LIFETIME INCOME DISTRIBUTION AND REDISTRIBUTION IN AUSTRALIA: APPLICATIONS OF A DYNAMIC COHORT MICROSIMULATION MODEL

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Abstract

The first part of the thesis describes the construction of Australia's first dynamic cohort microsimulation model. The model consists of a pseudo-cohort of 4000 males and females, who are aged from birth to death, with the processes of mortality, education, marriage, divorce, fertility, labour force participation, the receipt of earnings and other income, the receipt of social security and education transfers and the payment of income tax being simulated for every individual in the model for every year of life.

The second part of the thesis describes some of the results which can be derived from the model. These include the differences in lifetime income by lifetime education and family status, the distribution of lifetime income, the difference between the lifetime and annual distributions of income, the lifetime and annual incidence of taxes and transfers, and the direction and extent of intra and inter-personal redistribution of income over the lifecycle due to government transfers and income taxes.

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Dedication

To the memory of my mother and of my father

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Analyses of cross-section samples of the populations of industrialised countries at a single point in time have typically found the *distribution of income* to be highly unequal. For example, in 1984 the top 10 per cent of Australian households received more than 13 times as much pre-tax income as the bottom 10 per cent (ABS, 1987b:22), while in 1978-79 the top 10 per cent of all income units received more than one-quarter of total income and the bottom decile received only 1.7 per cent of total income (Ingles, 1981:30). Broadly comparable inequalities have also been found in OECD and other industrialised countries (Stark,1977; Sawyer,1976).

Similarly, the numerous studies of the *income redistribution* achieved by various government taxes and expenditures, also based upon cross-section data, have generally concluded that the net effect of such programs is to succesfully redistribute income from rich to poor (Saunders, 1984). While the studies range from those which simply allocate personal income taxes and cash transfers [(1)], to those which also embrace other taxes and other types of government expenditure[(2)], the findings of the latter are strikingly similar. Thus, annual net fiscal incidence studies typically conclude that taxes are broadly proportional to income or slightly progressive (with the progressive effect of income taxes being offset by other regressive taxes); that cash transfers, and to a lesser extent other government expenditures, are progressive; and that the combined effect of both taxes and outlays is to transfer income from the rich to the poor.

(1). For example, see Kakwani (1983), Saunders (1982) and Collins and Drane (1981, 1982) for Australia.

(2) For example, see CSO (1990), O'Higgins and Ruggles (1981), Webb and Sieve (1971), Peacock and Browning (1954), Barna (1945) and Cartter (1955) for the UK; ABS (1987b) and Harding (1984, 1982) for Australia; Reynolds and Smolensky (1977) and Gillespie (1965) for the USA; and Dodge (1975) and Ross (1980) for Canada.

But do these conclusions still hold when a much longer time period, such as an entire lifetime, is considered ? For example, at any single point in time, a large proportion of those with low incomes are retirees, who might have enjoyed high incomes in the past while in the labour force, or students or teenagers, who will probably earn much higher incomes in the future. It thus seems likely that, if one could somehow measure the past and future incomes of all of those captured in a cross-section survey, their *lifetime* incomes would be much more equally distributed than their incomes during the single year or weeks embraced by the survey. But how much more equal ?

Similarly, while income taxes appear progressive in net fiscal incidence studies, taking a greater chunk of the income of the rich than of the poor, and income-tested cash transfers appear even more effective in directing resources to the poorest in society, it is likely that many of the cash transfer recipients of today were the high income taxpayers of yesterday. Thus, when a longer time period is considered, it is conceivable that the wide-ranging programs of government taxation and expenditure common to all industrialised countries simply redistribute resources across the lifecycle of individuals, funding the cash transfers and services received by each individual while they are studying or retired from the taxes collected from that same individual during their peak working years. It is thus possible that government programs do not redistribute income from rich to poor at all, as net fiscal incidence studies suggest, but merely enforce the reallocation of income during the lifecycle - in other words, that all of the redistribution achieved by taxation and expenditure programs is *intra-personal*, rather than *inter-personal*.

Such doubts have been raised before. The major variations in income which may occur from year to year take place against the backdrop of a pronounced hump-shaped pattern of income over the course of the lifecycle, with income rising from the low levels apparent during the early years of workforce entry to peak during the prime working years before slumping again in retirement. This variability has given rise to heated debate about the extent and measurement of income inequality and of income redistribution. For example, Friedman's celebrated Permanent Income

Hypothesis suggested that the distribution of well-being was better measured by the distribution of 'permanent' income rather than the distribution of income at a single point in time (1957), because the latter was affected by both transitory income fluctuations and lifecycle effects which tended to increase the extent of measured income inequality.

Other economists have criticised the conventional cross-section measures of income inequality, arguing that they overstate the degree of inequality in society by confusing the to-be-expected *intra*-personal variation of income over the lifecycle with "the more pertinent concept of *inter*-[personal] income variation which underlies our idea of inequality and social class" (Paglin, 1975: 598). The same concerns are echoed by Polinsky, who also points out that "one cannot infer from a sequence of diminishing cross-sectional Gini coefficients that lifetime incomes are being equalized. Lifetime income inequality may in fact be staying constant or even increasing" (1973:221).

Still others have suggested that the cross-section studies of the redistributive impact of government activity may be flawed. As Layard points out, the annual approach first "exaggerates the basic inequality of incomes and then it exaggerates the amount of redistribution" (1977,46). The same concern is echoed by Reynolds and Smolensky, who argue that "a single year accounting period exaggerates the size of government redistribution by almost any definition of redistribution" (1977:24).

Many economists therefore agree that the distribution of well-being would be better measured by the distribution of lifetime income rather than annual income (Carlton and Hall, 1978:103); that it would be desirable to measure the lifetime redistributive impact of government activity rather than the annual impact; and that existing annual studies are likely to overstate both the degree of inter-personal income inequality and the extent of inter-personal income redistribution achieved by government.

Apart from the major questions raised above about the degree of inequality in lifetime income and about the direction and magnitude of any income redistribution achieved by government programs, there are a host of other policy issues and questions which can only be addressed with the use of longitudinal, rather than cross-section, data. For example, to what extent is poverty a transitory or permanent experience ? How much lower are the lifetime incomes of women than men, because of their greater tendency to reduce workforce participation during the years of family formation and growth ? How much higher is the lifetime income of those with university degrees ?

Sources of Longitudinal Data

Answering such questions about how personal circumstances *change over time* or about *lifetime* profiles requires longitudinal data. However, as Atkinson points out, the "immediate problem with the lifetime approach is that of obtaining the required data" (1983:45). There are a number of possible sources for such data. In some industrialised countries lifetime data does exist (for example, in the form of income tax, social security or social insurance records), and if access to such confidential data is granted they can be used to generate lifetime profiles (Bourguignon and Morrisson, 1983; Schmahl, 1983; Kennedy,1989). Unfortunately, administrative or tax data usually have the major disadvantage that key personal characteristics which are relevant to lifetime profiles are not recorded (such as education or marital status), because they are tangential to the original purposes for which the data was collected. In addition, such data rarely cover entire lifetimes.

Australia, which has a needs-based social security system quite different from the social insurance systems of Europe and America, as a result does not collect longitudinal social security records. The income tax records might represent a potential source of data, but they do not seem to have ever been exploited. In any event, in all administrative data the records of those who have not yet died are necessarily incomplete, so that simulation techniques are usually still required if one wishes to generate lifetime profiles.

A second source of longitudinal data is to survey regularly the same individuals over a number of years, thereby producing *panel data*. Such panels are not very numerous, partly because it is not until some years after the commencement of a study that any interesting longitudinal data become available, and also because such panels require a major and long-term funding commitment by governments or other sponsoring bodies. In addition, such panels suffer from a number of difficulties, including the problem of attrition of the original sample and the likely impact of such attrition upon the reliability of the results (Atkinson et al, 1990:73)

The best known panel study is the Michigan Panel Study of Income Dynamics (PSID), which has surveyed a representative sample of US households and their offspring every year since 1968 (Morgan, 1974; Elder, 1985). Reflecting the growing interest in longitudinal data in the last decade, the Survey of Income and Program Participation longitudinal study was also set up in the US in the mid 1980s (David, 1985), while panel studies have also been carried out in the 1980s or are currently being conducted in West Germany, Luxembourg, the Lorraine region in France, Sweden, the Netherlands and Belgium. For most of these surveys, any results are currently available for only a few years.

In the UK, the OPCS longitudinal study has provided a wealth of invaluable information, but has the critical limitation of not including income data (Brown and Fox, 1984). The forthcoming British Household Survey panel study, which will ask a very wide range of questions about income and other household characteristics, will not produce usable longitudinal data for another couple of years (Rose, 1989). In Australia there are no comprehensive longitudinal survey data, although there is a small panel study of 15-25 year olds which began in 1984 (McRae, 1986; Eyland and Johnson, 1987; Dunsmuir et al, 1988).

However, even though panel studies do provide invaluable data on transitions between states over time, they do not of themselves provide *lifetime* profiles. Even the Michigan panel study has surveyed only about one-fifth of the lifetimes of the original respondants; various econometric or simulation techniques still have to be applied to the longitudinal data produced from such panels in order to provide lifetime estimates. [1]

Consequently, it became clear that answering questions about the lifetime distribution of income in Australia or about the lifetime incidence of taxes and transfers, particularly in the absence of any comprehensive longitudinal data, would require the simulation of lifetime profiles. A number of methods of simulating lifetime profiles were investigated.

Simulating Longitudinal Data

Economists have frequently attempted to simulate longitudinal profiles for either one cohort (ie. a group of individuals born in the same or adjacent years) or a range of cohorts. One possible approach is to simulate particular features of the lifecycle, such as the distribution of earnings or of labour supply over the entire lifetime. For example, Blomquist used wage rate, labour supply, assets, inheritance and tax functions to simulate the distribution of lifetime income in Sweden (1976).

Similarly, Blinder (1974) pioneered a lifecycle model of consumer behaviour for the US, simulating earnings and inheritance for individuals with different taste parameters (eg. between labour and leisure), while Davies simulated the lifetime distribution of income and wealth for Canada, extending the Blinder model to include transfers and self-employment income, and basing it upon married couples rather than individuals (so as to incorporate the impact of changes in family size over the lifecycle) (1979).

Such models may employ longitudinal data collected over two or more time periods (David, 1971; Lillard, 1977) and use these to estimate lifetime earnings, labour supply or other functions. Others may simply utilise cross-section data for

(1). A third possible source of data is recall surveys, in which individuals attempt to remember the date of major events such as labour force entry and exit, changes in marital status and family size, etc. Such surveys suffer from obvious problems of measurement error.

one year and create *synthetic cohorts* (Miller, 1981; Ghez and Becker, 1975). In this method the characteristics of the sample are attributed to the simulated cohort. ie. it is assumed that the behaviour of the five to 15 cohorts whose characteristics are captured in one cross-section survey can be linked together to accurately represent the lifetime behaviour of a single cohort. For example, this means it is assumed that at the age of 20 the synthetic cohort will be earning what males aged 20 were earning in 1988 and that at the age of 60 they will be earning what males aged 60 were earning in 1988.(1)

While the above approaches shed light on particular aspects of lifetime profiles and are thus of great interest, they fail, to a greater or lesser extent, to capture the enormous degree of change in the circumstances of individuals over time. For example, plotting the lifetime earnings profile of married men fails to take account of the fact that very few men stay constantly married and constantly in the labour force for their entire working lives. Thus, men may move between the married and non-married states a number of times during their lives with the death or divorce of their spouse, may become disabled and drop out of the labour force, and so on.

Ignoring the degree of change over time in personal circumstances when attempting to provide a picture of lifetime welfare is an important ommission. Perhaps the major lesson from the longitudinal data which has been collected is the astonishing degree of change over time. The PSID data from the US, for example, shows that:

- families are constantly dissolving and reforming;

(1) Since wages actually tend to increase over time with the economic growth rate (Moss,1978:124), such models sometimes attempt to take account of this by imputing an assumed rate of earnings growth over the lifecycle. For example, with some particular rate of economic growth, the imputed earnings at age 60 of the simulated cohort might end up being double the actual earnings of males aged 60 in 1988. In addition, such models also often incorporate a discount rate, so that the value of earnings or income received later in life is deflated (Blomquist, 1981; Richardson et al, 1981). This is to take account of individuals' time preferences (ie. people would prefer to have an extra $10,000 to spend now rather than in 20 years time), and also because in economic terms money received now is worth more than money received in 20 years time (with the difference being due to the additional interest which could be earned on the money during the next 20 years if it were received now).

- earnings vary enormously from year to year, even for those who are employed full-time full-year;

- there is substantial relative income mobility, so that individuals and families do not retain their relative place in the income distribution but move up and down from year to year; and

- there is frequent movement into and out of the labour force, with a significant proportion of even prime age males entering and exiting the labour force each year, while the labour force status and thus earnings of more marginal groups is continuously changing (Duncan, 1984; Elder, 1985; see also Clark and Summers, 1979).

