1984).

[104] Pearce et al (1983).

[105] Pearce et al (1983).

also found that when social class differences in male mortality in New Zealand were investigated separately for Maori, Pacific Island polynesian and 'other' New Zealand males, all three groups displayed strong social class mortality gradients. It was also found that for each class:-

> Maori mortality rates were approximately 50% higher than the 'other' category, while the Pacific Islander rates generally occupied an intermediate position.[106]

Pearce and his colleagues also demonstrated that some 20% of the Maori excess mortality is attributable to social class factors. However, the point of particular interest to this paper is not the social class implication, but the actual finding that there is a considerable difference in mortality between occupational groupings.[107]

As Pearce points out, lower class males are at increased risk, Maori males are at increased risk and that these effects are compounded so that lower class Maori males experience particularly high mortality rates.[108] Pearce goes on to show that for males aged fifteen - sixty four, social class differences in mortality for 1985-7 were undiminished from the differences in 1975-7 although overall mortality had declined by 15%.[109] It is possible, however, that an increase in retirement age following the increase in National Superannuation qualification age may change mortality patterns.

Harding quotes Australian mortality studies that show that for males aged fifteen - sixty four, professional, clerical and retail occupational categories show death rates substantially below average, whereas mining, transport and communications show death rates considerably above average.[110] These figures are similar to the findings for New Zealand and the UK. Harding also discusses USA research that found that mortality

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[106] Pearce et al (1984) page 31.

[107] Davis and others have gone on to show that the effect of ethnicity on mortality applies to females as well as males. Davis (1984).

[108] Pearce et al (1984).

[109] Pearce et al (1991).

[110] Harding (1990b).

varied not only with occupation, but also with education and income. Discussing Kitagawa and Hauser, she says:

> These authors pointed out, however, that the assumption that income was inversely related to mortality could be complicated by a reverse causal path, because the approach of death itself could be the cause of decreased income during the year or years preceding death.[111]

Harding quotes Kitagawa and Hauser as saying that education could be a more reliable indicator of socio-economic differences in mortality than income. Thus, for her model, Harding uses education rather than income or occupation as the socio-economic determinant of mortality. Bacacia has argued that in the New Zealand scene occupation may not be an adequate indicator because many unemployed do not state their 'usual occupation'.[112]

In Australia, Harding faced a similar problem to one that exists in New Zealand - that of lack of data. To get around the lack of data for the education issue, Harding used data from the USA. The use of the data assumes that the Australian situation is similar to that of the US and that the education/mortality relationship will not change over time. As Harding was developing a dynamic model, she was able to change over time the amount of education each person received. Harding considered that after age forty five, the amount of education did not change significantly enough to have an effect on mortality.

The relationship between education and mortality does not seem to have been investigated in New Zealand. Without detailed investigation, US data is probably not applicable to New Zealand because of the different ethnic populations. However, the lack of knowledge of the education/mortality relationship will have little effect on the analysis to be carried out in this research. This is because there is little change in education in the group to be studied, and what change there is will probably not have any effect on mortality or the choice of occupation. Thus the current relationships

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[111] Harding (1990b) page 51.

[112] Bacica (1984).

between education and mortality can be considered to hold over the whole of the forecast period for the group being studied. However, when the model is used to analyze policy change effects on younger groups, more detailed investigations will need to be made into the relationships between mortality, education, social class and occupation. This becomes even more important as dynamic models are developed.

Although the studies mentioned above have shown the importance of a range of factors in determining mortality rates, the main source of information and labour force projections, *"Population, Labour Force and Household Projections 1991-2031"* published by the Department of Statistics[113], does not provide projections by ethnicity, occupation or education. As the author did not have sufficient information to do demographic projections himself, unofficial projections were obtained from the Population and Demography Division of the Department of Statistics. These unofficial projections were by age-group, gender and ethnicity and based upon the 1986 census. An extension to the model could incorporate mortality once suitable forecasts and mortality data for females become available.

In a static model the mortality variables are subsumed within the population projections and are accepted as exogenous. Thus the reweighting of the database includes an adjustment for the effects of mortality. However, this method only changes the weight variable on the individual record and not the marital status. That is, for instance, when a married male is assumed to die, the weight representing the total population of married males should decrease, while the weight representing widowed females should increase, but reweighting does not allow for specific records to change states. Because the reweighting acts in this way, it is not possible to assess the income impact on a particular group of people of a movement from a married state to a widow/widower state. (This is an area in which dynamic models have an advantage).

The methodology used for reweighting is as follows:

1.   a table of estimated weights is input,

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[113] Department of Statistics (1991).

2.   the weights on the database records are aggregated into a table under the same categories as used for the table input,

3.   the input weight table is divided into the aggregated database weight table on a cell by cell basis to form an adjustment table,

4.   the database is then run against the adjustment table with the weight on each record being adjusted by the ratio in the relevant cell in the adjustment table.

The formula used for reweighting is:

$$new\text{-}weight = old\text{-}weight \times \frac{projected\text{-}number}{actual\text{-}number}$$

where projected-number $\equiv$ number determined from population forecasts
actual-number $\equiv$ number from database.

For those types of analyses where demographic data is available in more than three dimensions, it is an easy task to modify the reweighting procedure to cater for the additional dimensions. It is just a matter of changing the dimensions of the table aggregation procedures. While the model reweights the database before applying the policy rules, it is possible to reweight the output database after the policy rules have been applied and before the results have been analyzed (as is usually done with TAXMOD). The first method of reweighting was used in this model as it is considered that the latter method of reweighting would invalidate the effects of the Monte Carlo processes in the labour force participation module.

Disability-Invalidity

Disability/Invalidity (or in its wider term including sickness - morbidity) relates to the health of people and directly effects both their ability to work and the type of work they can undertake. Thus the disability or invalidity status of a person can have an important impact on their income at any point in time, and their earning power over their lifetime. The Age Concern/National Mutual survey carried out in 1990 shows that, for the elderly,

there is a correlation between income, health and whether people live alone.[114] The disability and health status of a person during their working life not only has a severe impact on income at any point in time but also on earning power over the lifetime. However, the quality and availability of information on disability rates is limited and there is little information on entry into and exit from disability/invalidity states.

Disability/Invalidity is, by its nature, a dynamic condition. The human body is a living thing. It is prone to accident and breakdown, but does have a built-in repair mechanism. This means that people can move in and out of a disability/invalidity condition giving disability/invalidity its dynamic status. However, studies (even international studies) on the subject of movement into and out of disability states are not common. Harding was not able to find any applicable to Australia, therefore as a proxy she used cross-sectional data obtained from an Australian survey of disability.[115] There do not appear to be any New Zealand studies into the dynamics of disability/invalidity either, nor do there appear to be many cross-sectional studies into disability/health. The most comprehensive New Zealand study appears to be that carried out by Jack and others.[116]

Harding quotes the Australian Bureau of Statistics 'Disability and Aged Persons Survey' of 1988 as finding that:

the incidence of disability varied with sex and increased sharply with age.[117, 118]
Therefore, to assess the opportunities of persons to earn income over their lifetime, it is important to identify probable health states by age and gender. Disability forecasts by age are not available as part of a single wider matrix. Therefore disability will be handled in the dynamic part of the labour force module rather than in the demographic aging module.

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[114] Age Concern (1990).

[115] Harding (1990a).

[116] Jack et al (1981).

[117] Harding (1990a) page 55.

[118] This type of distribution is also apparent in Jack et al (1981).

The Australian definitions of disability and handicap are based upon the World Health Organisation International Classification of Disabilities and Handicaps.[119] The definitions are as follows:-

A disabled person is a person who had one or more of the following disabilities or impairments. These had to have lasted or be likely to last for six months or more.

(a)   loss of sight;

(b)   loss of hearing;

(c)   speech difficulties in native language;

(d)   blackouts, fits or loss of consciousness;

(e)   slowness of learning or understanding;

(f)   incomplete use of arms or fingers;

(g)   incomplete use of feet or legs;

(h)   long term treatment for nerves or an emotional condition;

(i)   restriction in physical activities or in doing physical work;

(j)   disfigurement or deformity;

(k)   need for help or supervision because of a mental disability;

(l)   long term treatment or medication (but still restricted in some way by condition).

A disabling condition is one or more of the above.

A handicapped person is a disabled person five years or more who was further identified as being limited to some degree to perform activities or tasks in relation to one or more of the following areas:-

(a)   selfcare;

(b)   mobility;

(c)   communication;

(d)   schooling;

(e)   employment.

Note: all disabled under five are considered handicapped.[120]

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[119] Australian Bureau of Statistics (1981) page xvi.

[120] Australian Bureau of Statistics op cit.

For the purposes of the model, the use of data relating to handicapped would be more applicable than that referring to disability alone. This is because the model looks at income earning capability and disability as defined is not a sufficient condition to effect income earning. In Australia in 1981, 8.6% of the population were handicapped with a further 4.6% disabled but not handicapped.[121] When looking at various age groups it is found that over 10% of the forty five - fifty four age group, over 20% of the fifty five - sixty four age group, over 25% of the sixty five - seventy four age group and over 45% of the over seventy four age group are handicapped.[122] A figure that is of importance for the analysis carried out in this thesis is that 10.3% of the disabled are in the sixty - sixty four age group. Other data of interest include: 6.8% of persons in the fifteen - sixty four age group are handicapped, but only 3.8% of the labour force are handicapped. Also labour force participation for the handicapped is 39.5% as compared with labour force participation of 70.1% for all fifteen - sixty five.[123]

The problem of lack of data is again demonstrated here. In Australia, over 10% of the forty five - fifty four year old population have a handicap, that is, they are health restricted in some way.[124] In New Zealand, less than 3% of this age group receive sickness and invalids benefits. It is not known how many in this age group receive disability allowances, and it would be difficult to find out as some receive the allowance for their children, others for health related expenses etc. However, it is difficult to accept that the unaccounted for 7% would all be working restricted hours on account of health. Therefore the model only uses sickness and invalid benefit numbers and ACC numbers in the health related area.

The HEIS database has only one variable that gives any indication of health status. This is the variable that indicates what type of benefit is being received and includes sickness and invalid benefits and disability allowance. However, this indicator is broad and doesn't indicate the health status of those who do not qualify for a benefit, neither does

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[121] op cit page 1.

[122] op cit page 5.

[123] op cit page 69.

[124] Jack et al found that about 9% of this age group had a physical disability. Jack et al (1981).

it allow for the identification of whether a disability allowance is paid along with another benefit.

As mentioned above, health status is a dynamic event, often changing. However, the transition is very often dependent upon the health experienced in the previous time period. Thus to more correctly represent the actual situation, transitional probabilities are necessary, but without knowledge of the transitional probabilities the Monte Carlo methodology becomes a random distribution rather than dependent upon the state in the previous period. This situation is not entirely suitable for long term health problems such as those suffered by Invalid Benefit recipients whose health state in any period is heavily dependent upon their health state in the previous period. For sickness beneficiaries, the problem is even more complex. The Sickness Benefit is a short term benefit, but a large proportion of beneficiaries demonstrate a similar behaviour profile to Invalid Benefit recipients, a benefit a number will transfer to in time. Another large proportion of Sickness Benefit recipients show a similar profile to unemployment beneficiaries, right down to seasonal flows.[125]

If one were to be assessing longitudinal behaviour, using transitional probabilities would be highly significant. For many studies, however, comparison of point in time analyses is all that is required and therefore the probability of being in a particular state would suffice, unless it affects other variables such as wealth and employability. The model being developed here will use expected state probabilities allocated by the Monte Carlo method. The statuses will be allocated according to the probability of being in each health state, the health state being proxied by the probability of being on a sickness or invalids benefit. The probability of being on an invalids or sickness benefit is determined by forecasting the Department of Social Welfare benefit time series. Although these are historic probabilities, it is considered that they will be applicable to this analysis. Malcolm quotes a study by Robine and Ritchie[126] which shows that while average life expectancy is increasing, disability free life expectancy is not.[127]

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[125] The author's own unpublished research.

[126] Robine and Ritchie (1991).

[127] Malcolm (1992).

Other Demographic Variables

There are a number of other demographic variables of importance in determining labour force participation and household income levels. These include household types, marital status, number of dependents and other variables. One variable of particular importance is household type as household type differs quite substantially between ethnic groups. While the Department of Statistics does produce projections of households, the projections are not available by ethnicity.

At this stage, these additional demographic variables are not included in the reweighting matrix. However, as more extensive data and more sophisticated techniques become available, it will be possible to make adjustments to household type numbers using reweighting procedures mentioned earlier in this chapter.

Economic Aging Module

The economic variables are those that determine the level of income that a person has as well as how it is expected to change in response to changes in the economy. All financial related variables are adjusted in the economic aging module, although because of their significance in social and economic policy, taxes and social welfare benefit rules are applied in separate modules.

Most of the parameters that are used to adjust the economic variables are obtained from the analysis of the macro economy. In some of the more sophisticated microsimulation models being developed currently, there are some quite sophisticated feedback links between the microsimulation models and the macrosimulation models used to develop the parameters used for adjusting the economic variables.[128] These links are being developed to show the interdependence of the macro and micro economies and the dynamism of the total economy. However, as this model is only a basic model, nothing of that level of complexity has been attempted.

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[128] Merz (1991).

The income data obtained from the HEIS survey is quite detailed and a wide range of variables are held on the database. However, the database that is being used for this research is a subset of the ASSET database, which in turn is a subset of the original HEIS data with the addition of some imputed variables. Many of the HEIS income variables are amalgamated on the ASSET database and are not able to be separately identified. This means that the adjustment parameters used for aging the data will be a little more general than would be the case if the original HEIS data were being used. There is one income variable from the HEIS survey data that is not accounted for at all on the database used here. The variable is 'other irregular income'. It is not known what effect the omission of this variable will have on this analysis, however, as the income is irregular, it may not have much effect on retirement planning.

While there are quite a large number of historic time series tracking different forms of income, the number of series that have been published as forecasts are much more limited. Further, in this time of economic change, different economic forecasters will produce differing forecasts of indicators. While several economic forecasters have produced forecasts, most of the forecasts are only for two - three years ahead. One of the few economic forecasters that regularly publishes longer term forecasts is the New Zealand Institute for Economic Research (NZIER) whose forecasts are utilised for this project.[129]

The majority of economic variables are adjusted by multiplying through by an index of expected movement. The standard equation is:

$$y_2 = y_1 \times \Delta_2$$

where y_1 ≡ income variable from first period
y_2 ≡ aged income variable
Δ ≡ index of expected change in variable over period.