Another possible approach, which attempts to incorporate this diversity and change in individuals' circumstances during the lifecycle and to categorise each individual by perhaps 50 to one hundred variables during any given year, is provided by *dynamic microsimulation models.* After consideration of the above options, it was decided to attempt to construct realistic lifetime profiles using the techniques of dynamic microsimulation.

1.2 MICROSIMULATION MODELS

Microsimulation models (sometimes also called microanalytic simulation models) were pioneered in economics by Guy Orcutt in the United States in the late 50s and 60s (Orcutt, 1957; Orcutt et al, 1961). The defining characteristic of such models is that they deal with the characteristics and behaviour of micro-units, such as individuals, families or households. In contrast to the better-known macroeconomic simulation models, which examine relationships between national economic sectors and agreggated variables, microsimulation models examine the effects of policy and economic changes at the micro level (Merz, 1988).

Given a representative sample of micro-units, such as that provided by the 1986 Australian Income Distribution Survey (IDS), these micro-effects can then be *aggregated* for all the microunits in the sample to produce estimates for the entire country. For example, if the household characteristics, earnings and other income received by every individual recorded in a survey such as the IDS are known, then the impact upon each of these individuals of a policy change such as an income tax cut can be calculated. After multiplying by the weighting accorded to every individual captured in the survey (to make the sample accurately reflect the characteristics of the entire Australian population) the total cost to revenue of the tax change can be calculated.

Static Models

There are three major types of microsimulation models. The most widely used are *static microsimulation models*, which begin with a representative sample of the entire population of a country and are used for estimating the *immediate* impact of policy changes. A very large number of static models have now been developed in industrialised countries (Hellwig, 1989a; Merz, 1988) and there are, for example, at least three such models in the UK, including TAXMOD (Atkinson and Sutherland, 1988). The Australian Department of Social Security is also currently developing such a model, and other models have also been constructed in Australia (Gallagher, 1990; King, 1990).

Static models are normally based upon detailed sample surveys, which provide information about the earnings, family characteristics, labour force status, education and housing status and so on of every micro-unit in the sample. Such models then typically incorporate the receipt of social security benefits and income tax liabilities, by applying the rules for eligibility or liability to the micro-units. In this way the immediate distributional impact of a policy measure, such as a 5 per cent increase in cash transfers to the aged or a cut in income tax rates, can be modelled, and reasonably precise estimates of the characteristics of winners and losers and of the total cost can be calculated.

While still regarded as static models, attempts are often made to age the original cross-section samples by a few years. This is often done because sample surveys are usually a little out of date, due to infrequent surveys or to the delay which occurs before micro-unit record tapes are issued for public use. To improve the accuracy of the models 'static ageing' techniques are used, which include reweighting the past sample to make it more like the current world and inflating incomes to current levels (King, 1987; Merz, 1986). For example, if it is known that the proportion of sole parent families or of owner-occupiers has increased since a survey was conducted, the weights attached to different family types might be altered to reflect this (Sutherland, 1989:11).

In addition, while most static models normally show the estimated effects of a policy change *assuming that people's behaviour does not change*, attempts are now being made to incorporate behavioural change in static models, eg. by allowing labour supply or consumption patterns to vary in response to tax changes (Huther et al, 1989; Piggot, 1987). Such efforts, currently being undertaken by the UK Institute for Fiscal Studies amongst others, are still in their infancy, but ulitmately will result in models which hold certain characteristics fixed (such as family composition) but allow other sample characteristics to vary (such as labour force participation and earnings).

Dynamic Population Models

The second type of microsimulation model is a *dynamic population model*. Such models start from exactly the same random samples of the population as the static models described above, but then attempt to project the micro-units forward through time. The micro-units are 'aged' one year at a time, through the simulation of demographic and other events such as death, marriage, divorce, birth, children leaving home, etc.

This ageing is based on probabilities, which are attached to every single micro-unit in the sample for every year of life, and is undertaken using Monte Carlo selection processes and statistically estimated 'operating characteristics'. For example, when simulating marriage, a random number ranging between 0 and 1 is attached to the record of every individual in the model for every year of life. Then, in a particular year, the probability of marriage, based upon the demographic characteristics and life history of a particular never married 'person', is compared to this random number. If the random number is less than the probability of marriage, then the unmarried individual is selected to marry. If the random number is greater than the probability of marriage, then the person is not selected to marry that year and thus remains single for a further year, going through the whole procedure again in the next year of life. For example, if in a particular country there is a 5 per cent probability of single females aged 25 marrying in that year, then five per cent of the single females aged 25 in the dynamic population model will be married at that age; the females selected to marry will be those whose random number in the year they were aged 25 was less than 0.05.

The various probabilities of demographic and other events happening to people are estimated from the official statistics, sample surveys and so on of a country and are then used in the dynamic model. After the major demographic events have been modelled, other characteristics which are heavily dependent upon demographic characteristics can also be imputed, such as education, labour force status, unemployment, and housing. Finally, the receipt of earnings and of social security payments can be added, subsequently followed by income tax and other tax liabilities.

Dynamic population models require formidable computing resources to run, as the characteristics of the micro-units in the initial year and every subsequent simulated year have to be stored, and any subsequent analysis is thus frequently based upon hundreds of thousands of observations. While technological change has meant that the cost of such models is now falling to much less prohibitive levels, there are still only a handful of dynamic population models in existence, including DYNASIM in the USA and the related PC version developed by Steven Caldwell (Orcutt et al, 1976; Caldwell, 1990); the SFB3 and DPMS models in West Germany (Galler and Wagner, 1986; Heike et al, 1987); the more recent HCSO model constructed by the Hungarian Central Statistical Office (Gegesy et al, 1989) and the DEMOD model in Czechoslovakia, both of which are partly based on the DPMS code ; and the Netherlands model NEDYMAS, used for analysing the redistributive impact of social security (Hellwig, 1989b). However, both the central statistical office in Canada, Statistics Canada (Wolfson, 1989a), and the National Institute for Economic and Industry Research in Australia (King et al, 1990) have begun construction of such models.

Dynamic population models are particularly useful for forecasting the future characteristics of the population and thus for modelling the effects of policy change during, for example, the next 5 to 50 years. For example, in West Germany there were questions about whether the policy of shifting nursing of elderly persons needing care from nursing insitutions to family members would be sustainable in the longer term, in the face of a declining birth rate and a rise in the proportion of elderly people. The West German SFB3 model was used to model likely demographic and other changes to the year 2050, and indicated that there would be a susbstantial future increase in demand for professional nursing services (Galler, 1989:20). Similarly, one could use dynamic population models for forecasting estimated changes in schooling outlays or benefits to sole parents as a result of shifts in the birth rate or the divorce rate, or for estimating the cost in future decades of current changes to superannuation and age pension provisions.

Dynamic Cohort Models

The third major type of microsimulation model is a *dynamic cohort model.* In this type of model exactly the same 'ageing' processes are simulated as in the dynamic population model, but *only one cohort is aged rather than the entire population.* Typically, the cohort is aged year by year from birth to death, so that the entire lifecycle of one cohort is simulated. While the same total lifetime profiles could be generated using dynamic population models, such a procedure is grossly inefficient when the lifetime circumstances of only one or two cohorts are of interest.

Existing examples of dynamic cohort models include DEMOGEN within Statistics Canada, the longitudinal variant of the West German SFB3 model, the EVENT model in Norway (Schweder, 1989), and LIFEMOD, which is currently being developed by the Welfare State Programme at the LSE (Falkingham, 1990).

While dynamic population models are used to answer questions about the future structure of the population and typically map only a few decades of the lives of individuals from many different age cohorts, dynamic cohort models are generally used to simulate the *entire lifetime* of a single cohort of individuals and thus to answer lifetime questions. Dynamic cohort models can be used for such purposes as the analysis of lifetime earnings and income distributions, to determine whether the state is effectively redistributing between periods of relative want and plenty during the lifecycle and to examine the lifetime incidence of taxes and government spending programs.

In Canada, for example, DEMOGEN was used to assess the distributional and financial impact of proposals to include homemakers under the Canada and Quebec Pension Plans (Wolfson, 1989b). In West Germany the SFB3 dynamic cohort model was used to analyse the lifetime distributional effects of education transfers and also the degree and direction of redistribution between individuals contributing to the German statutory pension system (Hain and Helberger, 1986). Dynamic cohort models could also lend themselves, when run for two or more widely spaced cohorts, to the evaluation of inter-generational equity.

As with the static microsimulation models, the dynamic models currently all appear to assume that individuals do not vary their behaviour in response to changes in their environment intitiated by government policy change. Incorporating estimated behavioural responses to tax changes or real wage increases is problematic, because econometric studies designed to assess the magnitude of behavioural change have produced such widely divergent estimates of the relevant elasticities that it appears that the most that can be done is to present the results for a number of different estimates (Hagenaars, 1989:31).

It is also not entirely certain whether the elasticities obtained from cross-section data can be assumed to reflect accurately lifetime behavioural response. For example, using panel data, Heckman and MaCurdy found evidence that labour force participation decisions are made with a very long term horizon in mind, and that the *future* expected values of variables determined *current* labour supply decisions (1980:67). It is thus possible, for example, that while higher real wages might lead to increased labour force participation in the short-term (as found in numerous studies, such as Bureau of Labour Market Research (BLMR) 1985a; Miller and Volker, 1983) this could nonetheless be partly or fully offset by earlier retirement during the later working years. Improved wages could therefore conceivably lead to no increase in labour force participation over the total lifetime. Given these difficulties, dynamic models have not yet attempted to incorporate behavioural response, but there is no doubt that this will be undertaken in the future.

1.3 PROBLEMS OF DYNAMIC MICROSIMULATION MODELS

Apart from the resources required to write and run the hundreds of pages of computer code which comprise dynamic microsimulation models and the difficulties in finding adequate software (Hellwig, 1989c), a number of methodological and data problems face those constructing such models, and the magnitude of these problems and their implications for the accuracy of any results produced by the models should be fully appreciated.

The Income Unit in Dynamic Models

As all those involved in lifecycle modelling have discovered, the family or household are both inappropriate units to use in longitudinal analysis because both are subject to such major changes in composition. Essentially, it is a hopeless task to try to follow a family through time because, for example, a family originally consisting of a husband, wife and two children frequently splits into two separate households with divorce, is further modified with the remarriage of one or both of the former partners, and then is split again as the children leave home and start their own families.

In such circumstances, regarding all of the newly split families as all belonging to the same family unit is clearly nonsensical. On the other hand, family composition cannot be ignored in any assessment of standards of living because it has such a major impact upon welfare. Thus, a female with no earned income who is single is likely to have a very different standard of living to an apparently equally low income female who is married to an employed spouse. To solve this difficulty, Duncan and Hill proposed using "the household as the unit of measurement but ... the individual as the unit of analysis, attributing to each individual the characteristics of the household in which he or she lives" (1985:362).

Dynamic models can thus incorporate the impact upon the living standards of individuals of changes in their family composition. Most models appear to include only individuals and nuclear families within their structure, so that only households consisting of single adults or married couples with or without children are modelled. Multiple income unit households and those with other dependent or non-dependent relatives (such as grandparents) are currently not usually included, although it is relatively simple to add to models the relevant probabilities of parents returning to live in the houses of their children. This will no doubt be done in the near future, given the increasing concern about the care of the elderly and the costs of an ageing population. Most dynamic models already trace kinship networks, so that parents, children and siblings can all be easily linked together.

Age, Cohort and Period Effects

All dynamic models face major methodological problems in attempting to disentangle age, cohort and period effects (Morgan and Duncan, 1986:359). *Age effects* are changes that occur with the increasing age of individuals, such as the growth in earnings that occurs with increasing experience and age and the decline in birth rates as women become older. The shape of the cross-section age-earnings distribution changes over time, not just due to the impact of the cohort and period effects discussed below, but also due to the independent effect upon age-earnings profiles of changes in occupational composition, changes in demand, a more highly educated workforce and so on (Weiss and Lillard, 1978). In other words, the relationship between age and whatever variable is of interest (in this case, earnings) is not fixed but can vary over time.

Cohort effects are effects specific to a single cohort of individuals born in the same or adjacent years. Easterlin , for example, has argued that those born in larger cohorts, such as the baby boomers, face higher unemployment rates, lower age-earnings growth rates, delayed marriage and lower fertility rates due to their less favourable economic circumstances and a higher incidence of stress-related problems (1980). Similarly, after examining empirical evidence, Berger (1985) recently found that larger cohorts have lower earnings upon workforce entry than smaller cohorts and that the negative effect of cohort size appears to worsen with increasing experience, with larger cohorts having flatter age-earnings profiles than smaller cohorts (see also Freeman, 1979).

The importance of cohort effects is apparent in Figure 1.1, with the growth in the average wages in the five years to 1975 of those aged 21 to 25 in 1970 far exceeding the growth in wages of those aged 51 to 55 in 1970. In other words, the younger cohort fared much better than the older cohort during this five year period. This phenomenon is also apparent in the UK at the moment, where the small size of the cohort currently aged 15 to 20 is causing a relative increase in the wages paid to those in this age group.