Income from accident compensation, job superannuation, maintenance and self employment (both agriculture and other) is adjusted by the expected movement in

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[129] NZIER (1992).

wages. Bursary, National Superannuation, taxable benefit and unemployment benefit income is adjusted by the expected movement in the consumers price index (CPI) as this index is usually used to adjust their rates. The other investment income variable is adjusted using the expected movement in investment income. The wage/salary income variable is adjusted by the expected quintile movement. (The determination of the quintile movement is discussed in the section on exogenous parameters). The income quintiles were determined from HEIS and other official income statistics. However, there are a number of sources of income that are not separately adjusted as the database being used has them aggregated together. An example of this is other regular income which is adjusted using the CPI as it was considered that this would be a reasonable proxy for its actual movement as the variable aggregates income from several different sources.

Redundancy income is not adjusted as changes in legislation and employment contracts have reduced the amount of redundancy income being paid out by amounts not yet analyzed. Income from drawings while available on HEIS are not included in the income calculations because of the difficulties with defining what part of drawings is taxable income. Interest, dividend and investment income are adjusted by the relevant index of expected movement in income.

In most cases the indicators are straight forward as NZIER has published a forecast of an indicator (usually an index) that directly applies to the variable. In some cases there is either no directly applicable indicator, or one in a form different from that required for this analysis. In this situation, either the best available forecast is used or the variables are left constant.

For those variables that relate to forms of social assistance where the rates are set by the Government (these include family support, Guaranteed Minimum Family Income (GMFI), bursaries etc) it will be assumed that there will be no change over the period concerned. This is a reasonable assumption in the current economic climate where very powerful pressure groups are pressuring the Government to reduce expenditure on social assistance. Although a case could be put to adjust these forms of income in line with

the movement in the CPI, in the past they have tended to be adjusted at the Government's pleasure and most have not been adjusted in the past two to three years. Therefore it would seem reasonable to assume that as the Government is predicting low inflation and low wage movement over the next few years, there will be no movement in the rates paid for these forms of income.[130]

The forecast that is used for wages and salaries in this model is for the average movement in gross values for these items. To obtain an indicator applicable to smaller groups of the population, the movement of each income quintile relative to the average movement over recent years was analyzed. As it is difficult to find forecasts of quintile movement, an assumption was made that this relativity would continue to apply and an index table was constructed giving estimated movements for each quintile over the period of the simulation. While it would have been preferable to use deciles, the most easily available source of wage movements is a publication of the Department of Statistics. This publication has wage and salary movements by quintile only.[131]

There is one further complication in the area of economic aging. Most forecasts of economic indicators are prepared on an annual basis, based around a December or a March year. However, as the Department of Statistics in their ASSET Newsletter advise that:

> Income and expenditure variables have been synchronised to rates prevailing at the midpoint of the quarter of the interview[132]

As the HEIS survey is carried out continuously over a twelve month period, there are four quarters of data. The first step of economic aging would, therefore, be to age all four quarters to the same period so that the annually based parameters can be applied correctly. This would be done by applying the required number of quarterly index movements to each quarter of data that would bring them up to the same period. This

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[130] Late Comment: As this thesis was being prepared early in 1993, the Government announced that the benefit rates for 1993/94 would be adjusted by the CPI rate.

[131] Department of Statistics (1992a).

[132] Department of Statistics (1992c) page 2.

action was not carried out for this analysis as suitable quarterly indexes were not available for all the economic variables.

Labour Force Participation Module

In a country with only a short history of a money economy, the main source of income for most people is their own labour effort. Thus labour force participation and employment are an extremely important part of any analysis into the income effects of social policy.

It is with the inclusion of a module to specifically incorporate labour force participation and unemployment behavioural effects that this model differs from most static models. Usually, with a static model, it is assumed that behavioural responses to policy changes take a while to work through and will not show up over the time frame that the static model simulates. Thus it is assumed that the standard aging of demographic variables will be adequate. However, standard demographic aging will not be sufficient for the analysis to be carried out in this project because are no current or previous data suitable. The policy change being investigated is intended to encourage behavioural changes in the effected population and thus available data will not be suitable.

Poot and Brosnan[133] analyzed unemployment and labour force participation as reported in the 1981 census, comparing the results with previous censuses. Revell and Brosnan[134] took the labour force analysis further and analyzed labour force participation as reported in the censuses from 1891. The important finding from these studies is that trends in participation rates differ for different ethnic and gender groups, and also differ for different age groups.

There are three aspects to participation that have a major influence on earnings received from labour supply. They are the actual participation in the labour force, unemployment

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[133] Poot and Brosnan (1982).

[134] Revell and Brosnan (1986).

and occupation (to which education is related). That these can have a significant impact on income is demonstrated by the following findings of the Planning Council:-

- working age Maori are less likely to be in the labour force than non-Maori;

- while at the broad industrial level the Maori workforce is distributed in a similar pattern to that of non-Maori, occupational differences are more pronounced;

- far greater proportions of Maori are employed in manual occupations whereas non-manual occupations are growing faster;

- Maori unemployment rates have been higher than non-Maori rates for over 25 years;

- unemployment spells tend to be longer for Maori than non-Maori;

- non-Maori have higher educational qualifications than Maori;

- Maori on average earn less than non-Maori.[135]

The lower average income when employed along with greater unemployment and greater likelihood to be out of the labour force mean Maori on average have a lower lifetime income than non-Maori.

Women have a lower expected lifetime income than men for many of the reasons that give Maori lower expected lifetime earnings, that is they are less likely to be in the labour force and on average they earn less than males. A further feature of women's labour force participation is that they are also less liable to work full time in paid employment and more likely to work part time than men. Women also tend to work fewer hours than men when in full time paid employment.[136]

Unfortunately, although research has shown links between a number of variables and income earned from labour force participation, data is still hard to come by. The only regularly published labour force participation series incorporating age group includes one other variable only. That variable is gender. There is no labour force participation series published incorporating both age group and ethnicity.

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[135] Planning Council (1989b).

[136] Planning Council (1989b).

An element that can have a very major impact on labour force participation is health status. Factors that effect health status are health in previous periods and occupation (or previous occupation). It is difficult to determine the effect of previous occupation as a person whose health is starting to deteriorate may have changed from the occupation that caused the health problems to another totally different occupation. A number of analyses have used highest educational qualification as a proxy for occupation as they believe that education as a major determinant in the choice of career a person makes.[137] Prebble et al also use education, in this case because occupation was not available on the HEIS database they used.[138] However, on the database used for this research, occupation is available while education is not.[139]

There are five possible scenarios related to health changes that could have an impact on income. A person could change their occupation and/or change the number of hours worked. If they have enough other income they could withdraw from the labour force. If they are more than 75% permanently incapacitated for work that may receive invalids benefit and if they are temporarily unable to work because of a medical or sickness related problem they may receive a sickness benefit or accident compensation payments.

Another factor that can effect the labour force participation of a person (particularly an older person) is the level of unearned income they have. Unearned income can be from a pension scheme, various forms of investment and saving, from a spouse (either paid employment or unearned income) or perhaps from an endowment. Because information about endowments is not readily available, this form of income will be ignored. On the HEIS database endowment income is contained in the irregular income variable, one that is not separately available on the subset used for this analysis. It is thought that the omission of this form of income will not have much effect on the analysis. This is because endowments would effect only a few people in the age group being analyzed. The group of this age most likely to receive endowments would be widows, but their

[137] Harding (1990a).

[138] Prebble and Rebstock (1992).

[139] Occupation is available coded to the 2 digit level of the New Zealand Standard Code of Occupations.

endowments would probably be more likely to be non cash assets and not appear in this HEIS variable.[140]

To determine whether an individual has investment income is relatively straight forward, the relevant variables are inspected to see if they are non-zero. However, for a married couple, it is not so much the amounts credited to the individual that are important. It is the income available to the household that is of interest in terms of labour force participation. Another point of interest is that married women often retire from the labour force at an earlier age than their husbands. This apparently happens because married women are generally younger than their spouses and often retire at the same time as their husband. An indication of this is the number of women who qualify as underage spouses at or around the time their husband qualifies for national superannuation.[141] In 1991, of those spouses of national superannuitants who were not receiving National Superannuation in their own right (almost all of whom were under sixty), approximately 53% were financially dependent to some extent upon the qualified spouse. That is they had no income or had inadequate independent sources of income. Coupling together the early retirement of spouses with over 50% of them being out of the full time paid workforce and financially dependent on the other partner leads to the assumption that approximately 50% of spouses will withdraw from the full time paid workforce (or 'retire') when the principal income earner retires.

Unemployment is another factor that is having an increasing impact on incomes. Over recent years, the proportion of the male unemployed, particularly those who are in the older age groups, has been increasing faster than that for any other group.[142] Once an older person has been made unemployed it is difficult to obtain other paid employment. This situation has been recognised by the Government and they have taken two forms of action in this area. The Government has passed legislation making it illegal to discriminate in employment on grounds of age. The Government has also created a

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[140] This highlights some of the problems that occur when analysing income adequacy when wealth/asset data is not included in the analysis.

[141] The author's own observations.

[142] Planning Council (1989b).

special category of unemployment benefit for those over the age of fifty five, where the regulations are slightly less restrictive than for the main benefit.

In the model as it currently is, it is assumed that if a person has not worked in the past year and the household income is below the unemployment benefit level, he/she will receive the unemployment benefit. Although the assumption may not be totally correct as there are possibly some households that have withdrawn from the labour force and live either a subsistence lifestyle or live on undeclared earnings, it is a reasonable assumption and reduces the complexity of the model.

Because the current model was developed specifically to investigate labour force behaviour of those over fifty five, it assumes that those on benefits in the first period will remain on benefits in the second period. This assumption is another simplifying one and could be replaced in future versions of the model. In order to do this it is necessary to obtain a set of transfer probabilities determining the probability of changing state (by age, gender and ethnicity preferably) and then allocating the state using the Monte Carlo methodology.

To determine whether a person receives a benefit or accident compensation, the Monte Carlo method is used to allocate the status as indicated by the probabilities selected. The income allocated is the particular rate for which the person would qualify under the benefit allocated, or in the case of accident compensation, 80% of the previously recorded wage/salary.

The algorithm simulating the behavioural changes will use the 'Monte Carlo' method. With this method each record is given a random number between zero and one. The record will then be given the characteristics associated with the range of probabilities within which the random number falls. For instance, if the probability of not becoming an invalid is 0.6 and the random number is 0.6 or less, the record will retain a healthy status. If the random number is greater than 0.6, the record will receive an invalidity/disability status.

Benefit Calculation Module

The final element that determines the living standards of the population is how the Government redistributes income. It does this through the taxation system and through government expenditure. Whereas a complex model is able to allocate all government expenditure including indirect expenditure, the model developed here will only deal with direct income tax and social welfare benefits.

It is in the area of tax-benefit calculations that microsimulation models were first extensively used for policy analysis. This is because much of government social policy has to do with redistributing income, the most direct methods being through social welfare benefit payments and income tax receipts. Thus the core modules involved with the implementing of policy changes usually include the benefit and tax calculation modules. If the policy changes only involve changes of rates or assumed take-up rates for benefits, the policy changes will usually only require alteration of exogenous parameters. However, if the policy changes are structural changes, then the benefit calculation module may need to be substantially rewritten.

The social welfare system is complex and needs careful treatment in the model. The complexity of the social welfare system arises from what the system is trying to do. The New Zealand social welfare system has on the whole been developed incrementally with each element added in an attempt to deal with a specific situation. The New Zealand system has been described as one of the 'reluctant social security' systems, a group that includes major Anglo-Saxon nations such as the United Kingdom, the United States of America, Australia and Canada.[143] The systems in this group are minimalist highly targeted systems. The more targeted a system the more detailed its regulations and the more complex it becomes (along with substantially increased administrative costs), while the more universal a system is the less complex it becomes. With the current emphasis that governments are putting on cutting back social welfare expenditure, there is increasing demand for tighter and tighter targeting which in turn

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[143] Esping-Andersen (1990).

is leading to more and more complex systems. This underlines the need for powerful microsimulation models to demonstrate that the actual outcomes will be those desired by Government and to show that the targeted population will actually be reached in the way intended.

Currently there are over forty benefits (officially known as POBOCs - Payments On Behalf Of the Crown) under the Social Welfare Act and over ten under the War Pensions Act. Each of these POBOCs has several regulations governing such areas as qualification, rates of payment and abatement due to other income. For instance, the term 'Unemployment Benefit' can cover some seven sub benefits and has six different rates of payment. As well as this, a person qualifying for an Unemployment Benefit may also qualify for one or more forms of supplementary benefit.

As a result of the complexity of the social welfare system coupled with the limitation of the data available on the subset of the HEIS database used for this project, only the most relevant aspects of the social welfare system will be modelled for this analysis. When the model is extended in the future, more elements of the social welfare system will need to be included.

Some of the benefits that initially will be excluded from the model are:-

Disability Allowance - this allowance can be received by any person who satisfies certain physical criteria, whether or not they are receiving another benefit. Suitable data relating to the identification of this allowance are not available on HEIS. Although data about probabilities could be available from the Department of Social Welfare it is not easily available and much analysis would be necessary to ensure compatibility with the HEIS data. Therefore this benefit has been excluded at this stage.

Accommodation Benefit - this benefit is excluded for a number of reasons. It is based on expenditure on accommodation, which while available on HEIS is not available on the subset used for this thesis. With the privatisation of the Housing Corporation of New Zealand, the Government has reviewed accommodation assistance. As a result this benefit was replaced with a

substantially revised benefit in July 1993. As only a small proportion of the sixty and over population receive Accommodation Benefit, it is considered that the omission of the benefit will not substantially effect the results of the analysis. Youth Rates (including rates for those under twenty five) - the youth rates of the various benefits are excluded from the model at this stage in the interests of simplicity as the analysis will only explore those aged sixty to sixty five.

Any benefit relating only to those under the age of sixty as these are unnecessary for the analysis to be carried out for this thesis.