Period effects are those which affect a number of different cohorts who are alive at the same time, and are due to living in a particular time period, such as the Great Depression, war or periods of buoyant economic growth. For example, in time periods when the rate of real economic growth is 3 per cent then wage earners can expect their wages, roughly speaking, to increase at about 3 per cent a year (Moss,1978:124). However, when economic growth plunges to one per cent

Figure 1.1. Wage Rates by Age: Longitudinal Cohort Profile

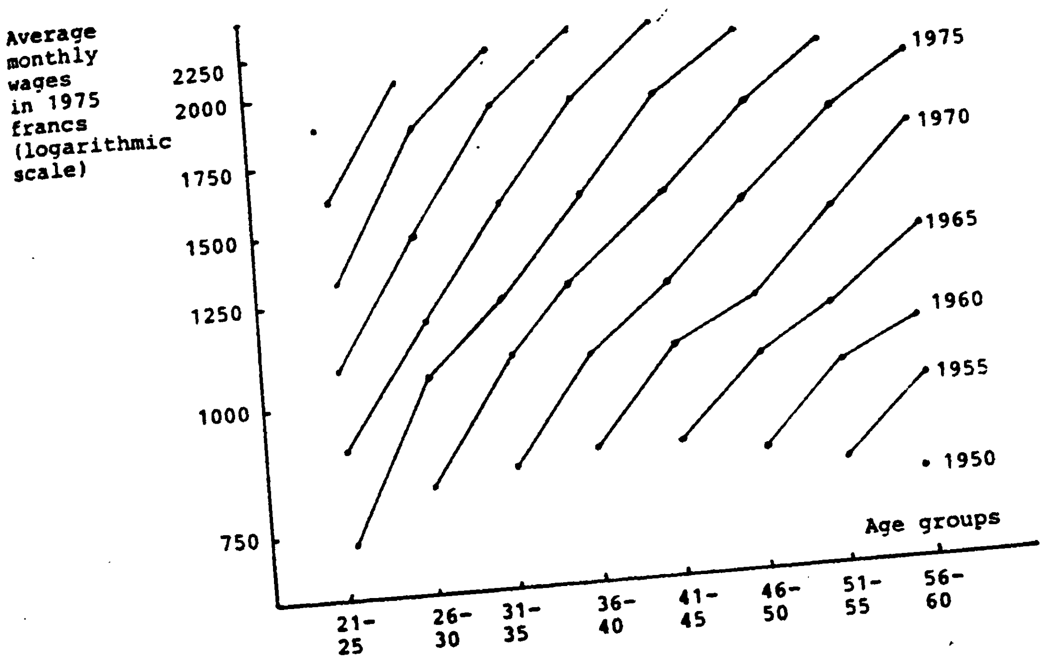
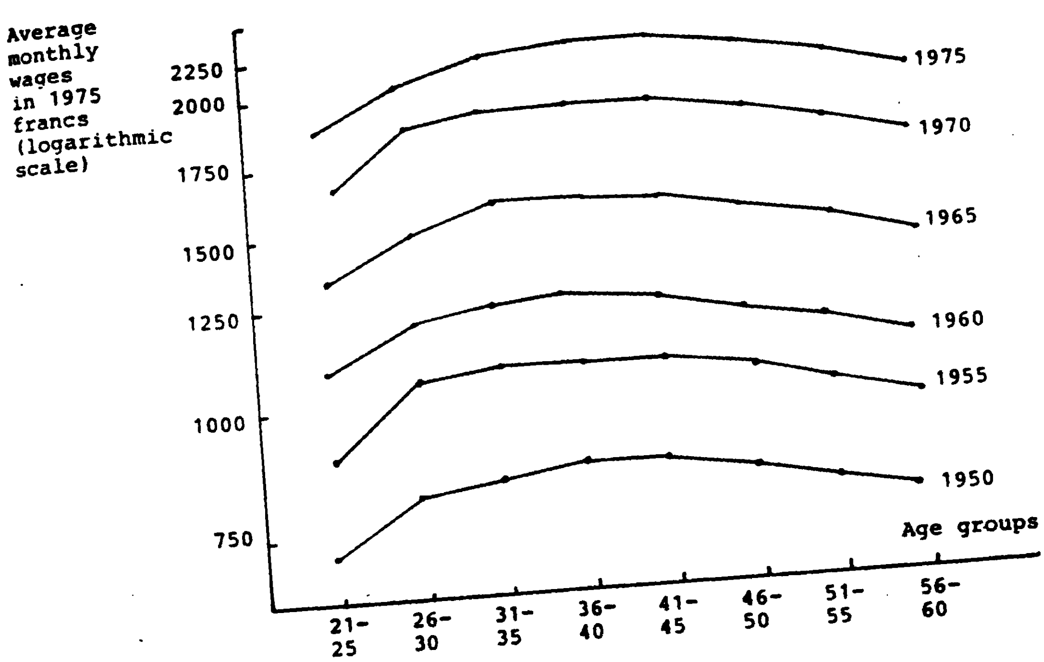


Figure 1.2. Wage Rates by Age: Cross Section Profile



Source: Baudelot (1983:102).

or zero, all cohorts are likely to experience much slower earnings growth, and the total amount of income earned during the life of a particular cohort is thus very heavily dependent upon the circumstances of the particular decades in which they were alive (Ruggles and Ruggles, 1977:122).

The significance of period effects is demonstrated in Figure 1.2, which is based on exactly the same data as Figure 1.1, where the wage increases accruing to all cohorts between 1955 to 1960 were lower than those won in adjacent time periods.

The problems created by the impact of age, cohort and period effects upon the data used to set the parameters in dynamic microsimulation models extend into every area of the models, not just earnings. For example, when trying to model the probability of marriage one can take the probabilities of marriage for women aged 25 in 1986, aged 26 in 1986, aged 27 in 1986 and so on. These are the annual rates for a particular year (conceptually equivalent to the cross-section 'snapshot' shown in Figure 1.2), which have the major advantage of being easily obtainable from official statistics, but are sensitive to temporary period effects. Thus, if only cross-section data are available, measuring the independent effect of age is made difficult because of cohort and period effects.

An alternative is to obtain marriage rates for a real cohort and use these to parameterise the lifecycle model. ie. by obtaining marriage probabilities for women aged 25 in 1986, aged 26 in 1987, aged 27 in 1988 and so on (conceptually equivalent to the 'movie' shown in Figure 1.1). While these cohort rates accurately portray the lifecycle trends of one individual cohort, they are incomplete (eg. we do not yet know how women born in 1960 will behave once they reach the age of 35).

In addition, the experience of the particular cohort considered might have been affected by major period effects and this could mean that their experience is unlikely to be replicated by any other cohort. For example, divorce rates in

Australia shot up after the introduction of the Family Law Act in 1976, so any model based upon divorce rates of cohorts during this period would incorporate a very strong but temporary period effect (Raymond, 1987:38). If these temporarily high divorce rates were then used in a dynamic microsimulation model, too many of the micro-units in the model would get divorced and the total proportion of the micro-units who had the marital status of divorced would be much higher than in the real world.

The problem for microsimulation modellers is that most of the data sources used to set the parameters of dynamic models reflect the combined impact of age, cohort and period effects, and that these effects are not easily disentangled. That is, if one uses longitudinal data to set the parameters, then period effects are not controlled for, while the cohort effects which are captured may not be replicated by other cohorts in the future. On the other hand, if one uses cross-section data, then cohort effects are not controlled for, and the period effects which are captured may be affected by unusual historical circumstances. While with sufficient years of data it is possible to attempt to correct for unusual cohort or period effects, there is no real solution to this problem but to accept that the world is ever-changing, that any panel or cross-section survey data, no matter how thorough, may not provide an accurate guide to future behaviour and that there is no perfect way to model the unknown future.

In practice, however, the great strength of dynamic microsimulation models is their enormous flexibility. The policy maker can make his or her own decisions about future trends and change the parameters in the model accordingly. For example, if it is felt that fertility rates are too low and have been affected by the cohort effect of a particular generation of women delaying their first child by an average 5 years, then the fertility rates used in the model can be increased. Similarly, if labour market experts believe that the labour force participation rates of married women will continue to increase during the next 20 years then current rates can be appropriately inflated. If there is disagreement about, say, the future impact of a new policy on retirement age and thus on projected age pension expenditure, then a range of assumptions can be modelled, and such sensitivity analysis can provide a guide to the likely range of possible costs.

Data Availability and Quality

A third major problem with dynamic microsimulation models is that they are only as good as the data upon which they are based. The types of data required are extensive and ideally include, for example, death rates by age, sex and socio-economic status; marriage rates by age, sex, education level and previous marital status; divorce rates by age, sex, duration of marriage, and number and age of children; labour force participation rates by age, sex, education, marital status, age of children, disability status, duration of time in the current labour force state and previous labour force status; attendance rates at primary, secondary and tertiary institutions by age, sex, parental socio-economic status and previous education; and earnings by age, sex, marital status, hours worked, previous earnings, education level and so on.

Cross-section data are not usually adequate for setting the parameters in dynamic models, as it is the probabilities of *transition between states* which are critical. In modelling housing status, for example, it is not sufficient to have a cross-section survey which shows what proportion of married couples with two children in each age group are owner-occupiers, private renters and public renters. What is really required are data on the probability of entering and exiting each type of housing tenure by a range of relevant characteristics, such as age, income, education, family status, duration in the current housing sector, change in family circumstances such as divorce or marriage and so on.

Because the models are attempting to capture transition rates over time, the availability of longitudinal data is particularly important, because many of the relevant transition probabilities are heavily dependent upon *duration* in a particular state and/or status in the *immediately preceding year*. For example, in modelling the probability of remaining in the labour force for a further year, data which shows labour force status at two separate points in time is obviously required. But, in addition, as some research has suggested that the number of years *already* spent in the labour force significantly affects the probability of staying in the labour force for a further year (Picot, 1986:20), panel or recall data spanning the last 10 to 20 years may be needed.

Similarly, there is evidence that the incidence of unemployment is very highly concentrated over time (OECD,1985), so that those who have been unemployed during a number of periods in the past have much higher probabilities of experiencing unemployment than other individuals. In a dynamic model it is thus not sufficient to make the probability of experiencing unemployment in the current year simply dependent upon whether the individual was unemployed last year. Such a methodology results in a simulated world in which a very large number of people experience a few years of unemployment during their lifetimes, rather than the more accurate picture of a much smaller number of people experiencing many years of unemployment during their lifetimes.

In many countries, including Australia, the necessary panel or recall data are not available, and the various transition probabilities in dynamic models are thus based upon longitudinal data collected in other countries, upon surveys which asked about status in only the current and immediately preceding year, or upon annual data which contains no information about duration in some state such as marriage. While attempts can be made to adjust the probabilities in line with the results of longitudinal data in other countries, such ad hoc measures are obviously not very satisfactory and reduce the predictive accuracy of the models to an unknown extent.

While longitudinal data are needed, extensive and recent cross-section sample surveys of all relevant variables are also very useful when setting up dynamic microsimulation models. For example, tertiary education participation rates in a country might have increased substantially since a panel study was started. In modelling tertiary education usage, a dynamic model might therefore mix together cross-section and longitudinal data, using up-to-date cross-section data on tertiary participation (sub-divided by such variables as age and sex) to set the overall probabilities of *entering* the first year of tertiary studies, but deriving the probabilities of *remaining* in tertiary studies for the second and subsequent years from the panel study.

When either longitudinal or cross-section surveys are used to set the parameters in dynamic models, the models will incorporate any sampling and coding errors present in the original surveys, so that the quality of the data upon which the models are based is an important consideration. In addition, large sample size is critical, so that the population can be stratified by a substantial number of explanatory variables and the enormous variation present in the real world can be adequately represented in the model.

Finally, in most countries there is not one enormous survey which covers all of the variables used in constructing dynamic models, but rather a large number of surveys, each of which address a particular area of interest. In such cases, statistical matching techniques have been developed to merge, for particular types of micro-units, the expenditure data contained in one survey to the income and health data contained in a second survey and the labour force data contained in a third survey (Paass, 1986; Klevmarken, 1983). In the Canadian static microsimulation model, for example, the original sample survey upon which the model was based was known to under-sample very high income earners (because of their higher non-response rate), so the more comprehensive records of high income earners contained in a special high income tax file were merged with the original sample. Such statistical matching techniques are still a relatively recent innovation, and the likely degree or direction of any bias introduced remains uncertain.

Because adequate data in every area covered by a model are not usually available, dynamic models tend to rely on whatever pieces of data are around and can be used. This obviously reduces the accuracy of the models, but they are normally constructed so that they can be immediately amended as soon as better data become available.

1.4 OUTLINE OF THE THESIS

The first part of this thesis describes the procedures used to construct a dynamic cohort microsimulation model for Australia. The model consists of a pseudo-cohort of 2000 males and 2000 females, who are tracked from birth to death and experience major life events such as schooling, marriage and unemployment. The cohort are 'born' in 1986 and live for up to 95 years in a world which remains exactly as it was in their birth year. Given the uncertainty surrounding future changes in marriage and birth rates, labour force participation rates, education rates and so on, this means that a *steady-state* world has been assumed in the initial version of the model. Thus, the first version of the model does *not* attempt to estimate what the actual experience of the cohort born in Australia in 1986 will be. Instead it seeks to answer the following question: *If the demographic, labour force, income and other characteristics of the population and all government policies existing in 1986 remained unchanged for 95 years, what would the distribution of income be like and what income redistribution would be achieved by government programs ?*

Although the steady-state assumption may appear unrealistic at first glance, it is probably the most useful benchmark against which to evaluate current government policies and changes to those policies. As Summers pointed out in 1956, the instability of the size distribution of income makes data about the the lifetime income distribution in the past of little help in analysing the lifetime income distribution of today, while the future distribution of lifetime income is unknown. Summers saw great potential in the construction of steady-state or 'latent' income distributions, which would allow one to answer questions about lifetime income distribution given *existing* economic conditions and government policies. He argued in favour of constructing a latent lifetime size distribution of income, which "refers neither to what has happened nor to what probably will. It is a 'maybe' size distribution which has a very, very small probability of eventuating." (1956:4). Similarly, both the DEMOGEN and SFB3 dynamic cohort models assume a steady-state world when evaluating the impact of both existing and possible government policies (Wolfson, 1988:233; Hain and Helberger, 1986:63).

The first part of the thesis is devoted to describing the simulation in the model of demographic processes, disability and education, (all in Chapter 2), labour force participation (Chapter 3) and the earned and unearned income of the pseudo-cohort (Chapter 4). Much of this modelling relies heavily on the 1986 Income Distribution Survey (IDS) micro-data tape released by the Australian Bureau of Statistics (ABS), and key features of this survey and the definitions of important variables used extensively in the model are summarised in Appendix 1. Any sampling, coding and other errors present in the 1986 IDS (and other data sources) are therefore reproduced in the model. In addition, the institutionalised population are excluded from both the 1986 IDS and the model, and there is thus no attempt to include, for example, aged persons in nursing and other institutions (although the movement of the elderly into and out of institutions remains a high priority for the next version of the model). The definitions of variables in the simulation, such as employed and unemployed, are also necessarily the same as those used by the ABS.

Because only earnings, investment, superannuation and maintenance income are simulated, the definition of income in the model is not fully comprehensive, in the sense of Simons' classic definition (1938). Not only are less significant components of income not simulated, such as the receipt of accident and workers compensation, but such items as unrealised capital gains, fringe benefits, imputed rent, the value of production for home consumption, and the imputed value of leisure are also excluded (Scitovsky, 1973; Moon and Smolensky, 1977). While it is difficult to include many of these items in the income base, it must be recognised, as Ingles points out, that "the inclusion of some or all could significantly affect the shape of the measured income distribution, as well as any assessment of the redistributive impact of government policies" (1981:5).

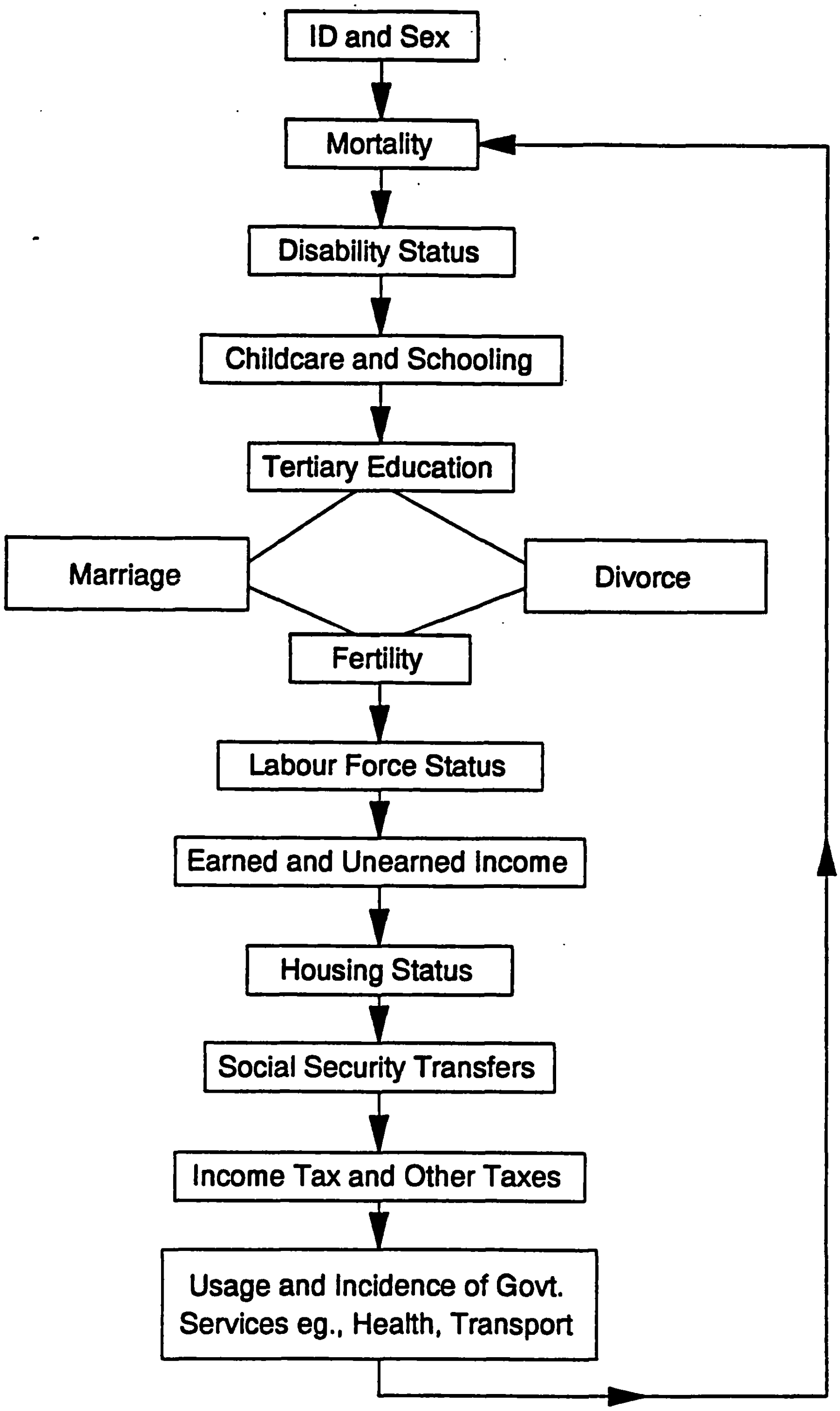
Given the demographic and economic profile of each individual built up during these early modules, the receipt of social security and education cash transfers and of education outlays is then simulated, and the procedures used to do this and the assumptions made regarding the allocation and valuation of government expenditures are discussed in the early sections of Chapter 5. The next section of Chapter 5 describes the imputation of income tax, and the assumptions made about the incidence and burden of the tax. The various income measures utilised in the model are also outlined in Chapter 5; because of the problems mentioned earlier, of taking account of family circumstances when only the lifetimes of individuals can be traced in any meaningful way, some of the income measures are quite new and can be difficult to understand when first encountered. All income measures in the model are expressed in constant or 'real' 1986 dollars.

Figure 1.3 illustrates the steps, described in detail in Chapters 2 to 5, which are followed in the model for every individual for every year of life. Thus, if an individual is selected to experience another year of life, all of the following modules are run through to determine the characteristics of that individual in that year of life.

For example, if a 13 year old is selected to experience a fourteenth year of life, any change in disability status will occur during the second module, changes in schooling status will be assigned in the third module, and the probabilities of change in all subsequent modules will be zero so that, for example, the young teenager will remain unmarried, out of the labour force, and not in receipt of earnings for the whole of that year. In contrast, if a married 60 year old female is selected to experience another year of life, the probability of entering schooling or tertiary education will be zero, so that these characteristics will not change, but the woman might become widowed, enter or leave the workforce or commence the receipt of age pension.

Unfortunately, housing status has not been included in the first version of the model, principally because there were no adequate housing data on the 1986 IDS

Figure 1.3: Planned Structure of the HARDING Dynamic Cohort Microsimulation Model*



* Child care, housing status, indirect taxes and government services apart from education are not yet included in the model.

micro-data tape which could be used for the simulation of housing, and longitudinal data on housing were also not available. However, housing status is not as criticalfor simulating the social security and tax systems as in, for example, the UK, as the rent assistance provided to those receiving social security transfers in Australia is relatively minor and there is no mortgage interest tax relief for owner-occupiers.

In addition, although it is hoped to include indirect taxes and other government expenditures in the model in the near future, at the moment the simulation is limited to the major cash transfers, education outlays and income tax administered by the Federal Government. It must be fully appreciated, therefore, that most of the findings of the study only deal with the lifetime redistribution of *cash income* generated by the federal tax-transfer system. If the study embraced indirect taxes or other government expenditures, it is possible that quite different conclusions might be reached about the redistributive impact of all government activity or about the distribution of a lifetime income measure which included the imputed value of various government services. Inclusion of state and local government taxes and expenditures might also affect the conclusions.

A further issue is that in assessing the impact of government upon income redistribution, the distribution of income *before* specified government actions necessarily has to be compared to the distribution of income *after* such actions. This immediately raises the question of what the most appropriate 'before' benchmark - or counterfactual - is. Although heavily criticised (Reynolds and Smolensky, 1977), the most commonly used reference point is the 'zero government counterfactual', which measures the redistributive effect of government against the original distribution of pre-tax and pre-transfer income. While it is clearly invalid to assume that the distribution of factor income would remain the same if there were no government, such an assumption has been implicitly adopted in this study, because there are no data available suggesting how the lifetime distribution of factor income in Australia would change if government miraculously disappeared. However, this does mean that using the model to examine the impact of policy *changes* upon the distribution of lifetime income (ie. differential incidence) has greater theoretical validity than using it to examine how existing policies have affected the distribution of lifetime income (Musgrave et al, 1974:274).

The second part of the thesis describes some of the results produced by the model. As an initial exploration of some of the ways in which the model can be used, the sources and amount of lifetime income received by those with different educational achievements, various family characteristics and differing lengths of time unemployed are analysed in Chapter 6. While this chapter thus examines the lifetime incomes of those with specified lifetime characteristics, the following chapter approaches the issue from a different angle and instead seeks to identify the determinants of high and low lifetime incomes.

In Chapter 7 the simulated cohort are therefore ranked by the amount of *lifetime* equivalent income they receive and are then divided into deciles, so that the fortunes of those with radically different lifetime standards of living can be compared. This chapter thus answers the questions raised earlier about the distribution of lifetime income.

In Chapter 8 exactly the same records are used to create a synthetic *annual* income distribution (rather than a lifetime distribution), and the inequality of annual income is examined in Section 8.2. In Section 8.3 the inequality of the lifetime and annual income distributions is compared, by calculating Gini coefficients for the various lifetime and annual income measures and by constructing annual-to-lifetime income transition matrices. In Section 8.4, the difference between the annual and lifetime incidence of first cash transfers and then income taxes is assessed. However, such analysis makes it difficult to identify the extent of intra and inter-personal income redistribution occurring, because the amount of income tax paid during the lifetime so greatly exceeds the amount of cash transfers received (because income taxes finance the provision of so many other services, in addition to cash transfers). Consequently, in Section 8.5 the combined redistributive impact of cash transfers and of the income taxes *which financed those cash transfers* is examined. Finally, the lifetime incidence of education outlays is analysed in Section 8.6.

While Chapter 7 provides a picture of total lifetime income, it tells us nothing about the periods of relative poverty and plenty during the lifetime. Chapter 9 therefore discusses the distribution of income over the *lifecycle* of those with varying lifetime characteristics, and identifies the amount of taxes paid and transfers received at various ages. The first part describes the lifecycle income profiles of males and females on average, and then also examines the fortunes of those at the top and bottom of the lifetime welfare ladder. The second part contrasts the experiences of those who never married with those who married and raised large families, and traces the impact of children upon living standards at different stages of the lifecycle. Finally, the third section discusses the very different lifecycle profiles of those with different educational achievements.

In Chapter 10 some of the major findings of the study are summarised.

1.5 CONCLUSION

Many economists argue that the marked degree of income inequality, and the apparent significant redistribution of income from those with high to those with low incomes achieved by government programs of taxation and expenditure, revealed by studies based on a single year of data, overstate both the degree of inequality and the degree of redistribution. It has been suggested that assessment of such inequality and redistribution over a longer time period, such as a lifetime, would provide a more accurate guide to both inter-personal income inequality and the degree of inter-personal income redistribution achieved by the state.

To assess such claims, real or synthetic data on lifetime profiles are required. It has been argued that even when genuine longitudinal data exist, such as panel, recall or administrative data, such data are either unlikely to span the entire lifetimes of individuals or to exclude many important variables which are necessary to derive a complete picture of the differing lifetime circumstances of individuals. In addition, even where complete lifetime data do exist, the lifetime records of those who are now dead are likely to have been affected by the particular economic and social circumstances of the period during which they lived (such as World War 2 and the following years of major economic growth); their lifetime circumstances are therefore unlikely to be replicated by any cohort born in the 1980s.