Other supplementary benefits - most of these are expenditure related and are excluded at this stage because of the lack of expenditure data on the database used.

The limitation of the benefits incorporated in the model will not greatly effect the overall long term generality of the model. The wide range of benefits and allowances included together with the rules and regulations that are represented in the model will demonstrate how the omitted benefits and allowances could be included at a future date.

To apply the benefit rules, first each record has its total income (less benefits) assessed. If the income is below predetermined levels, the various benefit rules are applied. These rules will lead to the government assistance entitlement, if any, to which the person is eligible. The amount of assistance is then added to the total income. For the base run, 98% of the over fifty nine group will automatically have National Superannuation given to them and 8.6% of their unqualified spouses will also receive National Superannuation.[144] Of the group of unqualified spouses receiving National superannuation, approximately one third (2.9% of the total) are described as being the principle income earner and approximately two thirds (5.7% of the total) are described as the spouse of the principle income earner. The surcharge will be applied in the taxation step, as will family support and GMFI.

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[144] Calculated from HEIS.

The regulation associated with benefit payments that is of most consequence to the construction of the model is the abatement regulation. This regulation applies to all benefits except National Superannuation where the surcharge carries out a similar function. The abatement regulation states that a beneficiary may receive up to $50 ($60 in some cases) gross income in addition to the benefit. If the beneficiary receives between $50 (or $60) and $80 gross additional income per week, their net benefit is reduced by 30c for each additional dollar received over $50 (or $60). If the beneficiary receives in excess of $80 per week gross additional income, the rule stated above applies to the income between $50 (or $60) and $80 and the abatement is increased to 70c for each dollar received in excess of $80. As the marginal tax rate for income in the range where this applies is 28c in the dollar, the beneficiary will receive a net 2c for every dollar over $80 per week received. In effect the marginal tax rate is 98 cents in the dollar.

Because most benefits are seen as temporary assistance, flow data is of more importance than static data for the determination of those benefits. However, transitional probabilities are not available at this stage. Therefore, the model uses expected distributions as the probabilities and allocates them using 'Monte Carlo' techniques.

Tax Calculation Module

Once the government assistance has been determined, total income can be obtained and the taxation rules applied. New Zealand has a relatively straight forward taxation system with just two taxation steps along with a low income rebate and only a few exemptions. For further simplicity, the model developed here will treat taxation as three steps and ignore the exemptions. It is not thought that ignoring the exemptions will have any significant impact on the results of the analysis to be carried out in this research. For more general analyses, it will probably be necessary to include the taxation exemptions to understand the full effects of the Government's redistribution policies.

There are, however, three tax related elements that need to be included in the model. These are Family Support and Guaranteed Minimum Family Income (GMFI), and the National Superannuation surcharge.

Family support and GMFI are in the form of a tax rebate in that those who qualify for them have their wage or salary tax deductions reduced by the amount of family support or GMFI to which they are due. The reduction in tax can be either from the regular PAYE or from the tax reconciliation at the end of the tax year.

The level of family support to which a family is entitled is determined by the total income of the family and the number of eligible children in the family. There are two levels of abatement due to income and two rates of payment for children.[145] The amount of family support due is calculated by determining how much is due in relation to the number of children, then subtracting the abatement amount incurred because of the family income level.

The formula used is as follows:

$$FamilySupport = (child_1 \times rate_1) + (nochildren - 1)(child_2 \times rate_2) - (income \times abatementrate)$$

The amount of Family Support calculated is then subtracted from the amount of tax due to be paid as Family Support is a tax rebate.

GMFI calculations have not been included in the initial model as statistics regarding the take-up rate are not clear. Improved monitoring of this benefit by the Inland Revenue Department may produce higher quality information in the future.

The National Superannuation surcharge works in a similar way to the benefit abatement systems. The surcharge applies only to those receiving income from National Superannuation. It is an additional tax deduction on non National Superannuation income and is collected by the Inland Revenue Department.

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[145] Since the model was developed, the Government has announced a change in the structure of Family Support.

The National Superannuation surcharge is an additional tax on other income with a maximum amount equal to the amount of National Superannuation received. There is a free zone after which a constant rate is applied. However, there are other complicating factors. For income received from approved superannuation schemes, half of the amount is to be disregarded when calculating income for surcharge purposes. The formula used is:

$$surcharge = (otherincome - freezone) \times abatementrate$$

Conclusion

As New Zealand does not have a history of the use of microsimulation models for social policy analysis, the development of the model for this thesis has been a ground-breaking exercise. Microsimulation models are based around the idea of avoiding the complexities of macro models, but microsimulation models can still be difficult and time consuming to develop as was found during this project. Detailed information of the structure of other models was not available making the task more difficult, therefore the model was constructed in a prototype style and as such has room for considerable further development.

The microsimulation model developed in this thesis is designed to assist in analysing the impacts, benefits and costs of social policy at a different point in time. To estimate the likely conditions in a different period and the likely characteristics of the population in that period, the model employs three different methodologies to age the database.

The first aging method used is demographic aging. Demographic aging takes a 'weight' variable indicating the the size of the population represented by each record on the database and adjusts that weight to indicate the size of the equivalent population in the new period.

Economic aging is the second method of aging used by the model. This method takes the 'economic' variables such as the income and expenditure variables and adjusts them using indicators such as CPI or wage/salary movement estimates.

The third method of aging used by this particular model is 'dynamic' aging. Dynamic aging incorporates the distribution of transitional probabilities by the 'Monte Carlo' methodology in order to track how a group of people might change their behaviour in response to policy changes.

The model also includes groups of statments representing social policy rules. When analysing the impacts, costs or benefits of a policy change, the model is usually run at least twice, once under a base set of rules and one or more times under alternative sets of rules. A comparison of the different changes made on the unit records on the database by each set of policy rules will bring out the relative merits of the modelled policies.

However, regardless of how clever or sophisticated a microsimulation model is, the quality of the output is very dependent upon the database upon which the model acts. Chapter five describes and discusses the database around which the model described in chapter four was designed.

CHAPTER 5: DATABASES

Introduction

The type, depth and quality of analyses carried out using a microsimulation model are very much constrained by the unit record database upon which the model is based. The range of data held will determine which elements of social policy the model can analyze. The number and detail of the variables, along with the size of the sample population held on the database will determine the dept of the analyses, while the quality of the data collected will have a major impact on the quality of the results produced by the analyses using the model.

In New Zealand, there are a limited number of databases suitable for microsimulation modelling. These are described in the following sections along with a detailed discussion of the database used for the analysis carried out for this thesis.

Potential Sources of New Zealand data

Publicly known databases that contain detailed micro-unit information are the income tax database of the Inland Revenue Department, the Wanganui Computer Centre databases, debt collection agencies, the Register of Births, Deaths and Marriages, the Department of Social Welfare database of benefits, other government departments, insurance/finance companies and the Department of Statistics. However, access to the data on most of these databases is controlled by legislation to protect the privacy of the persons who are described by the data. This problem makes it difficult, if not impossible, to use much of this data for analytical purposes.

The most comprehensive unit record data that are available, but only to government departments, are those held on the Department of Statistics Household Expenditure and Income Survey (HEIS) database. The survey usually covers about 3,000 households incorporating around 9,000 people. Data held mainly relates to income and exenditure of these households. It is this data that are used for both the ASSET model and the Treasury TAXMOD model.

Another unit record database that is operated by the Department of Statistics is the Household Labour Force Survey (HLFS). This survey is more limited than the HEIS survey in the range of data obtained, but it does have more detailed information on current employment status and educational qualifications. The HLFS is also more extensive than HEIS in coverage as it samples 15,000 households each calendar quarter. It may be possible to strengthen the HEIS database in some areas by merge/matching data from the HLFS and HEIS databases.

The Department of Statistics is reviewing the availability of unit record databases to bona fide researchers. However, the major concern is the confidentiality of data. One of the options currently being investigated is the concept of a "data laboratory". A data laboratory would be an area within the Department where outside researchers can prepare analytical computer programs for running against unit record databases. The access to the unit record data is controlled in such a way that although the individual records are used by the computer programs, the only data output are in aggregated form thus protecting confidentiality.

Database Used for Analysis

As mentioned above, the basis of a good microsimulation model is a good database. As this project is being carried out under the auspices of the Department of Social Welfare (and therefore having access to the HEIS database), the starting point will be the Department of Statistics Household Expenditure and Income Survey database (HEIS).

While a reasonably wide range of data elements is available on HEIS and there are over ten years of data, there are still inadequacies with it. Some of the more major ones include:-

(a)   expenditure data is not necessarily collected for the same period as income data: for some households the income data is from a previous year, whereas the expenditure data is the current year;

(b)   income data comes from subject recall rather than formal Inland Revenue Department tax information (although tax returns and/or salary/wage payment slips are requested);

(c)   the sample size is relatively small meaning that many of the social welfare benefit categories (low income households) are under represented or are not large enough to be statistically significant;

(d)   there is a limited range of data elements, some of which have varied from survey to survey;[146]

(e)   the unit record data is only available to government departments;

(f)   aggregate benefits are under reported when compared to programme data;

(g)   wage and salary earners are over-represented while their average incomes are under reported compared to income tax returns, which are also under reported when compared to the national accounts;

(h)   self-employed average income is over-represented.

There are difficulties in overcoming most of these problems, but it is possible to lessen their effects by building in allowances for them or by adjusting the data elements to match up with information obtained from other sources. For instance, data for a particular HEIS survey is collected over a year long period. Therefore various data elements have to be aged so that they all represent the same time period. In view of the constraints surrounding the collection of this type of survey data, the efforts of New Zealand Department of Statistics are very good.

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[146] While coverage of expenditure and income is good, wealth/asset data is limited as is flow data (HEIS is basically cross-sectional not longitudinal).

Construction of the main unit record database will start with HEIS database and build upon that. Current areas of major concern in the social policy area include behavioral patterns in relation to labour force and paid workforce participation, and provision for retirement income. These areas are not well covered in the HEIS survey. Determining people's provision for retirement income is difficult for a number of reasons. The most important reason is that retirement income is dependent upon life-cycle income and life-cycle aspects are not collected in a cross-sectional random survey such as HEIS. However, HEIS does contain data on superannuation scheme contributions and income from benefit and superannuation schemes. This information will provide a basis for the assumptions used in the simulation of behavioral responses.

Description of Database

The unit record database used for the microsimulation model constructed for this thesis is the Household Expenditure and Income Survey (HEIS) database. What follows is a description of the HEIS database. Much of the information comes from a background file publically available on the Department of Statistics INFOS information system.[147]

A first very important point to make in relation to the HEIS database is that although the sample surveyed is selected using geographic location as one of the criteria, this information is not held on the unit record. While it would be beneficial for many purposes to study geographic breakdowns of unit record data, geographic locations are deliberately left off the unit record database as part of the processes that ensure confidentiality of information.

The main reason for the establishment of HEIS was to provide data on expenditure patterns of private households in New Zealand. This data was primarily to provide information for the revision of the Consumer Price Index (CPI), for the New Zealand System of National Accounts and to provide certain socio-economic statistics on individuals and households in New Zealand. The survey is a continuous survey in that

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[147] INFOS file STS344 New Zealand Household Expenditure and Income Survey. Updated January 1992.

it is conducted every year at present and covers the period 1 April to 31 March in each period. Statistics from the survey are produced annually for the twelve months ending March, starting from about the August after the period finishes.

The population surveyed is the New Zealand resident population residing in private households. For reasons of ease of access, residents living on the North and South Islands only are surveyed. Those living in remote areas, non permanent dwellings or non-private accommodation are excluded. It was estimated that 1,080,600 households were eligible to participate in 1990/91 and approximately 12% of private households did not contain an eligible household. Households are also selected so as not to include those recently surveyed in the HLFS.

The sample surveyed is selected using stratification techniques. The two islands are divided into 30 major superstrata, which are subdivided using multivariate techniques to provide 94 strata. Each urban stratum provides at least two primary sampling units and each rural stratum one per calendar quarter of the survey. The sample is so designed that there is an even geographic coverage each month and an even spread of the number of households surveyed each month. The 1991/92 period was the eighteenth round of the survey and 2934 households completed the survey documents. This was the lowest number except for the second round carried out in 1975.

The weight factor for HEIS is defined as the inverse of the probability of selection of that household. Thus if the probability of selection of a household is 1 in 250, then the weight for that household is 250.[148]

Some key definitions used are:
>   a household is either a single individual living in a dwelling who makes his or her own housekeeping arrangements,
>   or a group of persons living in or sharing a dwelling for most of the reference period who participate in some measure at least in consumption of food

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[148] Department of Statistics (1992d).

purchased for joint use by members, or who, if not dependent upon a household member, contribute some portion of income towards the provision of essentials for the household as a whole;

expenditure data are collected by the following methods:-

twelve month recall,

latest payment (for regular commitments),

fourteen day diary keeping,

expenditure data collected by diary keeping covers just one year in total for the survey, whereas recall data covers the previous year as well,

expenditures on tobacco, alcohol, ice-cream and meals away from home tend to be understed;

income is regarded as all receipts of a regular or recurring nature and is the actual before tax amount;

a child is defined as a person 0 - 14 years. This leads to the situation where the family type and the household type may differ. For instance a couple with a 16 year old child and a 10 year old child would be a family unit of 2 adults, 2 children but a household of 3 adults and 1 child.

The HEIS survey is conducted over the period of one year spread between two calendar years (April to March). The survey households are split into four groups with each group being surveyed over a different three month period. The HEIS database is thus a collection of four datasets. Each data set is separately identifiable and all variables in the set are adjusted to align on the midpoint of the quarter in which the data were collected. Thus the first timing adjustment needed is to align the variables from each survey period to a common time. The choice of the exact time chosen for each respective variable will depend upon the timing of the statistical series that are available and suitable for the forecasting of that variable. Although this activity should be done to align all four quarters, the model as used for this thesis did not align the quarters.

This was another of the steps taken to simplify and speed up the development of the model.

For some analyses, it may be found that for certain population types, the data are not accurate or the coverage incomplete. In this case these groups may have to be dropped from the analyses. If this is the case, the groups should not be dropped before the aging of the database because many of the aging parameters refer to the total population and to build the reweighting matrices correctly, all records on the sample database need to be included.