Consequently, answering such questions necessarily requires the generation of synthetic lifetime profiles. In Australia, where no usable longitudinal data exist, such a conclusion is inescapable. A number of methods of simulating such profiles were examined, and it was concluded that the relatively recent techniques of dynamic microsimulation provided the best way of simulating the constant changes in circumstances over time revealed by panel data.

While the techniques of static microsimulation are now well established and in constant use in many industrialised countries, dynamic microsimulation remains a relatively uncharted area and suffers from a number of serious problems. These include the difficulty of taking account of family circumstances when only individuals can be realistically tracked through time; the impact of age, cohort and period effects upon the data used to set the parameters in such models; and the vast amount of data required to simulate adequately the numerous demographic and economic processes which are important in the real world.

It must therefore be emphasised that that the construction of a dynamic microsimulation model is a daunting task. The techniques of microsimulation are still a comparatively recent development in economics and social policy, and the accuracy of the dynamic models still remains to be comprehensively tested. Although various techniques to validate the models have been tried (Wolfson,1989b:51), such validation is obviously fairly difficult when longitudinal data do not exist and when there are many reasons (eg. different death rates) why the results of the models will not neccessarily be comparable to existing cross-section data.

While the original purpose of constructing the HARDING dynamic cohort microsimulation model was to answer questions about lifetime income distribution and tax-transfer incidence, the extent to which the model provides accurate answers to these questions is unknown. This is in part due to the fact that there are severe limits upon the amount of the world that one person can understand and translate into computer code within three years. Many areas of the model are no doubt simplistic and will require improvement in the future. Even more importantly, constructing a dynamic model in the face of extremely severe data limitations - and in particular, in the absence of any comprehensive longitudinal data for Australia - means that many ad hoc assumptions have necessarily been made in the model.

Nonetheless, the model provides a prototype which can be built upon in the future as better data become available, and appears to generate the most reasonable answers which can be expected, given the current state of knowledge and data.

CHAPTER 2: THE DEMOGRAPHIC, DISABILITY AND EDUCATION MODULES

2.1 INTRODUCTION

The following sections describe how demographic processes, disability and education were simulated in the model. The various processes are described in the order in which they were simulated so that, for example, the modelling of education is described before that of marriage, as aspects of the simulation of marriage depended upon the education status of the cohort members. Section 2.2 summarises the simulation of mortality, Section 2.3 the modelling of disability status, Section 2.4 the simulation of pre-school, primary and secondary schooling and Section 2.5 the modelling of tertiary education. In Section 2.6 the family formation and dissolution procedures are described, while Section 2.7 canvasses the simulation of fertility.

2.2 MORTALITY

In the first module, an ID number and sex are assigned at birth and retained for the duration of the cohort member's life. Currently 2000 men and 2000 women are 'born'. Cohort members are also assigned at birth to a parental socio-economic status (SES) quartile with, for example, 25 per cent of the cohort being randomly selected at birth to have parents in the lowest quartile. (Parental SES is used later in the simulation of educational achievement.)

Before the age of 45, cohort members are randomly selected to die every year, in line with the probability of death by age and sex in 1986 (reported in ABS, 1987d:8). As explained in Chapter 1, the simulation of mortality (and most of the other major processes in the model) is achieved through the use of dozens of streams of random numbers allied with 'Monte-Carlo' selection processes. Thus, for the simulation of mortality, all cohort members are assigned a uniformly distributed random 'mortality' number ranging between zero and one in every year of life. Then, if the probability of death for 15 year old males is one per thousand of the male population, then two male cohort members will be selected to die at age 15 (assuming that the random numbers attached to 15 year old males are exactly uniformly distributed); the males selected to die will be those whose random numbers were less than or equal to 0.001 at age 15.

A substantial amount of research has shown that the likelihood of dying is affected not only by age and sex, but also by a range of socio-economic factors, such as occupation, education, income, class and so on (Powles,1977; Kitagawa and Hauser,1973; Australian Institute of Health, 1987; Health Targeting and Implementation Committee, 1988; Hart, 1987). Dasverma analysed Australian mortality data by occupation and found that there were considerable differences in the mortality rates of various occupational groups. For example, after dividing those males who died between the ages of 15 and 64 between 1970 and 1972 into 12 occupational categories, Dasverma found that those in the professional, technical, administrative and executive occupational categories had standardised mortality ratios of about 90, while those in the clerical, sales, and farmers and fishermen etc categories had ratios of about 100 (ie. the average). Craftsmen and labourers and those in service, sport and recreation occupations had ratios of about 120, while the ratio for those in transport and communication occupations reached 137, with the highest ratio of 162 being realised by miners and quarrymen (1982:87). Similarly, Lee et al found that in 1981 in Australia, the occupational groups with the lowest death rates were males in the professional (rates 29 per cent below the average), clerical (26 per cent below) and retail occupational categories (25 per cent below), while higher than average rates were experienced by males in mining (37 per cent above) and transport and communications (28 per cent above the average) (1987:20).

Occupation is not simulated in the model. However, American research found that mortality varied not only by occupation , but also by education and income (Kitagawa and Hauser, 1973:152). 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: "For this reason, it has been suggested that education differentials are probably more reliable indicators of socio-economic differences in mortality than is income" (1973:154).

Accordingly, the model uses years of education as the socio-economic variable affecting mortality. Unfortunately, as Dasverma pointed out, "it is not possible to analyse mortality differentials in Australia with respect to education or income due to non-availability of data" (1982:3). Given this lack of data, the American data were used as a guide when setting the relevant probabilities. Kitagawa and Hauser found that, in 1960, white males aged 25 to 64 with less than five years of schooling experienced mortality rates 64 per cent above those of men with four years of college. Among white females the relevant differential was 105 per cent. The difference between more comparable education levels was less extreme but still marked; the mortality of white males aged 25 to 64 with less than 8 years of school was 40 per cent higher than those with at least one year of college, while for females the comparable figure was 51 per cent. On this evidence the authors concluded that "improved socio-economic conditions associated with education might have a marked effect on the deaths of men 25 to 64 and on deaths to women of all ages 25 and over" (1973:153).

From age 45 onwards, therefore, the probability of dying in the simulation is made additionally dependent upon education, as well as just age and sex. This age was selected because by age 45 cohort members had completed their university education, which made the simulation of differential mortality easier. Although socio-economic factors presumably influence death rates before age 45, only 5 per cent of cohort males and 2.5 per cent of females die before this age, so that this simplification should have little impact.

To impute the effect of education, cohort members were divided into education quartiles at the age of 44, ie. the top 500 males ranked by completed years of education were assigned to education quartile one. Because the difference in mortality rates appeared to be more marked at the extremes of the spectrum, those belonging to the two middle quartiles were simply assumed to have the average death rates for people of their age and sex. Those in the top quartile were assumed to have death rates 10 percent below this average and those in the bottom quartile 10 per cent above the average rate. This meant that from age 45 onwards those in the bottom quartile (quartile 4) had death rates which were 22 per cent higher than those of quartile one members. There is no way of determining whether this 22 per cent spread accurately captures Australian socio-economic differences in mortality by quartile, but on the above evidence it seems unlikely to be an overestimate. One of the interesting future uses of the model will be to change these assumptions and examine the consequential effect upon tax-transfer incidence. The incorporation of differential mortality has a significant but not overwhelming impact, as Table 2.1 shows.

Table 2.1: Impact of Differential Mortality Assumptions

	Percentage of cohort still alive at ages		
	60	70	80
Males			
Education quartile			
- 1 (top)	21.4	16.9	9.1
- 2 and 3	21.1	16.1	8.1
- 4 (bottom)	20.8	15.5	7.3
Females			
Education quartile			
- 1 (top)	23.0	20.4	14.4
- 2 and 3	22.8	19.9	13.4
- 4 (bottom)	22.7	19.5	12.8

At the age of 96 all those still left alive are assumed to die, so that the model actually incorporates up to 96 full years of life for each sex. Although it is easy to continue to simulate life histories beyond this age, major computer storage problems were encountered during construction of the model, and truncating lifespans was a relatively efficient way of dealing with this problem, as only some 5 per cent of females and 2 per cent of males were still 'alive' at age 96, with the proportion dropping rapidly each year thereafter.

As a comparison of Figures 2.1 and 2.2 demonstrates, the population pyramid produced by application of the 1986 death rates does not match that actually existing in 1986. The proportion of the population who are aged 60 and over is higher in the simulation than in Australia in 1986, and the percentage who are aged 80 and over is double that of 1986. This is because the population structure actually existing in 1986 was a product of the higher death rates applying in earlier years and major events such as the two world wars (as well as birth rates and immigration). For example, death rates for 70 year olds were lower in 1986 than they had been 20 years earlier. Consequently, more of the 70 year olds in the model survive to reach the age of 71, thus producing a different population structure to the 1986 Australian population. In other words, the model shows what the population *would* look like if the death rates applying in 1986 continued for 95 years, rather than showing what the population *did* look like in 1986.

2.3 DISABILITY, HANDICAP AND INVALIDITY

This module imputes the disability, handicap and invalidity status of cohort members from birth to death. Construction of the module was severely restricted by the lack of longitudinal data about the probabilities of entry to and exit from various disability states. As a result, the 1988 Disabled and Aged Persons Survey (ABS, 1989), which is the most recent comprehensive cross-section data source on disability and handicap, was used to determine the percentage of males and females who were disabled and handicapped in each age group, but

Figure 2.1: Population Age Structure of the Simulated Population

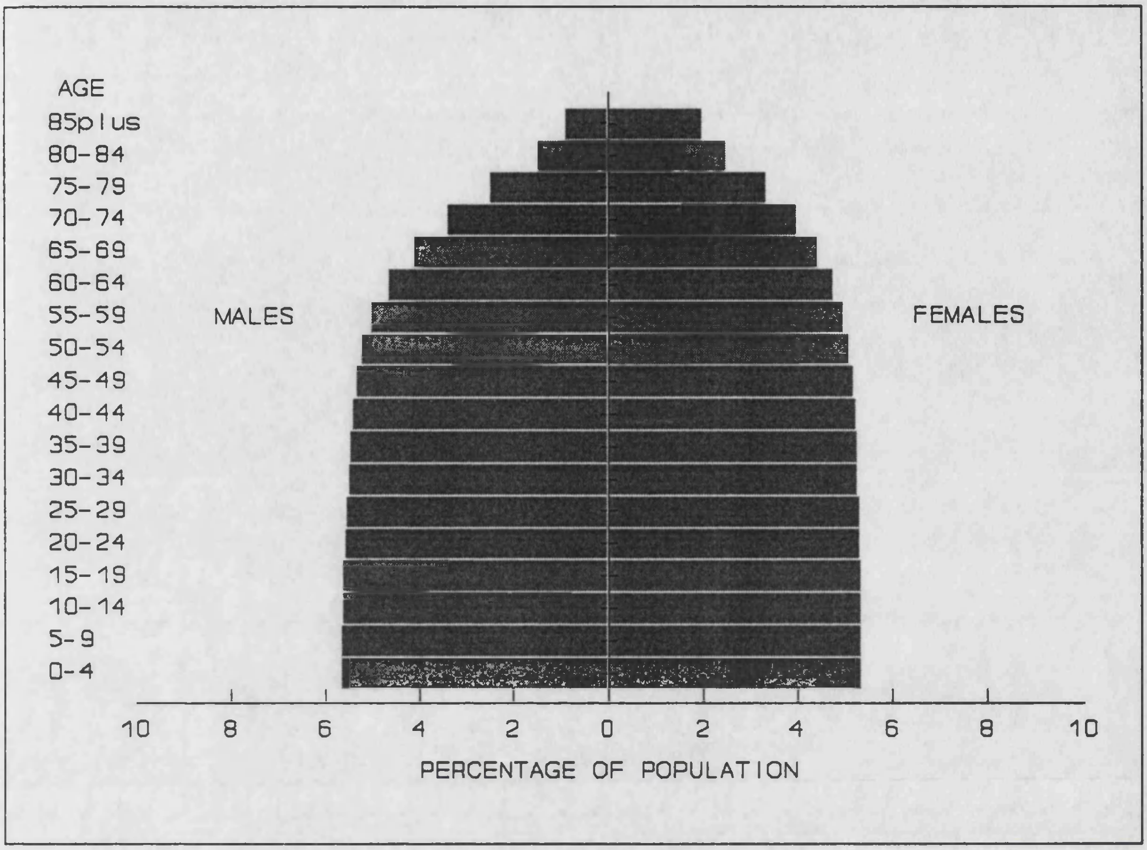
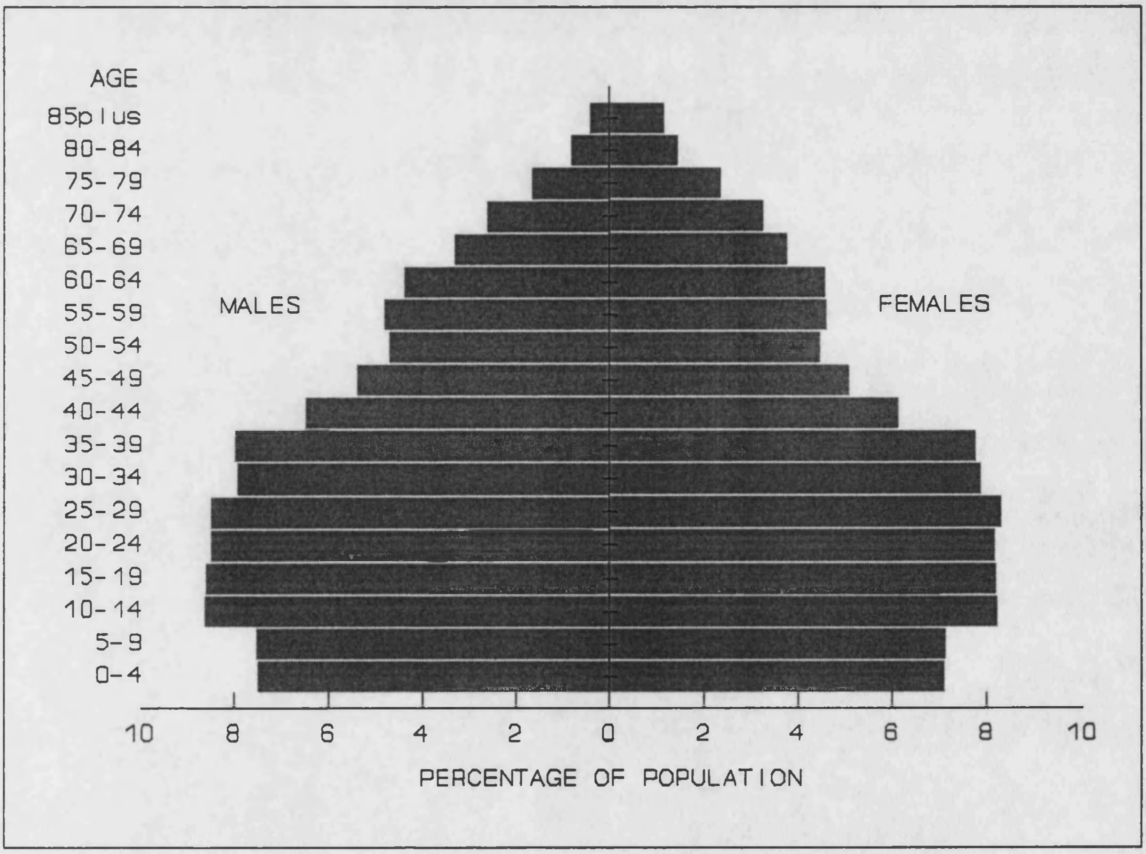


Figure 2.2: Population Age Structure of Australia, 1986.



Source: Australian Bureau of Statistics (ABS) (1988a) it could shed no light on the likelihood of exit or entry. This Survey found that in early 1988 a higher proportion of the population regarded themselves as disabled and handicapped than in 1981, when the last survey was undertaken (ABS,1984:71). However, no adjustment to the 1988 data has been undertaken, so it is implicitly assumed in the model to provide an adequate representation of the picture in 1986.

The 1988 survey found that 15.6 per cent of the population were *disabled* (ie. had one or more of a specified list of disabilities and impairments), and that the incidence of disability varied by sex and increased sharply with age (ABS, 1989:1). Accordingly, the probability of being selected to be disabled in the simulation varies by age and sex. Once assigned, disabled status is retained until death.

The ABS survey also found that 84 per cent of the disabled population were *handicapped*, with handicap being defined as a disability which limited the ability of a person to perform specified activities and tasks in areas such as mobility, self care and employment (1989). In the model the relevant proportion of the disabled were randomly selected to be handicapped in each age and sex group. Handicapped status was again retained until death, except where there was a decline in the proportion of handicapped persons, in which case the correct number of handicapped cohort members were selected to exit handicapped status.

A proportion of handicapped cohort males between the ages of 16 and 64 and cohort females between the ages of 16 and 59 were also randomly selected to be eligible to be *invalid* pension recipients (to receive invalid pension a person of workforce age must be 85 per cent permanently incapacitated for work). Essentially, the module records a 'yes' code in the invalidity status variable for all individuals randomly selected to be eligible to receive an invalid pension, a sheltered employment allowance or a rehabilitation allowance, in line with the probability of receipt by age and sex (calculated from DSS data on the characteristics of such recipients).

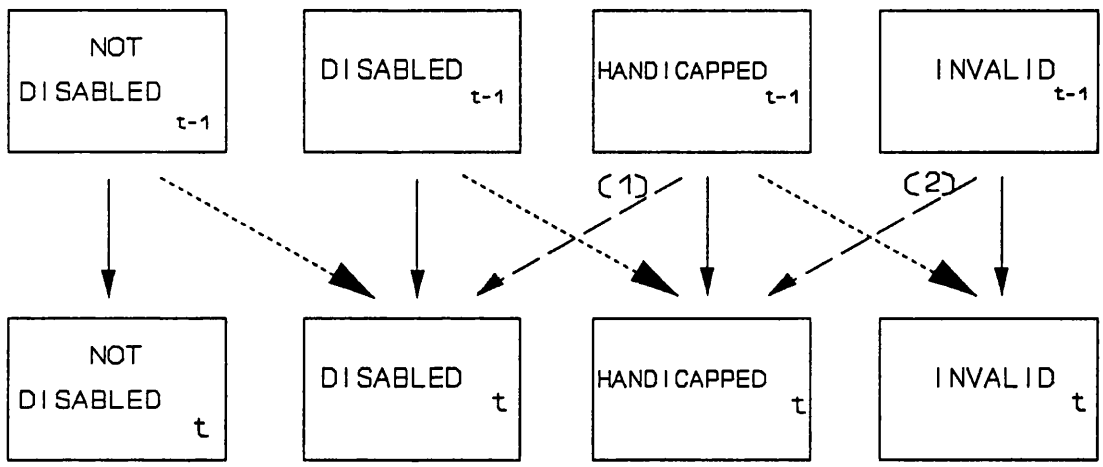
It is difficult to determine how long people remain on invalid pension as the Department of Social Security has no data on *completed* durations on invalid pension in 1986 (or any other year). However, data on the current and average duration of *existing recipients* (rather than terminated recipients) shows that duration on invalid pension tends to be very lengthy with, for example, the average duration on pension for females aged 30-39 being 10.6 years in 1986 (DSS,1986a:31). This suggests that a very substantial proportion of such recipients commenced invalid pension at the earliest possible age of 16 and remained on it thereafter.

Terminations of invalid pension in the year to June 1986 on the grounds of 'not permanently incapacitated' and 'other reasons' (such as voluntary withdrawal of pension) reached 7706, amounting to 2.8 per cent of all invalid pension recipients (DSS, 1986b:12). The number of invalid cohort members was so low that it was impossible to select 2.8 per cent of cohort invalids to exit invalidity status every year (or even to select 14 per cent every five years). Consequently, these exits were cumulated, and every ten years 28 per cent of existing invalids were selected to exit invalid status (with other handicapped cohort members then entering invalid status, in order to maintain the correct proportion of invalids).

Once a person left invalid status they had the same probability as all other non-invalids of being chosen for another period of invalidity. In other words, the probability of being an invalid was Markovian, and did not depend on any periods of invalidity which occurred before the immediately preceding year. The above steps in the simulation of disability states are summarised in Figure 2.3.

Disability, handicap and invalidity are all assumed not to affect the probabilities of schooling usage, re/marriage, divorce, childbirth and death, principally because no data were available to calculate the relevant probabilities. However, people who are coded as invalid are precluded from participation in tertiary education. This is not to suggest that severely disabled people do not attend tertiary institutions, but as a person has to be 85 per cent permanently incapacitated for work to receive invalid pension, it seems reasonable to assume that the proportion of invalid pensioners attending tertiary institutions must be negligible.

Figure 2.3: Structure of the Disability Status Module



(1) Exits at ages 15 and 65 for males and age 15 for females.
(2) Exits at ages 20,30, 40, 50 and 60 (with all males exiting at age 65 and all females at age 60, when invalid pension is no longer payable and is effectively replaced by age pension.

In addition, as the 1986 Income Distribution Survey does allow the identification of those receiving invalid pension (although it does not contain data on other disability states), it was possible to make invalidity status affect employment status in the labour force participation module and thus subsequently affect earned and unearned income. Recent British research has shown that the workforce participation rates of the disabled are approximately half those of non-disabled people in the UK and that their earnings are lower (although this is principally due to fewer hours worked rather than a lower hourly wage rate) (Martin and White, 1988). However, the applicability of these data to Australia was uncertain, and therefore no attempt was made to adjust the labour force participation patterns of those who were disabled but not invalid.

The simulation of disability in the US DYNASIM model was much more complex than that outlined above, because the builders of the model were fortunate enough to have the PSID longitudinal data, and could thereby calculate the probability of yearly exits and entries to disability states by a range of characteristics, including race, marital status, education and disability status in the preceding year. They found that under 35 year olds (and to a lesser extent females) had significantly greater odds of recovery than other disabled groups (Orcutt et al, 1976:181). There are, however, no comparable longitudinal Australian data and better modelling of such exits represents a future area for improvement of the model.

However, if it is assumed that those who are disabled when they are children are likely to retain those disabilities, then the age group of key interest from the standpoint of possible exit from disability states is 15 to 35 year olds; as only some 6.5 per cent of the population are disabled between ages 15 and 30 (and 75 per cent of these are handicapped and thus perhaps rather less likely to exit disability status), the exclusion of recovery from disabilities in the simulation should not markedly affect the imputed incidence of relevant government expenditures.

2.4 PRIMARY AND SECONDARY SCHOOLING

This module assigns preschool, primary and secondary schooling status to cohort members aged four to 19. Some 75 per cent of each Australian birth cohort begin primary school at age five (variously termed preparatory, kindergarten, reception etc by the different States). However, Queensland does not have a Pre-Year 1 grade, so that most students there commence Year 1 at age six, while in other states a minority of any given birth cohort commence Pre-Year 1 at ages four or six. Although the model does not simulate attendance by State, but only on an

Australia-wide basis, the model captures these differential starting dates so that, for example, those who leave school at the end of their 16th year may have completed four, five or six years of secondary schooling.

Pre-School

There are limited reliable data on the usage of *publicly funded* preschools by age and sex, particularly as all three levels of government are involved in funding preschools. In the model it is assumed that some 74 per cent of four year old children use preschools, after comparison of the number of children using pre-school in November 1984 (ABS,1986a:7) with the number of four and five year olds in the population and after taking out the estimated number of five year olds using preschools.

Only those children attending publicly subsidised preschools are relevant to the calculation of expenditure incidence. On the basis of Queensland data, which appear to provide the only detailed breakdown by age of usage of government-assisted and unsubsidised preschools, 11 per cent of four year olds attending preschool are assumed to attend unsubsidised centres (ABS,1986b;12). Overall, therefore, 66 per cent of all cohort four year olds are selected to attend publicly funded preschools. Most five year olds begin primary school and are thus no longer at preschool, but all of those who delay primary entrance until the age of six are assumed to attend preschool at ages four and five.

Primary School

Beginning at the age of five, cohort members are allocated to either a government, Catholic or Independent school (with independent schools representing the private, non-Catholic schooling sector) with the probability of attending each sector being dependent upon sex and parental socio-economic status. Unpublished data supplied by the ABS from their 1986 National Schools Statistics Collection were used to determine the correct proportion of students in each of the three sectors by age and sex. These data show, for example, the percentage of male 13 year olds attending Catholic schools.

The ABS data do not, however, provide information about the socio-economic status (SES) of the families of students in each sector. Yet there is a substantial body of research which shows that a greater proportion of the students in private schools are drawn from families with high SES, that the likelihood of completing Year 12 is strongly correlated with SES, and that the probability of entering university also varies greatly by SES (eg. Williams et al,1987; Quality of Education Committee, 1985:46; Anderson and Vervoon, 1983:77; Hayden, 1982). Although SES is clearly very important, there do not appear to be any recent data about the socio-economic status of the parents of *primary* school students by schooling sector.

The results of the 1971-72 national survey of *secondary* school leavers have therefore been used to set the relevant primary school entrance probabilities, even though it must be recognised that the occupational status of parents would be likely to change during the period from when their children entered primary school to when they left secondary school. This survey showed that about 27 per cent of public school leavers, 36 per cent of Catholic school leavers and 70 per cent of independent school leavers had fathers whose occupation was categorised as professional, professional-technical or employer-managerial (Radford and Wilkes, reported in Anderson and Vervoon, 1983: 82). It also showed that very few of the children of skilled and unskilled manual fathers attended independent schools. While the above study is rather dated, research has shown that the socio-economic distribution of students at secondary schools, universities and CAE's has remained remarkably stable over time (Anderson and Vervoon, 1983).

After translating the probabilities of attendance by occupation of father (which was not simulated in the model) into probabilities of attendance by parental socio-economic status (which was in the model), the following probabilities, shown in Table 2.2, of being assigned to a schooling sector at age 5 were used in the simulation [1]. For example, 10 per cent of all male children whose family belonged to the top SES group were sent to independent schools (Table 2.2).