The database used in the analysis for this thesis is a subset of the HEIS database after it has been processed by the ASSET microsimulation system. The main effect of the ASSET system is to aggregate income variables to calculate total gross incomes, calculate taxes and apportion social welfare benefits in relation to the calculated gross incomes. The ASSET database therefore contains additional aggregated variables that do not appear on the base HEIS database. Not included on the ASSET database are personal identifiers or variables relating to geographic location. Demography and income plus a few other variables are the only variables that appear on the subset database that the analysis was carried out upon. While the ASSET database has over one hundred variables on it, only forty-five of those variables are leased by DSW and occur in the database that was used for this project. The truncated database used for the analysis has meant that the model was limited in its ability to simulate a wide range of effects of policy changes.

Chapter five has described the unit record database that is used by the model described in chapter four. Chapter six puts the model and database together and describes an analysis carried out using both the model and the database.

CHAPTER 6: THE ANALYSIS

Introduction

The basic model developed in this thesis is a general model. That is, it is built up of those elements that are commonly needed for microsimulation analyses. However, for most microsimulation based analyses, the general model will need to be tailored for the specific analysis to be carried out. The analysis in this thesis is no exception. Chapter six will first describe the analysis that will be undertaken, then discuss the adjustments made to the model for this particular analysis and finally go on to discuss the results of the various analysis runs.

The Question

Apart from debt servicing, National Superannuation is the biggest single programme of government expenditure. As such it has become a target for pruning by those who wish to reduce government expenditure. The elderly population is increasing both in absolute numbers and as a proportion of the productive labour force. This will mean that the cost of National Superannuation will continue to increase unless the qualification rules change. It is said that National Superannuation at its present level is unsustainable and will be even less so in the future.[149] Further, it said to be unsustainable because it costs too much of the taxpayers money and the increasing numbers of people drawing National Superannuation in relation to those paying taxes will mean that the economy will suffer.

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[149] The Treasury (1987); the Task Force on Private Provision for Retirement (1992a).

In the public discussions on the effects of the increase in the qualification age for National Superannuation, the assumptions on which the reasons for the increase are based and the relationships between those assumptions do not appear to have been clearly addressed.

As one of the methods to reduce the number of those eligible, and thus the cost of National Superannuation, it has been decided to increase the qualification age from sixty to sixty five. Much has been made of the estimated savings to be obtained from this move, but what has not been demonstrated is how the decision will impact upon the incomes of those people effected or how sensitive the decisions are to the assumptions regarding disability/invalidity and labour force participation. There has been little information and no analyses published in relation to the assumptions about the behavioural changes upon which the expenditure savings were based. Questions that remain unanswered include the following: What proportion of people will remain in employment? While it is known that invalidity/sickness increases sharply around age sixty[150], what increase will there be in numbers on Invalids and Sickness Benefits? It is assumed that those in the sixty - sixty four age group will continue with the same work habits as they had while they were fifty five - fifty nine, but how strong is this assumption? In this time of surplus labour, how will employers react? Will they continue to employ short term high priced older labour or lower priced longer term younger labour? There is an international phenomenom of people retiring earlier[151], how will this effect the numbers? What will be the impact on the individuals' incomes? What about the effect of the reduced incomes on the New Zealand economy? Anecdotal evidence suggests that the sixty - sixty four age group are large spenders, particularly in New Zealand, both on internal tourism and general consumption. Has this been taken into account in the estimates used?

To demonstrate how the use of microsimulation models can assist in the answering of some of the above questions, the basic model described in Chapter 4 will be adapted and used in a simple analysis. The question that will be looked at is:-

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[150] Australian Bureau of Statistics (1981).

[151] OECD (1985).

What are the likely differences in total income, disposable income and government income maintenance expenditure for persons in the sixty - sixty four age group, under the age sixty qualification and the fully implemented age sixty five qualification schemes for National superannuation? How will the effects differ between different sectors of the population?

For the analyses undertaken in this thesis, it is assumed that labour force participation has an inverse relationship with unearned income (including income from private superannuation schemes)[152] and the health status of the person (or spouse if married). Data required for a detailed analysis of the type to be carried out for the above question would include:

for prospective superannuitant,

age, gender, educational qualifications, health status;

paid work status (part/full time, temporary/permanent), occupation, industry employed in, whether beneficiary, work history;

gross income (all sources), whether has superannuation/pension plan, type of plan, investments;

household make up, housing tenure, wealth/assets, mortgages/loans/debts;

employers employment policy (may not be possible to obtain).

for prospective superannuitant's spouse or other household occupants,

income and employment data, relationship to prospective superannuitant.

other data required,

employment rates of 55-65 year olds by gender and marital status;

forecasted unemployment, labour force participation;

forecasted wage/salary, CPI, GDP movements;

forecasted demographic distributions;

benefit qualification regulations

taxation rules.

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[152] In general this is true, but there may also be some social class effect in that higher social classes tend to have higher unearned incomes and may also have greater labour force participation than lower social classes.

However, the model has been developed as a prototype model and uses a database with a limited range of variables. This has meant that only a small range of those variables that have an impact upon the level of income of the sixty to sixty four age group have been included in the model. The analysis, although significant in its own right, has been carried out primarily to demonstrate the capabilities of microsimulation models. Thus the model has the capability for extensive development in the future.

As historic data for some of the variables of interest, such as labour force participation of those aged sixty to sixty four, is either not available or of little relevance under the policy change scenario being analyzed, the transitional probabilities have had to be assumed or deduced from other data. Several runs were done with different probability assumptions to reveal the sensitivity of the results to the change in assumptions. The results show that assumptions do have an effect on the conclusions to be drawn.

The Method

To answer the question, one needs to run the database through the model first under the age sixty qualification rules producing an updated database. The original database then needs to be run through the model again using the age sixty five qualification rules producing another updated database. The two updated databases would then be compared and the differences analyzed. This in effect was what was done, but as usual with most analyses, the task was not quite as simple as it appeared on the surface.

First, there were several runs of the model to be done as the sensitivity to different assumptions was tested. Second, the occupational data for the sixty - sixty four age group on the HEIS/ASSET database were not adequate for the simulation of the age sixty five qualification option. The problem was overcome by making use of one of the important features of a microsimulation model, the ability to 'age' the database (as described in chapter 3). The aging was done in two stages. Each record had five years added to its age variable (thus those records in the fifty five - fifty nine age group were moved into the sixty - sixty five age group taking their occupations with them) and then the whole database was reweighted to reflect the expected population numbers five years

hence. The adding of five years to each record introduced a number of other problems that are further discussed below.

A second problem that flows on from the above is that full implementation of the age sixty five qualification was simulated for 1995/6. This is not a true reflection of the change as the age sixty five level is not reached under the present policy plans until 2005/6. However, it is not possible to obtain any substantive forecasts for 2005/6 and the few demographic forecasts available have wide confidence intervals. It was thought that the most reasonable compromise was to simulate for the 1995/6 year.

Another important requirement was to reflect the changes in labour force participation and employment as these actions have important implications for incomes. 'Monte Carlo' techniques are used to simulate changes in labour force participation. The Monte Carlo methodology is used as it allows for a random allocation of the labour force status, within selected groups, that may more accurately reflect real life. It is also possible to do multiple runs using the Monte Carlo technique to determine the properties of the distribution of the results.

As mentioned above, one of the objectives of increasing the qualification age for National Superannuation was to reduce the economic loss to the country of an economic resource being under utilised. The increase in qualification age thus is an incentive for the sixty and over population to change their behaviour and increase their labour force participation. Because of this, it is important for the model used for this analysis to include labour market behaviour. As earned income is an important source of total income, the expected increase in labour force participation could have an important impact on the incomes of those over fifty nine - the subject of the analysis to be carried out in this project. Therefore, variables that have an impact on earned income should be explicitly identified in the model.

It would be tempting to assume that the increase in National Superannuation qualification age would just cause a one time movement in the age structure of labour force participation. One could then take the transitional probabilities of the fifty five -

fifty nine age group and apply them to the sixty - sixty four age group as an indication of labour force participation behaviour after the increase. However, this would not be a correct assumption. Revell and Brosnan show that labour force participation of the over sixties was steadily declining prior to the introduction of National Superannuation with a qualification age of sixty in 1977.[153] This problem is not just local to New Zealand, it is an international one.[154] Another aspect that mitigates against using the fifty five - fifty nine transitional probabilities is that labour force participation also decreases as people age.[155]

Demographic Variables

Demographic factors that are liable to have an impact on a persons' labour force participation after they have reached age sixty are:-

Health Status	-	If their health is deteriorating they might change occupation, reduce hours worked, retire, go on a benefit.
Gender/ethnicity	-	Male Pakeha are more liable to be in the labour force than other groups, female Pakeha are more liable to be in part time paid employment.[156]
Marital Status	-	Married women, who are generally younger than their husbands, may withdraw from the labour force when their husbands retire.
Occupation	-	Those in manual occupations tend to retire at a younger age than those in the professions.
Education	-	Education can be considered to be a better indicator of labour force participation than occupation as occupation indicates the present

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[153] Revell and Brosnan (1986).

[154] OECD (1985). Bureau of Labour Market Research (1983).

[155] Revell and Brosnan (1986).

[156] New Zealand Planning Council (1989b).

situation whereas education demonstrates capability and inclination.

Dependents - As dependents increase expenditure, it is possible that dependents would reduce the desire to leave the labour force.

Social Class - Those in the higher social classes are more liable to be in the labour force and/or to have unearned income than those in the lower social classes. However, social class can be a difficult variable to measure and occupation is often used as a proxy.

Economic variables that can have an impact on labour force participation include:-

Assets - Assets can mean a reduction in future expenditure or can be converted into income or can be a source of future income, all of which can lead to an improved lifestyle. However, adequate data on assets is not available on the database used for this thesis.

Unearned Income - Unearned income reduces the dependency upon the job market for income.

Rate of Unemployment - The rate of unemployment indicates the availability of jobs.

In this particular analysis, the demographic variables that will be concentrated upon are those effecting mortality and disability/invalidity (morbidity).

A demographic variable that has major a effect on labour force participation is mortality. The effect of mortality was introduced by using population forecasts to recalculate the weights attached to each record. The Department of Statistics population forecasts were used to obtain the expected 1995/6 numbers. These were then used to reweight the

database the data obtained as a matrix of age group by ethnicity by gender.[157] In part, because only being able to obtain forecasts of the population by three variables, other variables effecting mortality were not able to be included. The population forecasts indicate a continuing decline in the mortality rates for the whole population, but a continuing higher proportion of Pakeha in the over sixty age groups than in the overall population.

An element that is related to mortality that is not included in this analysis is the increase in the demand for Widows Benefit. The increase in demand is caused by the increase in the qualification age for National Superannuation coupled with the increasing rates of mortality as the age groups get older. Those on Widows Benefit are mostly women, and women who are widowed in their early sixties were usually married to men older than themselves and who have a higher mortality rate.[158] As mortality changes are usually accounted for in the reweighting of the data, to estimate the effects on Widows Benefit would require quite a complex analysis for the model in the form used in this thesis because of the particular form of labour force state change methodology used.

One area of the social welfare system that may be of major importance with the increase in the qualification age of National Superannuation is the invalidity/sickness area. The proportion of the population with health problems increases as age increases, with a noticeably increasing rate after age sixty.[159]

It is difficult to find data to represent disability/invalidity. The only data series that relate to disability/invalidity and incomes are the Department of Social Welfare statistics on health related benefits. Unfortunately there are no reliable data relating to the expected demand for health related benefits by the sixty - sixty four age group. This is because National Superannuation has been available to almost all New Zealand residents over the age of sixty and is paid at a higher rate. Thus those in the over sixty age groups have had no need for the health related benefits. Neither are there any New

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[157] The reweighting methodology is discussed in Chapter 4.

[158] New Zealand Planning Council (1989a).

[159] Age Concern (1990).

Zealand data available regarding the effect of health on employment incomes for this age group. Detailed disaggregated flow data is also not available.

To obtain estimates of the demand for health benefits by the sixty - sixty four age group, the demand for those benefits by the younger age groups was analyzed. Using the number of a particular age group on the benefit as a proportion of the total population for that age group, it was found that the proportion of an age group receiving Invalids Benefit was steadily increasing with age, a proportion that appeared to increase simulate exponentially. The demand for Sickness Benefit decreased from the twenty - twenty four age group to a minimum for the thirty five - thirty nine age group and then increased again. The movement again appeared to be exponential through to fifty five - fifty nine where the rate of increase flattened out. To obtain forecasts, the age group data was regressed and forecast forward using simple regression techniques, details of which are contained in Appendix II. Figures 6.1 and 6.2 graph the Sickness Benefit and

Figure 6.1 Proportion on Sickness Benefit

Figure 6.2 Proportion on Invalids Benefit
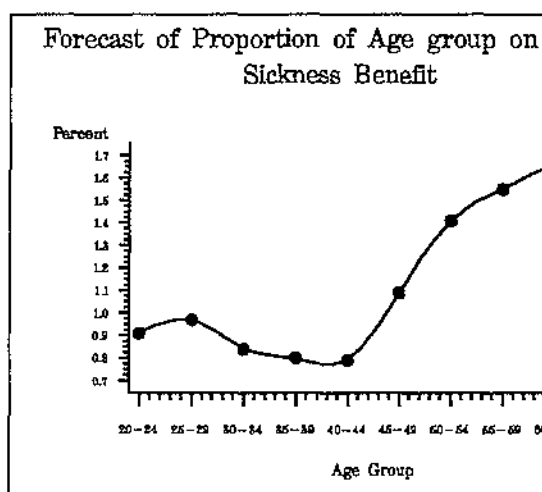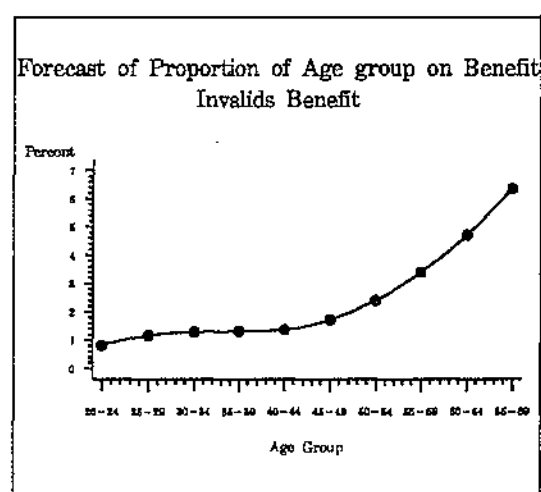

Invalids Benefit numbers as a proportion of the total population in the age group. To changes in sickness and invalid beneficiaries, the Monte Carlo technique was used with the proportions of the population to receive benefits obtained from the regression analysis. The forecasts indicated that 1.66% of the 60-64 age group could receive Sickness Benefit and 4.72% Invalids Benefit.