Table 2.2: Assumed Probability of Attending School Sectors by Sex at Age Five

	Probability of Attending Each Schooling Sector at Age Five		
	Government	Catholic	Independent
Males			
- SES 1 (top)	.67	.23	.10
- SES 2	.76	.20	.04
- SES 3	.82	.16	.02
- SES 4 (bottom)	.79	.20	.01
Females			
- SES 1 (top)	.66	.24	.11
- SES 2	.75	.20	.04
- SES 3	.81	.18	.01
- SES 4 (bottom)	.78	.21	.01

While this gave the initial attendance probabilities, there are substantial shifts *between* the three schooling sectors each year, particularly at the cross-over point between primary and secondary schooling (Department of Education (Commonwealth), 1980). The Victorian Ministry of Education appears to be the only government department to have examined flows between the three sectors in detail and these data are used to parametise the model, with some adjustment to reported flows so that the total number of cohort students remains constant (the

(1) In using the results of the above survey to set the model parameters a method had to be found of mapping the occupational categories used in the survey onto the SES quartiles used in the simulation. To do this, it was assumed that the 25 per cent of fathers who belonged to SES Group 1 consisted of all of the professional fathers and about 75 per cent of the employer-managerial category. The remaining employer-managerial members, clerical-administrative workers, sales-clerical workers and about half of the skilled manual workers were assigned to SES Group 2. The other 50 per cent of fathers, consisting of the remaining skilled manual workers, semi and un-skilled workers and the unemployed were assigned to the bottom two SES Groups.

original flow figures being affected by immigration and emigration from the state of Victoria)(1986). While Victoria has a greater proportion of secondary students in private schools than most other States, this does not mean that the *proportion* of students changing sectors in any one year will necessarily be unrepresentative.

Four possible flows are modelled - from government to Catholic and independent schools respectively, from Catholic to government schools and from independent to government schools. A negligible number of students swap between the Catholic and independent sectors so this flow is ignored, and in years when the proportion of students shifting from government schools falls belows one per cent then the potential flow is aggregated for a year or two until the shift exceeds one or two per cent. Students can currently shift sectors at ages 6, 9, 11, 12 and 14.

The Victorian data also allow calculation of the number of students repeating any given year of primary and secondary schooling. Because the probabilities of repeating a year by sector are so low, no attempt is made to model students repeating individual years of schooling. However, the effect of repeating a year is captured when students exit schooling, because it affects the number of years of secondary schooling that a student is assumed to have completed (with the relevant distribution being derived from the National Schools Collection).

Secondary School

At the ages of 15 to 19 inclusive, students are allowed to either continue for another year of secondary schooling or drop out of school. The probability of continuing their education (and completing Years 10, 11 and 12 respectively) is based upon their age, sex, parental SES and type of school attended. The probabilities for age, sex and sector can be calculated from the National Schools Collection data, while the likely difference in these probabilities by SES is imputed from Williams' results about the proportion of students completing Year 12 by a variable termed 'family wealth', which is based upon housing characteristics and the family's possession of material items such as dishwashers and telephones

(1987). Williams found that 22 per cent of male students belonging to families in the lowest family wealth quartile had completed Year 12 by the age of 19, with the proportion increasing to 33 per cent for male students in families in the middle two quartiles and rising further to 52 per cent for male students belonging to families ranked in the top quartile of family wealth (1987:166). The relevant proportions for female students belonging to the same 1982 cohort were 28, 41 and 52 per cent respectively.

Once students have dropped out of school they cannot return. An additional simplification is that, while some one percent of 20 year olds are still in school, this percentage is too low to justify the additional modelling effort, so that all teenagers still at school at 19 are assumed to leave school at the end of that year. The steps involved in simulating schooling are summarised in Figure 2.4, while Figure 2.5 traces the passage through the schooling module of a sample of four males and four females from the pseudo-cohort. For example, Male No 21 completes two years of preschool, attends a government school from ages 6 to 11 inclusive, and then shifts to an independent school at age 12, leaving school at the end of his 17th year. Similarly, Female No 2010 also attends two years of preschool, and then attends a Catholic school from ages 6 to 16 inclusive, so that at the start of her 17th year she has left school.

Apparent Retention Rates

The apparent retention rates by SES and by sector produced by the model are shown in Table 2.3. These retention rates are comparable to those of Australia in 1986 in that, for example, women have higher retention rates than men, while independent schools have higher retention rates to Year 12 than any other sector, followed by Catholic and then government schools. The model appears to perform well, as the average retention rates by sex produced by the model to Years 10 and 12 are almost identical to those reported by the ABS (1987a), with some 45 per cent of males and 52 per cent of females remaining at school until Year 12.

Figure 2.4: Structure of the Schooling Module

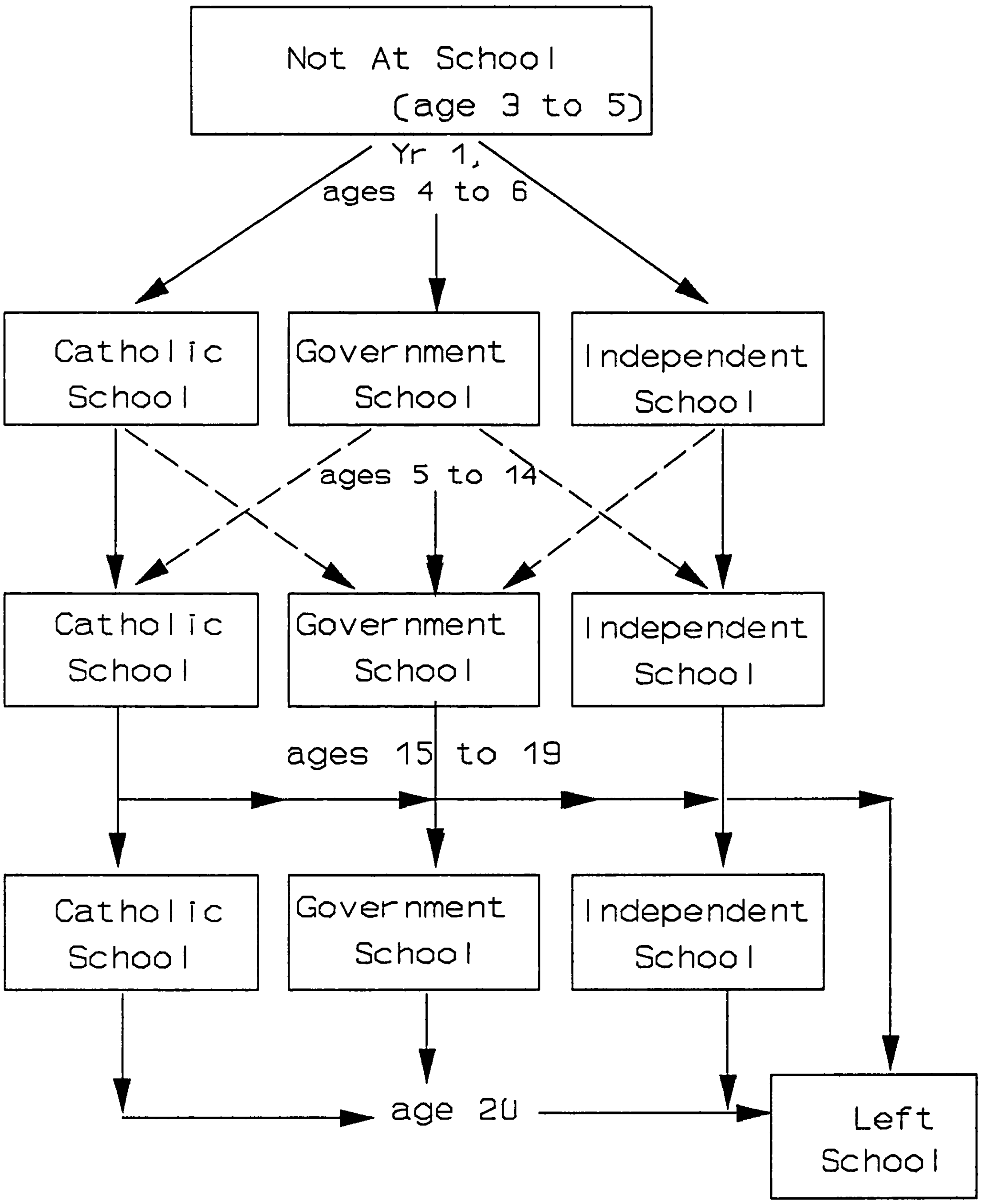
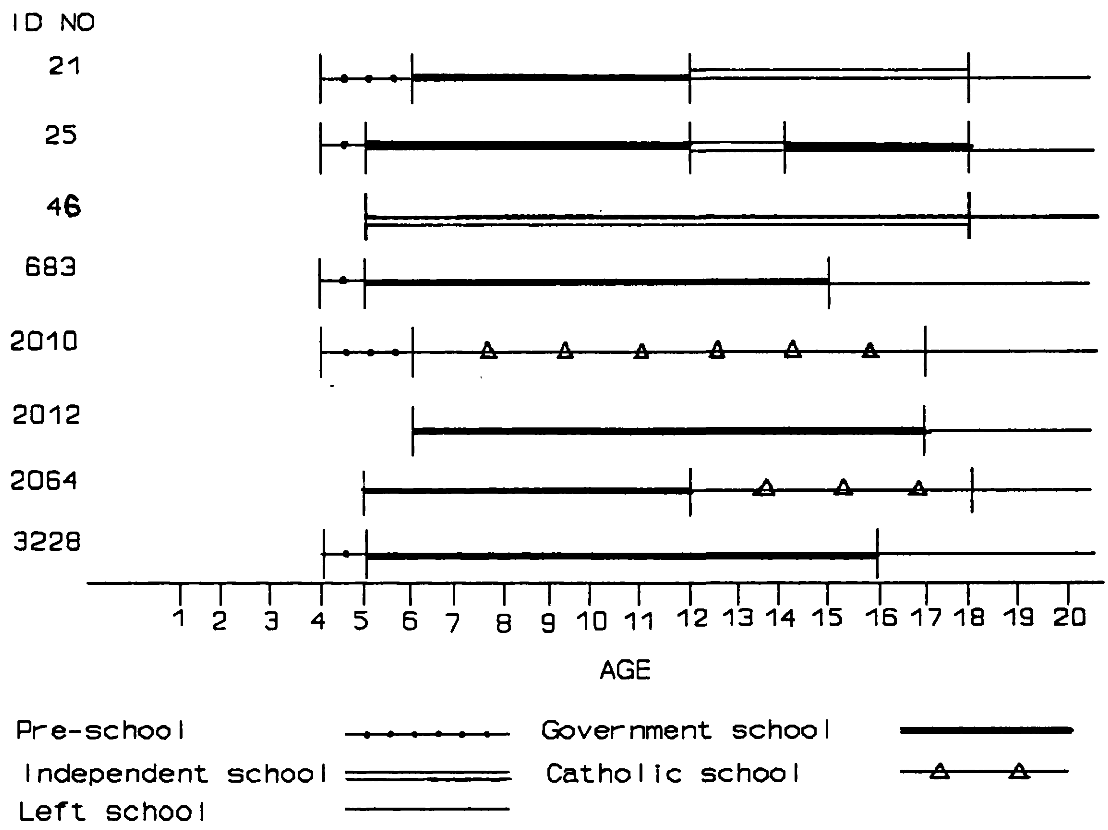


Figure 2.5: Schooling Records of Eight Individuals in the Model



Note: Males have ID numbers ranging from 1 to 2000, while females range from 2001 to 4000.

The results by *schooling sector* are, however, very different. This is because apparent retention rates simply show the number of Year 12 students in a given sector in 1986 divided by the number of Year 7 students in 1981 in the same sector; this methodology means that gradual sectoral shifts, such as occurred during the early 1980s when the proportion of all students attending private schools was increasing, can distort actual retention rates. The model holds the sectoral shares fixed at their 1986 levels and thus shows the retention rates that would result if the split between sectors in 1986 remained constant for the next 14 years.

The retention rates by SES for each sex are also higher than those found by Williams (1987). This is probably largely due to the increase in retention rates between 1984, when the Williams sample was surveyed, and 1986. In addition, Williams found when he resurveyed the 1978 class at the age of 22 that retention rates to Year 12 were significantly higher than when he had surveyed the 1978 class at the age of 19. In other words, many of the sample managed to complete Year 12 between the ages of 19 and 22. In the model, such late completers are all assumed to complete before the age of 20. The results by SES also compare reasonably well to those produced by the Department of Employment, Education and Training (1987b:17), although the Department's study is by SES deciles rather than SES quartiles.