An attempt was made to include the effect of health on labour force participation using Australian data, but the exercise proved to be too complex. It did not appear to be possible to determine a relationship between Australian labour force participation and the effects of the New Zealand health related benefits. Neither was it possible to obtain estimates on the reduction in hours worked or changes in occupation caused by health problems.[160]

Although ethnicity and gender are important determinants of health status,[161] these elements have not been used in determining those on Sickness and Invalids Benefits. This was because the ethnicity data held on the Department of Social Welfare database is not complete, and the age group data were not available by gender. It was not possible to carry out special runs to obtain the age group data by gender, but this is an exercise that should be undertaken in the future.

Marital status and number of dependents were not included in the variables used to estimate labour force participation in this analysis. They were not used because there is no reliable data on the effects of these two variables on the labour force participation of the sixty - sixty four year olds. Intuition and studies from other countries[162] would suggest that the presence of dependents would encourage participation, but there is no relevant New Zealand research available to confirm this for the sixty - sixty four year olds. Similarly, while labour force participation rates for females aged fifty five - fifty nine suggest that a number of younger spouses retire when the older spouse retires, there appears to be little or no research available to indicate whether the presence of a spouse will encourage an increase or decrease in labour force participation by the sixty - sixty four year olds. Studies suggest marital status encourages participation for men[163], but discourages participation for women.[164]

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[160] These problems came about because the Australian and New Zealand systems have different regulations and the author was not able to obtain sufficiently detailed information on the Australian system to make detailed comparisons.

[161] Pearce et al (1984), Davis (1984).

[162] Persaud and Sutton (1990).

[163] Persaud and Sutton (1990).

[164] Rankin (1991).

Forecasts of the number of dependents are not available as part of a single matrix with other necessary demographic variables. An assumption was made that for the fifty five - sixty five year old population being simulated in this analysis, the proportions having dependents will remain static over the simulation period, except that those dependents that have reached twenty years of age were assumed to have become independent and were set up as separate households. This assumption seems reasonable as few people in this age group increase the number of children in the family.[165]

Apart from the reasons mentioned above for reducing the number of demographic data variables in this particular analysis, there is another very important reason for restricting the number of variables used to determine labour force participation. The problem is the small size of the population numbers in each cell of the analysis matrix. It is estimated that there will be only approximately 2600 people of Pacific Island ethnicity in the sixty - sixty four age group in 1996.[166] This number represents approximately 2% of the population in that age group and less than 0.1% of the total over fifteen population represented on the HEIS/ASSET database. As there are less then 10,000 records on the database, the number representing those people of Pacific Island descent who are sixty - sixty four is very small. If one considers gender as well as ethnicity, the numbers in each cell are approximately halved again. With so few in the actual population in each category, it is not a surprise to find that some categories are not represented on the database. In other categories there are so few records that one with unusual characteristics can distort the results. To overcome this problem, the criteria used for identifying the groups of records are selected in such a way that each cell has sufficient records in it so that the results will be reliable. For this reason the Māori and Pacific Island ethnic groups have been amalgamated for this analysis. To amalgamate Māori and Pacific Island ethnic groups in this way requires the assumption that these two populations have a greater similarity to each other than either has to the rest of the population.

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[165] The database being used did not have any people over 50 with children under 5.

[166] From population estimates provided by the Department of Statistics.

The low population numbers in the group being analyzed has also meant a restriction in the number of income groups under which the income changes were analyzed. To produce the most robust income groups giving a reasonable spread of population numbers within each group, the following groups were used:

under $10,000

$10,000 - $19,999

$20,000 - $29,999

$30,000 and over.

Marital status was reduced to just two categories because there were insufficient numbers under some categories of that variable as well.

In the usual method of static aging, the demographic variables are adjusted by having the weight variable indicating the frequency of that particular type of person in the total population changed to show the expected frequency in the future period. This means that the record of a sixty two year old male will represent a sixty two year old male both at the date of the survey and at the date of the simulation. This created a problem because a very high proportion of those over fifty nine at the time of the survey were retired and their former occupations not recorded. To overcome this loss of occupation data, it was decided to increase the age of all records on the database by five years for all runs. This meant that the record of a fifty five year old male at the time of the survey (1990/1) represented a sixty year old male at the time of the simulation (1995/6). Aging in this way also required further modifications in the area of dependents. An arbitrary decision was made to move all dependents who were aged fifteen - nineteen and would become aged twenty - twenty four, to separate households. While this assumption is not totally correct and more detailed data may be available, the more detailed data should not be significantly more relevant. This is because high unemployment, reduced benefits and other socio-economic factors are causing major changes in household arrangements and these could be expected to continue over the next five years. The householder record that contains information on household make up also needed to have adjustments made to it. As there are few of those aged sixty and over who have dependents aged between twenty and twenty four, it is not considered that the method described will bias the results very much.

Economic Variables

It was possible to obtain five year forecasts of a number of economic variables, which meant that on the whole, economic variables were adequately aged. Most of the economic variables are income related and have a considerable impact on labour force participation and employment decisions. Efforts were made to determine a base level of unearned income that would provide the incentive for people to retire. It was not possible to discover any New Zealand based research in this area. However, a basic investigation of the 1990/91 HEIS/ASSET database provided some indicative levels that were incorporated in the model. The investigation showed that some 9% of males and 11% of females aged fifty five - fifty nine had retired from the labour force and they had a minimum unearned income of $6500. While there were insufficient cell numbers for the finding to be conclusive, the value seemed reasonable enough to use as a minimum when applied to the sixty - sixty four age group. The investigation further indicated that the mean income for retired females was approximately $10,000 and for retired males approximately $ 19,000. Analysis of the age group participation rates suggests a likely participation rate, for the sixty - sixty four age group, of 62.6% for males and 20% for females,[167] while the current participation rates are 34.6% for males and 16.8% for females.

However, a basic investigation of the 1990/91 HEIS/ASSET database provided some indicative levels that were incorporated in the model.In an attempt to determine the sensitivity of the model to the assumptions regarding labour force participation, the model was run with three different participation rates, one of which also included a minimum unearned income level. The current retirement rates of 65.4% and 83.2% for male and female respectively can be considered to be the low participation extreme. The 9%/11% with unearned income below $6500 can be considered to be the high participation extreme, with the 30.8%/73.4% being a reasonable inbetween point. The 9%/11% with no income limit is included as a comparison with the 9%/11% with $6500 income limit. Figures 6.3 and 6.4 show male and female age group labour force

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[167] Details of the analysis are contained in Appendix II.

participation rates. The labour force participation rate was taken to be 100 - retirement rate.

The persons to receive unemployment benefits were determined in the same manner as

Figure 6.3   Proportion of Males in Labour Force
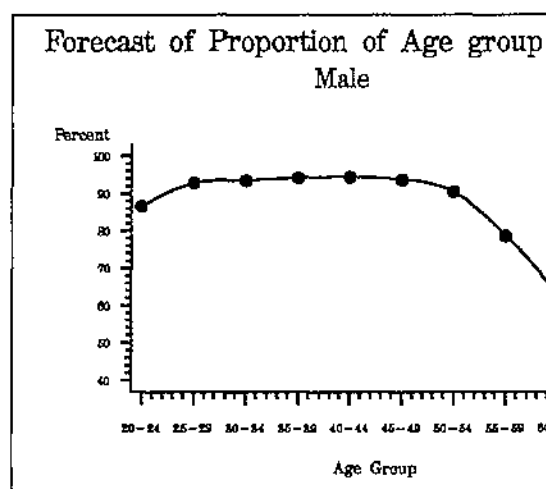
Figure 6.4   Proportion of Female in Labour Force
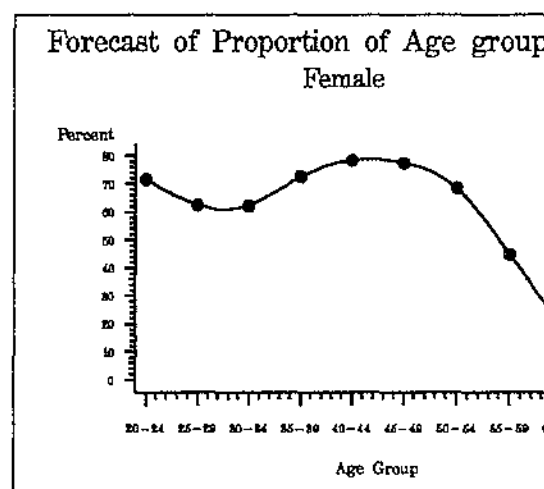
for those who were selected to receive sickness and invalids benefits.[168] The age group unemployment beneficiary numbers as a proportion of the total age group population were regressed and a forecast for the sixty - sixty four age group obtained. This rate was used as the base for the Monte Carlo method selection. Figure 6.5 shows the age group unemployment benefit rates.

As there is an over fifty five Unemployment Benefit with less stringent conditions than for other unemployment benefits, it was considered that all those in the sixty - sixty four age group that are not employed would be either on unemployment benefit or out of the labour force. Those in employment therefore became those in the labour force but not on a sickness or invalids or unemployment benefit.

There are some weaknesses in the way that those on benefits were determined, particularly for the Unemployment Benefit. It is probable that people on benefits,

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[168] The analysis appears in Appendix II.

especially unemployment benefits, tend to be from lower income households. However, there is no definitive research giving transitional probabilities relating previous income, occupation or education to the probability of being on an unemployment benefit in the next period. Thus it is possible that high income earners or those in high demand occupations that may have very low probabilities of becoming unemployed might have been selected for unemployment with the methodology used in the model.

Figure 6.5 Proportion on Unemployment Benefit

Another weakness regarding social welfare benefits is that in the model males and females are both selected using the same rate, although it is more likely that the different gender have different probabilities of receiving benefits. At the time the model was developed, up to date gender breakdowns of benefit data were not available. It was also considered that the historic data was unreliable and probably do not accurately reflect the current situation because it is known that the changes in the economy have produced changes in the beneficiary structure. In the future this data should be more easily available on a regular basis.

Income from benefits was determined by deleting all forms of wage/salary income, except hobby income, and then applying the particular rate that that person qualified for under the benefit they were allocated. As separate gender probabilities were not available for this analysis, the probability for the total group was used.

The Domestic Purposes Benefit (DPB) is another major source of income for some people (mainly women). The majority of persons who are over fifty four and on the

Domestic Purposes Benefit are those receiving the women alone benefit.[169] It is therefore assumed that those who were on DPB in the previous period will remain on that benefit, but no new persons will receive DPB. This assumption was made because in the current employment climate it is unlikely that people (particularly women) over fifty four, who have been out of the labour force for some time, will be able to gain employment. There is also an implicit assumption that women over the age of sixty become single only by the death of their spouse and therefore either do not require a benefit or qualify for another benefit such as Widows Benefit.

ACC compensation is related to employment and thus labour force participation, but again there is no suitable information for estimating the numbers of people in the sixty - sixty four age group who would receive ACC under the increased National Superannuation qualification age. Also, there has recently been a change in the ACC compensation regulations making the available historic data not now totally applicable. In the absence of alternative methods, it was decided to leave ACC compensation as is except where a record was randomly selected for taking out of the labour force. In this case, the ACC compensation income would be cancelled.

For persons selected to retire, the determination of income from a pension scheme is a much more difficult task. If all those who were being studied were retired, one could just look at the 'income from superannuation' variable. However, this thesis is analysing a group of people who have not yet retired. There is no information about how much a person has set aside for their pension, but there is information about how much they are currently paying into a pension scheme. It was this variable that was used to determine the pension for which the retired person was eligible.

The superannuation scheme with the greatest number of members of any superannuation scheme in New Zealand is the recently closed Government Superannuation Fund scheme for public servants.[170] Members of this scheme make up a significant proportion of both

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[169] Unpublished DSW data.

[170] GSF nos approx 56,700 according to GSF annual report 31 March 1992, approximately 240,000 contributing to employer super schemes according to Social Policy Agency (1992).

those receiving pensions from private superannuation schemes and also those contributing to private superannuation schemes. The pension payments under this scheme are related to the salary the person receives in their final years of employment in the public service (a defined benefit scheme). Therefore, it was decided to determine income from private superannuation using the rules similar to those applicable to the Government Superannuation Fund scheme. The income calculated to have been received from private superannuation under this methodology is probably higher than would actually have been the case for many people as the Government Superannuation scheme has one of the most generous pensions of any New Zealand schemes.

The Government Superannuation Fund scheme grants an annual pension calculated using the following formula.

$$annual pension = ave last 5 yrs salary \times \left(\frac{number years employed}{40}\right) \times .67$$

The .67 factor is included because the pension is reduced by 33% and paid tax free. To simplify the calculations it was assumed that all persons retiring had completed forty years employment and their recorded salary was equivalent to the average of the last five years.

The persons eligible for pensions were those selected to retire who were recorded as making contributions to a private superannuation scheme. Under one option used, there was also a minimum level for retirement of a pension of $6500 or greater.

The Application

The aspects that effected labour force participation that were finally investigated were :-

A   the sensitivity of the results to different values for the proportion of the age group who are assumed to retire,

B   the effect of an assumption that a minimum income of $6500 would cause a different behaviour response, and

C   the effects of the increase in qualification age on the numbers receiving

sickness and invalids benefits.

The numbers receiving unemployment benefits were used as a proxy for unemployment numbers. The relationship of the rate of unemployment to the level of unearned income required as an incentive to retire was not explored even though this is probably a very important relationship. The relationship was not explored as there is a lack of data and research upon which to base any analysis.

The analysis into the effects of the increase in qualification age was based around four variables. They were:-

1   the income group of the principal income earner in the household as shown on the 1990/91 HEIS/ASSET database,

2   the ethnicity of the principal income earner,

3   the gender of the principal income earner and

4   the marital status of the principal income earner.

This combination provided matrices of up to four dimensions. However, many of the possible combinations were not able to be utilised as the numbers in many cells were too small to allow for sufficient reliability in the results. Initially it had been intended to do a similar analysis using the income of the spouse of the principal income earner. This proposal was not carried out as the cell numbers were fewer than those using the principal income earner. It was considered that the additional work involved did not produce sufficient information additional to this analysis to justify its inclusion.

Even though each dimension of the matrix included a limited range of options, the small sector of the population under investigation caused substantial problems with cell sizes being too small. The exercise graphically illustrates the problems of trying to analyze the effects of policy targeting smaller and smaller segments of the population utilising data sources that were not designed specifically for the purpose.[171]

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[171] The author in his work at the Department of Social Welfare continuously comes up against the problem that beneficiary and other low income households are underrepresented on the HEIS/ASSET databases and as yet there are no adequate methods for overcoming this problem. Most of the methods used to date have proved to be internally inconsistent.

Results

The initial step of the analysis was to investigate the income effects using just a single dimension of the matrix. The first dimension used was income group as shown in Table 6.1. As would be expected the lower income groups had a greater relative reduction in total and disposable income than the higher income groups. What is surprising at first

Table 6.1 Analysis by Income

Income Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	<$10,000		-27.18%	-27.43%	-22.61%
	10 - 19,999		-20.76%	-21.41%	-24.52%
	20 - 29,999		3.99%	3.99%	-5.06%
	>=$30,000		13.00%	17.13%	12.32%
	All		0.94%	2.87%	-1.64%
Disposable	<$10,000		-27.28%	-27.77%	-23.07%
Income	10 - 19,999		-15.87%	-16.47%	-19.73%
	20 - 29,999		15.22%	15.28%	5.54%
	>=$30,000		23.13%	27.71%	22.71%
	All		8.48%	10.53%	5.87%
Average Implied	<$10,000	$12,250	$4,350	-$4,550	-$5,400
Subsidy	10 - 19,999	$11,450	$3,900	$4,350	$3,680
	20 - 29,999	$3,950	-$6,100	-$5,900	-$5,000
	>=$30,000	-$4,600	-$15,250	-$15,100	-$14,700
	All	$4,650	-$4,500	-$4,250	-$3,950

glance is that the highest income groups had increases in total and disposable income. Further investigation showed that the increased income for higher income groups should be the case as in all the alternative assumptions used in the analysis more people are assumed to be in paid employment than in the base scheme. For the higher income

brackets, the return from paid employment would be greater than the return from National Superannuation therefore increasing total and disposable incomes.

The actual cost to the government of the assistance provided is the difference between assistance paid to the group, and the tax received from that group. For lower income groups, the assistance received is greater than the tax paid, therefore, there is an implied subsidy from the government.[172] For higher income groups, the tax paid is greater than the assistance received, but as in most cases there is some assistance received there is an implied tax of the difference.

When looking at the implied subsidy, for the lower income groups there is a decrease in the average subsidy, while for the higher income groups there is an increase in the average nett tax paid. In terms of the proportion of income foregone, the lower income groups lose far more than the higher income groups, even when adjustments are made for increased employment and earned incomes. However, the movement in average implied subsidies shows that in absolute terms there is an increasing scale of losses from the lower income groups to the higher income groups, with the lower income groups losing less than the higher income groups. This last effect arises because higher income people when in paid employment receive wages or salaries that are higher than the income they would receive under National Superannuation. The movement from an estimated average subsidy of $4650 to an estimated average nett tax of $3900 or greater (depending upon the assumed labour force participation) shows that the new qualification rules will be successful in reducing government expenditure.

Analysing the ethnic grouping results (Table 6.2) shows that there will be little movement in the total income, but considerable increase in disposable income for the others grouping. For the Māori/Pacific Island grouping, there are reductions in both the total and disposable incomes. The others grouping closely follows the movement of the total age group population as it makes up the majority of the total population. The

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[172] The implied subsidy appears as positive figures in the subsidy rows. The negative figures are implied nett taxes.

Māori/Pacific Island group follows more closely the lower income groups as it is in the lower income groups that Māori/Pacific Islanders are more heavily represented.

Table 6.2 Analysis by Ethnicity

Ethnic Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	Others		1.80%	4.68%	-0.96%
	Māori/Pacific Island		-10.10%	-20.30%	-10.32%
	All		0.94%	2.87%	-1.64%
Disposable	Others		9.40%	12.32%	6.61%
Income	Māori/Pacific Island		-3.10%	-12.04%	-3.47%
	All		8.48%	10.53%	5.87%
Average Implied	Others	$4,100	-$5,150	-$5,100	-$4,650
Subsidy	Māori/Pacific Island	$10,400	$1,650	$4,200	$2,800
	All	$4,650	-$4,500	-$4,250	-$3,950

In investigating the effects of the qualification age increase by gender (Table 6.3), the pattern of change appears similar to that of the ethnic groups. Female headed households tend to have lower incomes (ignoring bequests) than male headed households and therefore have greater losses in disposable and total incomes (males have gains because of higher returns from employment). An interesting result (not shown in the tables) is that the predominant female headed household, the 'others' ethnicity, appears to have higher total and disposable incomes than the male headed Māori/Pacific Island group household.

Table 6.3 Analysis by Gender

Gender Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	Male		5.97%	7.73%	2.52%
	Female		-9.65%	-7.38%	-10.41%
	All		0.94%	2.87%	-1.64%
Disposable	Male		14.35%	16.25%	11.08%
Income	Female		-3.57%	-1.22%	-4.81%
	All		8.48%	10.53%	5.87%
Average Implied	Male	$2,750	-$6,800	-$6,600	-$5,750
Subsidy	Female	$7,900	-$650	-$300	-$900
	All	$4,650	-$4,500	-$4,250	-$3,950

The analysis by marital status (Table 6.4) shows that households headed by single persons lose a higher proportion of disposable and total income than households headed by married persons. This is understandable as households of married persons have higher average household incomes than households of single persons. Further, there is a greater proportion of women (who have lower average incomes than men) in the single person category than the proportion of men in that category. The analysis further shows that single person households appear to bear a greater nett loss of subsidy than married person households. This is different from the income, gender and ethnic breakdowns where the lower incomes have a lower loss of subsidy than those on higher incomes.

When the analyses were attempted on two dimensional matrices, a problem immediately arose.[173] The cell numbers, when using ethnic groupings, became too small for the results to be reliable. Therefore no analyses using ethnic grouping were carried out

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[173] The tables for the two dimensional analyses have been included in Appendix III.

beyond the first dimension. However, when analysing by the other variables, some more

Table 6.4 Analysis by Marital Status

Marital Status		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	single		-13.88%	-14.99%	-25.79%
	married		5.43%	8.28%	5.67%
	All		0.94%	2.87%	-1.64%
Disposable	single		-7.81%	-9.00%	-19.52%
Income	married		13.57%	16.64%	13.81%
	All		8.48%	10.53%	5.87%
Average Implied	single	$10,250	-$100	$200	$1,050
Subsidy	married	$1,750	-$6,850	-$6,600	-$6,550
	All	$4,650	-$4,500	-$4,250	-$3,950

interesting results came out. The group with the greatest reduction in disposable and total income was the lowest male income group (table A3.1). This is surprising as females, on average, have lower incomes than males and it would be expected that low income females would have the greater reduction in incomes. However, the lowest income group includes quite a number of negative incomes, mostly recorded by self-employed people. As the self-employed are predominantly male, the majority of the negative incomes have a reducing effect on the lowest male income group.

The group with the second greatest reduction in total and disposable income is the female $10,000 - 19,999 income group (table A3.2). This, again, is an interesting finding and no apparent reason for it is immediately apparent. It is possible that it is related to females having a much narrower income distribution than men, with the majority of them being in this income band. The groups to make the greatest gains in disposable and total incomes are, as would be expected, the higher income males. In

most income groups the implied subsidy/implied tax for males and females is similar. The exception is the female $10,000 - 19999 income group. This group has a very much greater implied subsidy than any other group. The result suggests that under the current rules most female headed households in this group (and a high proportion of all sixty - sixty four age group female headed households) have National Superannuation and other benefits as their only income. If that is the case it could provide another explanation as to why this group had such a drop in disposable and total incomes. The highest male income group has a higher implied tax under the high participation rate options than does the similar female group. This is because of the higher average incomes of the male group.

It was not possible to do a detailed analysis of marital status/income group as the low and high income groups for the single status did not have sufficient numbers to provide reliable data (tables A3.3 and A3.4). Again the married low income group had substantial reductions in both disposable and total incomes, while the high income married group had a substantial increase. The surprising results are that the two married middle income groups had very little change in disposable income, and the married $10,000 - 19,999 income group had the smallest change in the implied subsidy of any of the combinations analyzed. Another surprising result was the very high decrease in disposable and total income of the single $10,000 - 19,999 income group, along with the high gains of the $20,000 - 29,999 income group. Decreases of income for the single $10,000 - 19,999 income group probably reflect the high number of single people currently with National Superannuation as their only form of income. The decrease in incomes for the $10,000 - 19,999 income group may also tie up with the finding the females in the $10,000 - 19,999 income group have substantial decreases in incomes. It is probable that there are a much higher proportion of females in that group than males because of the higher mortality and the higher average income of males. Low cell numbers meant that it was not possible to confirm this suggestion.

The only other combination with sufficient number in all cells is the two dimensional gender by marital status matrix (tables A3.5 and A3.6). The biggest reductions in disposable incomes were for single females, while the biggest winners were for married

females closely followed by married males. The single females under all options had implied subsidies. Married males under the base scheme receive a nominal subsidy, but under the alternative assumptions pay the greatest implied tax.

Conclusions

The most significant conclusion that comes out of the analysis carried out for this thesis is that the increase in qualification age will have a significant impact on government expenditure and revenue. The analysis suggests that at 1995/96 rates and population, the age sixty five qualification age option would produce a nett expenditure of approximately $500 million less than the age sixty option, with an increase in nett tax of over $400 million. The increase in tax would be dependant upon the rate of paid employment for the age group. The $500 million reduction in expenditure is equivalent to about 9% of the gross National Superannuation expenditure for 1991/2, the last year before the gradual change was introduced. It is not known what proportion of nett National Superannuation expenditure it would be because detailed tax and surcharge information for national superannuitants is not published. Altogether, the reduced expenditure and increased tax is equivalent to around 15% of current gross National Superannuation expenditure.

A second conclusion is that the National Superannuation scheme as operating prior to April 1992 was progressive in its application. That conclusion is implied by the regressive effects of the removal of National Superannuation. That is, when National Superannuation was universally removed from a sector, those on lower incomes suffered a greater relative reduction in both total and disposable incomes. To a large extent, this is because the absolute value of the reductions were similar for all sectors of the population. Another reason is that higher income people when remaining in paid employment can receive salaries that are higher than National Superannuation rates.

Consistent with the effects being greater on lower income households, Māori and Pacific Island headed households were relatively more effected than the rest of the population, and female headed households more than male headed households. This was because

of the relatively lower household incomes received by those groups. In a similar way, single households are also more disadvantaged by the changes than are married households, again because of income levels.

An interesting anomaly that comes out is the effect of the income group on males, particularly for non Māori/Pacific Island males. The low income groups include some substantial negative incomes. The negative incomes are incurred by self employed who are predominantly males who are of other than Māori/Pacific Island ethnicity. This runs against the norm of Māori/Pacific Island people having on average lower incomes than others.

The use of a microsimulation model has allowed the effect of the change in qualification age for National Superannuation on various sectors of the population to be analyzed. The range of results under different assumptions of labour force participation demonstrates that the income effects of the age change are very sensitive to the assumptions used. More than 50% of the benefit to be gained from the change arises from the removal of National Superannuation. However, the gains from increased taxation are dependant upon the assumptions relating to labour force participation for the 60 - 64 age group, an area lacking in substantive published research.

Chapter six has described an analysis that demonstrated the usefulness of microsimulation modelling in social policy analysis. It has been done by illustrating the income impacts of the change in the National Superannuation qualification age on small sectors of the population. A discussion on the usefulness of the model is contained in chapter seven along with recommendations for the model's enhancement.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The objective of this thesis has been to demonstrate some of the shortcomings of traditional methods of social policy data analysis, introduce an alternative methodology called microsimulation (or microanalysis) and then to demonstrate how microsimulation models can assist in improving social policy analysis. Microsimulation modelling is a technique not widely known or used in New Zealand, but it is a technique that has been and is being used in the analysis of significant pieces of social policy.[174] Thus it is timely that the technique should be introduced and discussed. It should be noted that a microsimulation model is not an analysis model in itself. A microsimulation model conditions data according to sets of rules. The updated data is then analyzed by other computer programs to discover the effects of implementing the rules.

While the topic of microsimulation could have been covered in a purely descriptive manner, the actual construction of a usable microsimulation model can considerably increase the knowledge and skills gained during the project. A major component of the project, therefore, was to build a microsimulation model and utilise that model in the analysis of a recent change in social policy: in this case, the increase in the qualification age for National Superannuation.

The decision to build a microsimulation model rather than analyze an existing model was made as it was considered that the lessons to be learned from constructing a microsimulation model from scratch would give a much clearer picture of the structure

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[174] Prebble and Rebstock (1992); The Task Force on Private Provision of Private Provision of Retirement Income (1992b).

and requirements of this type of model. It was also considered that this approach would give a better understanding of the strengths and weaknesses of microsimulation models. Further, while researching microsimulation models the author was not able to find in New Zealand any papers that described or discussed the structure of this type of model or how the various algorithms are implemented in practice, thus giving additional confirmation of the need to build a model from the ground up. As a result of constructing the model a number of important implications relating to microsimulation models were uncovered some of which need to be addressed before microsimulation models can be effectively utilised to their full capabilities.

There are two main elements to a microsimulation model. These are the database that represents the population of interest and the relationships that represent the policy rules and the responses of the individuals in the population to those policy rules. A further item of importance when constructing a microsimulation model is the validation of the model. This consists of two steps, the validation of each individual relationship and the validation of the model as a whole to ensure that the interactions of the individual relationships produce valid results.

Microsimulation modelling is not based around deeply complex mathematical models with a background of many years of discussion providing a strong theoretical basis as is found with most of the techniques used in macroeconomic or other aggregated models. In practice, microsimulation models are based upon the basic principle of applying much simpler processes to individual records and in most cases individual variables on those records. However, it must be admitted that although microsimulation models use simple relationships which in most cases apply to individual variables, there can be large numbers of variables. each of which is usually assumed to act independently. The interaction of large numbers of variables and large numbers of records is implicitly complex and these interactions are not explicitly explained in most models. Because of this, some people may look on microsimulation models as a 'black box' approach. The complexity implicit in the outcome of the interaction of a large number of simple relationships has also meant that there is not yet a theoretical basis

to determine the reliability of the results of an analysis arising from a microsimulation model.

The complexity of the interactions between the processes portrayed by the relationships raises the question of whether a model should include all possible relationships or just a subset of them. If education policy only was modelled, would the estimated impact on the targeted population be the same as the impact estimated using a model that included social welfare policy as well? If education and social welfare policies were to be modelled using two different subset models, would the actual outcome be predicted correctly? It is only by thorough validation that questions such as these can be answered.

There were then, quite a number of valuable lessons to be learned from the development of the microsimulation model. One of the first lessons learnt was that to develop a good microsimulation model requires the investment of a large amount of time and effort. The effort needed is often not just for the construction of the model, but may also need to be put into the development of suitable databases and ancillary models for forecasting various parameters or for the production of aging variables such as transitional probabilities of labour force participation. The model developed for this project required more than six person months of hard work over a period of some two years with more time being required for data gathering and analysis. More complex models can take several person years of continuous work.[175]

The amount of resources required to construct a complex microsimulation model raises questions about how many models New Zealand can afford to operate and who should own and operate them. In the current economic climate, few government departments could spare the staff or expenditure to develop a full scale model themselves. However, if the government departments were to co-operate in developing the more complex models, would genuinely contestable advice be produced and how would the independent policy analysts be effected?

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[175] Lewis and Michel (1990).

Another set of lessons learnt came in the area of data and databases. The data used by microsimulation models falls into two types, the micro data that describe the individuals to be analyzed, and the macro data that will be used to change the environment in which the analysis subjects operate. The database of micro data upon which a microsimulation model is based can have a major impact upon the quality of the output from a microsimulation model. The micro data used in social policy analysis are usually produced from a sample survey. In New Zealand, the most comprehensive general sample survey is the Household Expenditure and Income Survey (HEIS) compiled by the New Zealand Department of Statistics. The model developed for this thesis is based upon a limited set of variables from the HEIS/ASSET database derived from the HEIS survey. New Zealand is fortunate in that it has an annual survey from which the data for the HEIS/ASSET database is obtained. The HEIS survey has thus provided a series of databases that are able to provide a base for both historic and forecasting analysis using microsimulation models. Although the survey is the most comprehensive sample survey regularly carried out in New Zealand, there are a number of aspects of it that create difficulties for extending the usefulness of microsimulation models.

Because of concern about confidentiality, access to the unit record data on the HEIS database has been restricted to government departments and those employed by or contracted to government departments. This has meant that the most suitable source of data of the type required for microsimulation modelling has not been available to independent analysts. This has limited the effectiveness of social policy analysis and also limited the number of models developed. Statistics New Zealand is reviewing its policy on access to the HEIS database and is considering developing a 'data laboratory' where research can be carried out in an environment such that Statistics can ensure confidentiality will be retained.

Another shortcoming with the HEIS database is the size of the sample. The sample surveyed is less than 10,000 and while adequate for general analyses of the total population, it is becoming inadequate for analyses of tightly targeted social welfare programmes. Social welfare programmes target small groups of people. In a survey with fewer than 10,000 respondents, the number representing the population targeted by

some social welfare programmes can be quite small meaning that outliers, if surveyed, can distort the results. The groups of people targeted by social welfare programmes tend to be reluctant to participate in sample surveys and therefore tend to be under represented on the database as well.

A third problem with the HEIS database is the limited range of data held. While income and expenditure data is reasonably adequately surveyed, there is very little data on wealth and assets. Neither is there any flow data indicating movement between states, for instance movements into and out of employment or sickness, to name but two examples.

An area that will hinder the development and implementation of microsimulation models for some time yet is the area of forecasted data. Microsimulation models, both static and dynamic rely heavily upon forecasts. Static models require forecasts of expected population distributions under such categories as age, gender, ethnicity, marital status, occupation, education as a multidimensional matrix. However, it is difficult to obtain forecasts for variables other than age, gender and household status. Dynamic models, to operate effectively, require forecasts of transitional probabilities of any variable of interest. The transitional probabilities required do not just cover the probability of being in a particular state, but the probability of entering and exiting that state as well. At present the only transitional probability series published is for the probability of being in a particular labour force participation state given a previous state, although a set of transitional probabilities have been produced for income quintile transition. Both these series are for the aggregated population.

The development of the model and the analysis carried out for this thesis also highlighted the shortage of detailed forecasts of economic variables. While a number of economic agencies forecast out one or two years, it is difficult to obtain forecasts for further out. For policy developments to be effectively analyzed, estimates should not be done just for the immediate period, but should also be done for five to ten years out when behavioral changes will have taken place.

The lack of appropriate, accurate statistics is an endemic problem in New Zealand. Internationally, a lack of data often constrains what can be done with microsimulation analysis. However, in New Zealand the problem is very much greater and there is nothing to suggest that the overall situation will improve in the future. Synthetic databases constructed from a wide range of data may be the only realistic answer to many of the database problems.

As mentioned earlier, the core of a microsimulation model is the set of relationships that are modelled. While it is possible to develop and verify algorithms for past relationships, to forecast the impacts of policy changes requires making assumptions about how the population will react to those policy changes. The process of adjusting for the future conditions and responses is known as aging the database. There are three commonly used methods of aging a database, each suited to a different type of process and requiring a different type of data. For the more sophisticated dynamic aging, transitional probabilities are required. However, often this type of data is not available and the expected probability distribution is used instead, leading to inaccurate simulation of responses for outlying sectors of the population. The aging[176] of economic variables such as the income variables is done individually implicitly assuming that these variables operate independently. This may not be a totally correct assumption, but unless the user knows of the structure of the model the point may not be clear.

The assumptions incorporated in the relationships and processes must be carefully and clearly thought out. The implementation of inadequate or inapplicable assumptions can make the results meaningless. An example of an inadequate assumption occurs in the analyses carried out by Prebble and others[177] using TAXMOD.[178] The analyses that were carried out were based around the output of a labour force participation model detailed in the publication. This model assumed that labour force participation was only supply driven over the period used to derive the function. However, over that period there was a substantial reduction in demand for labour with the number of employed

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[176] Or uprating as King calls it. King, A. (1992).

[177] All of whom were employed by The Treasury at the time. Prebble and Rebstock (1992).

[178] Prebble and Rebstock (1992).

decreasing while the number of unemployed wanting work was increasing.[179] Thus the use of supply side assumptions alone in the modelling would mean that in these analyses the expected outcomes would be incorrect.

It is of major concern that although there are numerous shortcomings in both the traditional methods of analysing policy developments and in the data available for microsimulation models, analyses are being done and policies are being developed based upon analyses which may be inadequate because of the lack of suitable data or because of the use of inappropriate tools. While tools such as microsimulation can add significantly to the depth of social policy analysis, the tools need to be understood and used in applicable ways with qualifications put upon the results indicating the limitations of the models, data and assumptions used.

Finally, more lessons were to be learnt in writing the computer programs that implemented the model. For a model to run efficiently and fast, it should be written in a compiled language. The language used for the model demonstrated in this thesis, while it is easy to use for analyses of many types, has limitations when used for the types of data manipulation required for microsimulation. One particular problem was with the difficulties that arose when trying to process both the individual records of a married couple at the same time. Some computer languages do not handle this problem with ease. Future models should be developed using more flexible and extensive compiled languages.

A module that would greatly increase the flexibility of the model would be a 'user's interface' that would allow users of the model to specify those variables that they are interested in and wish to manipulate. It would also simplify the input of alternative values for many or all of the exogenous variables. This module, carefully designed, would provide the opportunity for detailed analysis of a wide range of policy options.

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[179] See table 2.7.

A more flexible model could also have a controlling program that selects and combines modules specific to the tasks in hand. This would allow for an extensive flexibility while minimising the running time by allowing the exclusion of algorithms not necessary for the specific analysis being carried out.

Analysts wishing to use microsimulation models need to assess the suitability of the model by asking themselves questions such as:-

Has the model been reliably validated?

Is the data suitable for the application to be simulated?

Are the base assumptions built into the model clear?

Are the assumptions applicable to the application?

Does the model allow the assumptions to be varied?

Are the aging methodologies suitable for the application?

Will the data allow the impacts on the target group to be reliably identified and quantified?

If new modules need to be written for the application, how will they be validated?

Of more particular concern to the analysis carried out for this thesis is that there is no detailed New Zealand based research into why people retire. Neither is there any detailed research into what incentives to retire are provided by assets and unearned income or what part health plays in labour force participation decisions.

The model developed for this thesis is a prototype, that is it is a bare bones model of how a microsimulation model should look. Thus, there are many holes and weaknesses with the model. However, the model has shown how a microsimulation model could be used, and the benefits to be obtained from using one. The construction of the model has led to a greater understanding of microsimulation models and their strengths and weaknesses. Nevertheless, the model has been successful in what it was developed for.

Some of the social policy developments that were discussed in chapter two could have benefited from the application of microsimulation models in their development. While

microsimulation models were not around in the 1890s and 1930s, they may not have made much difference anyway. This is because the main problem for the Old Age Pensions Act was lack of data, and in the 1930s adequate resources seem to have allowed a good job to be done.

However, a social policy development that could have benefitted considerably from the application of microsimulation is the National Superannuation Scheme. This scheme was put together by a small group of politicians and does not seem to have been submitted to a rigorous analysis. There do not appear to be any long term forecasts of numbers or expenditure associated with this scheme, as the only publically available estimate is an estimate of the first full year numbers and expenditure. Microsimulation, although not in use in New Zealand at the time, was starting to be used quite extensively in other countries. If used for the analysis of the National Superannuation Scheme, microsimulation could have demonstrated the impact of the changing age profile of the population and of the movement towards earlier retirement that was starting to occur.

The substantial changes in social and economic policy that have taken place since the election of the Fourth Labour Government in 1984 are policies that should have been submitted to detailed analysis using microsimulation models. If critical detailed public analysis had been carried out prior to the implementation of the policy changes, many of the 'unanticipated' outcomes would have been recognised at the time the policies were developed. While microsimulation models were only in their infancy in New Zealand at the start of the period (only being used for tax analysis), in more recent years they have quite often been used for a wider range of policy analysis.

Wider knowledge of microsimulation models along with a greater understanding of their strengths and weaknesses could considerably improve the quality and depth of analysis of many social and economic policies. But the models need to be used with care and with an understanding of the limitations that are imposed on them by the available data and the assumptions upon which the models are based.

Recommendations for Further Development

The first recommendation is that independent social and economic policy research groups become more active in contesting the policy advice provided by government departments. In order to do this, independent researchers need to have access to policy analysis tools of a similar sophistication to those used by government departments. As many of the major policy developments now have their cost/benefits and impacts estimated through microsimulation models, independent research groups should start developing microsimulation models of a similar type. Moreover, microsimulation models would also allow for examination of the distributional consequences of various policy options. This should be done in order to test the assumptions upon which the policy developments were made.

The model developed for this thesis can show the way, but for detailed targeted social policy of the type implemented in recent years, far more sophisticated and complex models will need to be developed. Developing models will require the investment of considerable time and effort, but the result should be much better social policy and more informed debate. It is in the area of dynamic microsimulation models that the non government research groups have an opportunity to get ahead.

A second recommendation for future development is that non government social policy analysts and research groups should put pressure on the Government and the Department of Statistics to allow access to unit record data. An alternative to this would be for these groups to develop large scale synthetic databases suitable for social policy analysis. Without access to this type of data, microsimulation models cannot reach their full potential. Furthermore access to data makes policy development a more open process and allows the various interested groups to contribute to policy development in a more informed fashion.

Other areas where activity would assist in upgrading social policy advice include research into the determinants of such key variables as labour force participation, employment and income levels. General research providing transitional probability data

of a type suitable for dynamic models is also necessary before these models can be widely used. More comprehensive forecasts of economic and demographic variables are also necessary before the full benefits of microsimulation modelling can come out.

In the area of databases, research needs to be carried out into how to strengthen the necessary databases. Until the law is changed, access to Statistics New Zealand databases by independent analysts will be limited. To overcome this limitation, much work needs to be done in creating synthetic databases from the numerous publically available data.

The limitations on the data available coupled with the use of inapplicable assumptions as mentioned above, puts severe doubt on the viability of the results of some of the analyses that have been carried out using the current microsimulation models. In several other countries, independent research groups operate major microsimulation models and publically analyses and critique social and economic policy programmes. In New Zealand this is an area that is ripe for filling by an enterprising research group willing to invest considerable time and other resources into the project. If more and better quality data becomes available and non government research groups are able to analyses in detail the impacts of social policy developments, there would an improvement in the quality of social policy developments. Detailed analysis of proposed social policy will expose inconsistencies and the possibility of repeating the 'unanticipated outcomes' of many of the recent social policy implementations will be reduced.

The model as it exists is a prototype model and therefore there is considerable room for development of the model. A module that would greatly increase the flexibility of the model would be a 'user's interface' that would allow users of the model to specify those variables that they are interested in and wish to manipulate. It would also simplify the input of alternative values for many or all of the exogenous variables. This module, carefully designed, would provide the opportunity for detailed analysis of a wide range of policy options.

A more flexible model could also have a controlling program that selects and combines modules specific to the tasks in hand. This would allow for an extensive flexibility while minimising the running time by allowing the exclusion of algorithms not necessary for the specific analysis being carried out.

For all the limitations mentioned, the model did demonstrate the usefulness of microsimulation models. The model was able to do what few other social policy analysis tools available in New Zealand can do, to estimate possible impacts of policy proposals on a small sector of the population. In so doing the model indicated that microsimulation models could be a major tool in improving the quality of social policy development and analysis in New Zealand.

APPENDIX I: LIST OF VARIABLES

A list of variables used in the model along with the parameters (indicators) used to adjust them is as follows:-

Demographic Variables

sequential record number	indicates what quarter data collected
AGE	age of person
AGE1, AGE2, AGE3, AGE4	number of dependent children in specific age groups
BENTYPE	indicates which Social Welfare benefit received
ETHOR	ethnic origin of person, aggregated to 2 for Māori/Pacific Island and 1 for Others
FBKIDS	number of dependent children
GROUP	identifies family group within household
HHLDTYPE	indicates make up of household
MS	marital status of person, aggregated to 2 for married and 1 for others
PRIN	principal income earner
SEX	gender of person
SPSE	principal income earner with spouse present
SP	spouse of principal income earner
WEIGHT	number of persons of this demographic description in total population

Economic Variables

OCCUPATN	occupation of person
HOURSPW	number of hours per week in paid employment
FTWKS	number of weeks in past year in full time paid employment

Income related variables	*Adjustment Indicator & source*
ACCOMPACC	compensation - use wage movement *
BURSRY	bursary, set arbitrarily - use CPI
DRAWINGS	drawings - not used
FAMBEN	family benefit, should be zero - not used
GMFI	not used
JOBSUPER	job superannuation related to salary - adjust by wage movement *
MAINTNCE	maintenance, now % of income - adjust by wage movement *
NATSUP	National Superannuation gross weekly rate - set arbitrarily by Govt but usually CPI

REDUNDCY	redundancy, related to wage/salary - use wage movement *
SUPERANN	income from employment, not usually inflation proof - not adjusted
SEAGRIC	selfemployed agriculture - use wage movement *
SEOTHER	selfemployed other sectors - use wage movement *
TXBLBEN	taxable benefits, standard rates - use CPI
UNEMPBEN	unemployment benefit, standard rates - use CPI
WAGSAL	wage/salary income quintile movement - devolved from average wage movement *

Variables created in model

ABATE	abatement amount, amount gross SW benefit is to be abated
AGEGROUP	agegroup of person, five year groups
ASSINC	income assessable for tax(wagsal+selfemp+ natsup+othinc+unempben+txblben+bursry)
BENABATE	benefit abatement, calculated income for benefit abatement purposes
DISINC	disposable income(totinc-tax-surch)
ESTSUP	estimated employment superannuation
FSUPINC	family support - set arbitrarily by Govt - assume no change
INCGROUP	income group, four income groups
OTHINC	other non regular incomeother income index * (assinc-wagsal-selfemp-natsup-unempben-txblben-bursry)
OTHREG	other regular income - all groups CPI * (totinc-assinc-swbenft-bursry)
SELFEMP	total income from self employment (seagric+seother)
SURCH	calculated national super surcharge
SWBENFT	social welfare benefits - taxable benefits+unemp
TAX	income tax due
TOTINC	total income (assinc+othreg+jobsup+estsup+maintnce)

Other economic variables used by the model include:-

Variable

wage/salary income quintiles	estimated from published income data
CPI	Consumers Price Index*

obtained from NZIER Quarterly Predictions September 1992

The above tables list the economic variables and sources of the indicators that will be used to adjust them. In most cases the indicators are straight forward as NZIER has published a forecast of an indicator (usually an index) that directly applies to the

variable. In some cases there is either no directly applicable indicator, or one in a form different to that required for this analysis. In this situation, either the best available forecast is used or the variables are left constant.

The adjustment mechanisms for the demographic variables are described in the text.

Appendix II: Regression Models

Regression Models used for Calculating Numbers on Benefit and in the Labour Force.

The following data and models were used for calculating the estimated proportions of the population on sickness, invalids and unemployment benefits. For those series that were not just linear or quadratic, only the end part of the series that was linear or quadratic was used. The modelling was carried out in this way in orrder to make use of simpler processes. It is considered that the results were quite satisfactory for the analysis carried out in this thesis.

These regressions were carried out using the SAS Proc Forecast procedure under the EXPO option.

For Sickness Benefit.

Age Group	Data	Forecast	Statistics	
20-24	0.91		N	4
25-29	0.97		NRESID	4
30-34	0.84		DF	1
35-39	0.80		WEIGHT	0.05
40-44	0.79	0.78	S1	-30.74
45-49	1.09	1.12	S2	-91.92
50-54	1.41	1.38	S3	-181.98
55-59	1.55	1.56	SIGMA	0.0482409
60-64		1.66	CONSTANT	1.5599991
65-69		1.68	LINEAR	0.1399999
			QUAD	-0.08
			SST	0.3464
Note: data for under age 39 not used.			SSE	0.0023272
			MSE	0.0023272
			RMSE	0.0482409
			MAPE	1.8148036
			MPE	-0.00636
			MAE	0.0215781
			ME	-3.125E-6
			RSQUARE	0.9932818

The regression for Sickness Benefit gave quite a good fit. However, the number of points used (4) was probably too small even though the forecast of interest was just one extra point. (See figure 6.1 for a graph of the data plus forecast)

For Invalids Benefit.

Age Group	Data	Forecast	Statistics	
20-24	0.82		N	5
25-29	1.17		NRESID	5
30-34	1.28		DF	2
35-39	1.32	1.32	WEIGHT	0.6

40-44	1.37	1.36	S1	2.8759057
45-49	1.72	1.74	S2	2.4940794
50-54	2.40	2.39	S3	2.2541899
55-59	3.40	3.39	SIGMA	0.0146896
60-64		4.72	CONSTANT	3.399669
65-69		6.35	LINEAR	1.158229
			QUAD	0.3193579
			SST	3.04888
Note: data for under age 35 not used.			SSE	0.0004316
			MSE	0.0002158
			RMSE	0.0146896
			MAPE	0.459199
			MPE	0.0168915
			MAE	0.0080242
			ME	0.0007282
			RSQUARE	0.9998585

The regression for Invalids Benefit used one more point than that for the Sickness Benefit. The trend in the data is much smoother than that of the Sickness Benefit and therefore the regression has a much closer fit. The general trend in the data matches that of surveys of health status.[180] (See Figure 6.2 for a graph of the data plus forecast)

For Unemployment Benefit.

Age Group	Data	Forecast	Statistics	
20-24	11.16	11.53	N	8
25-29	9.67	8.47	NRESID	8
30-34	7.02	8.05	DF	5
35-39	5.64	5.70	WEIGHT	0.5
40-44	4.64	4.70	S1	5.5610372
45-49	4.80	4.20	S2	5.7793864
50-54	4.87	5.17	S3	6.521633
55-59	5.85	5.77	SIGMA	0.7933943
60-64		7.46	CONSTANT	5.9271159
65-69		9.58	LINEAR	1.2427203
			QUAD	0.5844278
			SST	41.700688
			SSE	3.1473725
			MSE	0.6294745
			RMSE	0.7933943
			MAPE	6.8575817
			MPE	0.1716902
			MAE	0.4781685
			ME	0.0195468
			RSQUARE	0.9245247

Unemployment Benefit was one series where the full data set was able to be used. Although the fit appears to be not quite as good as that for Sickness and Invalids, the

[180] Age Concern (1990).

use of the longer series suggests that the results may be more reliable. (See Figure 6.5 for a graph of the data plus forecast)

For Labour Force Participation - male.

Age Group	Data	Forecast	Statistics	
20-24	86.60		N	4
25-29	92.90		NRESID	4
30-34	93.50		DF	1
35-39	94.20		WEIGHT	0.1
40-44	94.40	94.09	S1	-278.75
45-49	93.70	94.72	S2	-1090.01
50-54	90.50	89.37	S3	-2354.87
55-59	78.60	79.02	SIGMA	1.6156473
60-64		62.65	CONSTANT	78.909606
65-69		40.79	LINEAR	-13.46007
			QUAD	-5.600003
			SST	161.3
Note: data for under age 39 not used.			SSE	2.6103163
			MSE	2.6103163
			RMSE	1.6156473
			MAPE	0.8035511
			MPE	-0.012505
			MAE	0.723075
			ME	-0.000775
			RSQUARE	0.983817

The male labour force participation data does not show a consistent trend, therefore only the last four data points were used in the regression.

For Labour Force Participation - female.

Age Group	Data	Forecast	Statistics	
20-24	71.80		N	5
25-29	62.60		NRESID	5
30-34	62.30		DF	2
35-39	72.80	72.07	WEIGHT	0.05
40-44	78.50	79.91	S1	-2993.334
45-49	77.50	77.92	S2	-9467.231
50-54	68.70	66.55	S3	-19375.79
55-59	45.00	46.06	SIGMA	2.051381
60-64		15.58	CONSTANT	45.905577
65-69			LINEAR	-25.56858
			QUAD	-9.514286
			SST	751.78
Note: data for under age 35 not used.			SSE	8.4163281
			MSE	4.2081641
			RMSE	2.051381
			MAPE	1.7625599
			MPE	-0.109568
			MAE	101525434

ME   -0.000396
RSQUARE   0.9888048

Although the fit was quite good, the forecast of 15.58% was not used as it seemed inconsistent when compared with the SB and IB forecasts. An estimate of 20% was used instead as this figure seemed more reasonable.

APPENDIX III: MULTI-DIMENSIONAL TABLES

Table A3.1 Analysis - Male by Income Group

Male by Income Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	<$10,000		-32.78%	-35.69%	-26.44%
	10 - 19,999		-14.40%	-14.47%	-17.80%
	20 - 29,999		4.52%	3.82%	0.95%
	>=$30,000		18.35%	22.19%	13.36%
	All		0.94%	2.87%	-1.64%
Disposable	<$10,000		-33.70%	-36.80%	-27.79%
Income	10 - 19,999		-7.67%	-7.74%	-11.32%
	20 - 29,999		18.53%	17.93%	14.58%
	>=$30,000		28.27%	32.49%	23.64%
	All		8.48%	10.53%	5.87%
Average Implied	<$10,000	$12,150	$3,900	$3,250	$5,650
Subsidy	10 - 19,999	$7,800	$1,250	$1,800	$1,200
	20 - 29,999	$4,100	-$5,500	$5,550	-$4,850
	>=$30,000	-$4,800	-$16,600	-$16,050	-$14,950
	All	$4,650	-$4500	-$4250	-$3950

Table A3.2 Analysis - Female by Income Group

Female by Income Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	<$10,000		-16.48%	-11.96%	-15.29%
	10 - 19,999		-29.19%	-30.60%	-33.44%
	20 - 29,999		3.25%	4.23%	-13.47%
	>=$30,000		-4.27%	0.77%	8.96%
	All		0.94%	2.87%	-1.64%
Disposable	<$10,000		-15.33%	-10.97%	-14.29%
Income	10 - 19,999		-26.22%	-27.49%	-30.36%
	20 - 29,999		10.87%	11.79%	-6.32%
	>=$30,000		5.90%	11.67%	19.69%
	All		8.48%	10.53%	-5.87%
Average Implied	<$10,000	$12,350	$4,900	$6,400	$5,050
Subsidy	10 - 19,999	$15,450	$6,850	$7,150	$6,350
	20 - 29,999	$3,700	-$7,050	-$6,450	-$5,200
	>=$30,000	-$4,350	-$11,150	-$12,150	-$13,850
	All	$4,650	-$4500	-$4250	-$3950

Table A3.3 Analysis - Married by Income Group

Married by Income Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	<$10,000		-19.82%	-19.56%	-16.72%
	10 - 19,999		-2.45%	-1.32%	-5.60%
	20 - 29,999		-3.38%	-2.58%	-4.33%
	>=$30,000		14.06%	18.37%	14.92%
	All		0.94%	2.87%	-1.64%
Disposable	<$10,000		-19.70%	-19.48%	-17.16%
Income	10 - 19,999		2.14%	3.26%	-1.09%
	20 - 29,999		8.34%	9.31%	7.05%
	>=$30,000		23.93%	28.66%	25.00%
	All		8.48%	10.53%	5.87%
Average Implied	<$10,000	$11,300	$4,900	$4.950	$5,900
Subsidy	10 - 19,999	$7,950	$2,700	$3,450	$2,350
	20 - 29,999	$2,250	-$6,500	-$6,400	-$6,150
	>=$30,000	-$4,800	-$15,350	-$15,150	-$15,200
	All	$4,650	-$4500	-$4250	-$3950

Table A3.4 Analysis - Single by Income Group

Single by Income Group		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	<$10,000				
	10 - 19,999		-36.33%	-38.49%	-40.61%
	20 - 29,999		24.03%	21.89%	-7.03%
	>=$30,000				
	All		0.94%	2.87%	-1.64%
Disposable	<$10,000				
Income	10 - 19,999		-31.04%	-33.09%	-35.45%
	20 - 29,999		34.56%	30.32%	1.73%
	>=$30,000				
	All		8.48%	10.53%	5.87%
Average Implied	<$10,000				..
Subsidy	10 - 19,999	$13,700	$4,700	$4,950	$4,550
	20 - 29,999	$7,250	-$5,350	-$4,950	-$2,700
	>=$30,000				
	All	$4,650	-$4500	-$4250	-$3950

Table A3.5 Analysis - Male by Marital Status

Male by Marital Status		% or $ Change from Base			
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	single		-9.51%	-11.39%	-19.78%
	married		7.91%	8.48%	3.92%
	All		0.94%	2.87%	-1.64%
Disposable	single		-2.54%	-4.54%	-11.83%
Income	married		16.60%	17.21%	12.52%
	All		8.48%	10.53%	5.87%
Average Implied	single	$8,350	-$1,950	-$1,350	$100
Subsidy	married	$350	-$8,350	-$8,300	-$7,650
	All	$4,650	-$4500	-$4250	-$3950

Table A3.6 Analysis - Female by Marital Status

Female by Marital Status			% or $ Change from Base		
	Option	Base $	9% m retire 11% f retire $6500 min super	9% m retire 11% f retire $0 min super	30.8% m retire 73.4% f retire $0 min super
Total Income	single		-20.06%	-14.27%	-27.48%
	married		20.67%	16.45%	20.70%
	All		0.94%	2.87%	-1.64%
Disposable	single		-15.17%	-9.76%	-23.02%
Income	married		23.67%	20.29%	23.78%
	All		8.48%	10.53%	5.87%
Average Implied	single	$12,100	$1,550	$1,450	$1,800
Subsidy	married	$6,700	-$3,000	-$2,150	-$3,700
	All	$4,650	-$4500	-$4250	-$3950

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