Table 2.3: Apparent Retention Rates to Years 10 and 12 Produced by the Model and From Other Data Sources

	Apparent Retention Rates Produced by the Model		Apparent Retention Rates From Other Data Sources
	Males	Females	
By Sector , Retention to Year 12			DEET(1987a)
- Government	.42	.48	.42
- Catholic	.47	.53	.57
- Independent	.67	.74	.91
By SES , Retention to Year 12			Williams(1987) Male/Female[1]
- SES 1	.60	.64	.52/.52
- SES 2	.50	.56	.42/.44
- SES 3	.40	.47	.32/.36
- SES 4	.31	.40	.22/.28
All Students			ABS(1987a) Male/Female
- Retention to Year 12	.451	.515	.456/.521
- Retention to Year 10	.943	.953	.932/.951

1) Retention rates for the 1982 class at age 19 by the family wealth variable, 'smoothed' to provide a linear increase between the top and bottom quartiles (Williams, 1987:166).(That is, Williams combined the results for the middle two quartiles - with the combined average completion rates for the two quartiles being 33 per cent for males and 41 per cent for females - whereas in the above table an attempt has been made to split the middle quartiles.)

2.5 TERTIARY EDUCATION

This module assigns attendance at universities, colleges of advanced education (CAEs) and Technical and Further Education institutions (TAFE) from ages 15 to 50. While it was originally intended that entrances and exits to each of the above three sectors should be modelled independently, giving rise to six sets of probability estimates when each sector was divided into full and part-time studies, calculation of the relevant flows between the sectors and the required probabilities became too complex. As a result, only the probabilities of entering and leaving the following four areas are calculated;

- full-time university/CAE studies;
- part-time university/CAE studies;
- full-time TAFE studies; and
- part-time TAFE studies.

Full-Time University/CAE Studies

Many of the cohort complete Year 12 at age 17 and commence full-time university or college of advanced education (CAE) studies at age 18. However, some leave school after completing Year 12 at age 16 and start university at age 17, while others defer entry for a number of years; such variation is captured in the model.

The probability of attending tertiary institutions by age and sex is calculated for 15 to 24 year olds using unpublished data from the ABS June 1986 Labour Force Survey, which divides 15-24 year olds into those still attending school full-time, those attending tertiary education institutions full-time and others. For 25 to 40 year olds the probability of attendance by age and sex is based on the ABS collection 'Tertiary Education Australia' (1987c) and the population benchmarks for June 1986 presented in ABS (1988a:22-23). For both of the above age groups, the division into part and full-time study and between the different tertiary sectors is that shown in ABS (1987c).

Probability of Entry to First Year of Full-Time University Study

From ages 17 to 20 inclusive, cohort members who have completed Year 12 of secondary school face a probability of selection for entry to Year 1 of full-time university, with the probability depending upon age, sex and parental SES. Socio-economic status is included as a major factor affecting university entrance during these early years, as a substantial body of research has shown that students from higher SES families are greatly over-represented at university (Anderson and Vervoon,1983; Linke et al, 1985; Power and Robertson, 1987; Crockett, 1987; Hayden, 1982; Wran et al, 1988).

The initial probability of attendance by age and sex derived from ABS (1987c) is thus adjusted up or down for 17 to 20 year olds, in accord with the socio-economic status of the student's parents. The results by Williams, on university/CAE attendance by sex and family wealth quartile, are used to determine the magnitude of these differences in probability by SES of entrance to first year university/CAE studies (1987:166). For example, at the age of 18, 30 per cent of female Year 12 graduates whose parents belong to the lowest socio-economic quartile and who have not yet entered full or part-time university are selected to enter the first year of full-time study at university, compared to 42 per cent of comparable females with parents in the top SES quartile.

From the age of 21 and thereafter, parental SES is not included as a factor affecting entrance to university, reflecting research showing that while higher SES groups are still over-represented among mature age students their dominance is far less pronounced than among students proceeding direct from school to higher education (Anderson and Vervoon, 1983:11). From ages 21 to 24, therefore, university entrance is simply based on age and sex, with those potentially eligible to attend comprising all cohort members who have completed Year 12 and have never attended university.

From ages 25 to 40 inclusive the pool of eligibles is widened to also include those who left school having only completed Year 10 or 11. This modification is designed to reflect the growing number of mature age university entrants who are admitted without a Year 12 certificate (with the Quality of Education Review Committee reporting that 15 per cent of commencing university undergraduates were admitted without a Year 12 credential in 1983) (1985:95).

Probability of Entry to Second and Third Years of Full-Time University Study

After entry to the first year of full-time university studies, students can either be selected to continue for a further year of full-time university study or to drop out of university. The pool eligible to be selected for a second year of study only comprises those who completed Year 1 in the *immediately preceding year*, and, similarly, those eligible to enter Year 3 only consists of those who completed Year 2 in the immediately preceding year. This also means that those who drop out of university after completion of Year 1 or 2 can *never* recommence full-time university (although they can commence part-time study to complete their degree).

The issue of how to treat university drop-outs and whether to allow them to ever re-enter full-time tertiary studies is complex, and the above solution of debarring Year 2 and 3 drop-outs from any future attendance lies at one end of a possible spectrum of simulations. The methodology lying at the other end of the spectrum - of allowing Year 2 and 3 dropouts to be eligible for commencement of Year 2 or 3 *at any time* in the future - was tested, but was found to be unsuitable. This is because, for many of the cohort, the completion patterns which were then generated were atypical with, for example, students frequently commencing Year 2 three years after dropping out of Year 1, and subsequently commencing Year 3 five years after dropping out of Year 2.

Such unlikely results were generated because the probability of completing a further year of tertiary education clearly does vary inversely with the length of time since the last year of university study was completed. However, there are no longitudinal Australian data which would allow calculation of the relevant probabilities and their inclusion in the program would in any event be extremely complex. Faced with the same problem, the designers of the US DYNASIM model were also forced to compromise, and used enrollment probabilities which produced the final attainment rates of completed years of college and did 'not bear any relation to the actual attendance pattern at college' (Orcutt et al,1976:130). Similarly, in the DEMOGEN model, education attainment was assigned at birth, and no attempt was made to simulate the year-by-year passage through educational institutions (Harding, 1990:41).

However, despite the data deficiencies, it was decided to attempt to simulate the yearly passage through tertiary studies in Australia, so that receipt of education cash transfers could be modelled adequately. There is relatively little firm data about tertiary education flows in Australia, partly because accurate measurement is complicated by such factors as student intra-state, inter-state and overseas transfers; students suspending their studies but later recommencing and completing; students switching from full-time to part-time study and vice versa; and so on. Because of this, it must be emphasised that the model only provides rough estimates of flow patterns. While it produces exactly the *right proportion* of males and females attending full-time university at each age, the *division* of those students into Year 1 students, Year 2 students and so on up to Year 9 students, is only an estimate based on very little data.

The probability of proceeding to a second year of full-time university education was taken from the flow charts of West et al (1986:26-27), with around 65 per cent of those commencing Year 1 in the simulation subsequently commencing Year 2. West et al also found that about 90 per cent of those who completed Year 2 had graduated within the next five years. In the model about 80 per cent of Year 2 full-time completers are selected to continue to Year 3 the following year.

Probability of Entry to Fourth and Subsequent Years of Full-Time University

Entry to Years 4 and 5 of full-time tertiary education differs from entry to Years 2 and 3, in that those eligible for entry comprise all of those who have *ever* completed Years 3 and 4 respectively (rather than just those who completed in the immediately preceeding year). This refinement was made because many graduates do not immediately proceed to graduate diplomas, Honours, Masters or Phd courses, but have a number of years in the workforce before recommencing their studies. The probability of completing a fourth or fifth year of full-time university is dependent upon sex (because slightly fewer women proceed to post-graduate degrees) and age (with a slightly higher proportion assumed to continue to further degrees at younger ages). Overall, 44 per cent of men and 38 per cent of women who have completed Year 3 in the model proceed to a fourth year of full-time university and about one third of these then proceed to a fifth year.

The maximum number of years of full-time university modelled is nine, and entrance to Years 6 to 9 is only allowed to those who have completed Years 5, 6, 7 and 8 respectively in the immediately preceding year. This does not completely capture the typical time pattern of Phd completion, where about one-third of candidates suspend their studies for a year or so and only a minority submit their theses within four years (Department of Employment, Education and Training, 1988a, 1988b). However, the former report showed that 75 per cent of male Phd candidates and about 60 per cent of female candidates submit within five years, which is the maximum amount of time allowed in the model, and the number of cohort members submitting after this is too insignificant to justify the modelling effort. The model appears at least as reliable as the DYNASIM model, in which it was assumed that all of those who attended graduate school did so for exactly two years and then left (Orcutt et al,1976:132).

The various probabilities for continuing to the next year of full-time university study are also set so that under plausible assumptions about how years of completed full-time study match to completed degree requirements, the correct proportion of the cohort graduate from full-time university with various degrees and diplomas. Thus, two per cent of male graduates and 0.6 per cent of female graduates emerge with Phds, 21 per cent of male graduates and 19 per cent of female graduates gain masters degrees or post-graduate diplomas, and the remainder earn bachelors degrees, diplomas and associate diplomas. This was the distribution of degrees and diplomas awarded in Australia by universities and CAEs in 1985 (ABS, 1987c:33,67). The procedures followed in simulating full-time university studies for one individual are outlined in Figure 2.6.

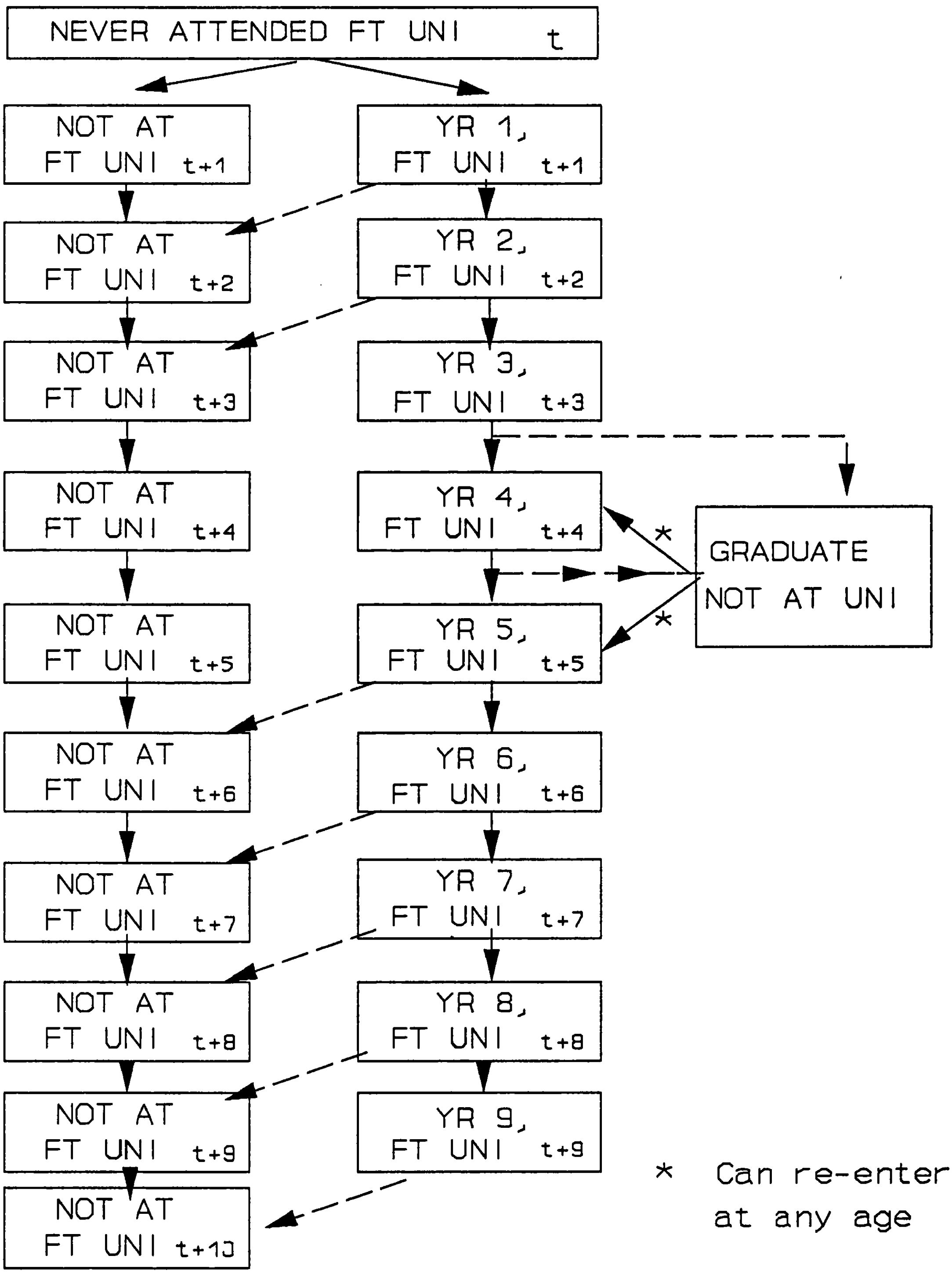
Part-Time University/CAE Studies

All of those who drop out of full-time university are eligible for possible entry to part-time university. Calculating flows between full and part-time sectors and the size of eligible populations was so complicated that only transfers from full to part-time study were allowed, with possible incorporation of transfers from part to full-time study being left for future consideration. At the moment, therefore, once a cohort member has completed a year of part-time university he or she can never attend full-time university. However, the flow modelled appears to be the most important one, as it allows cohort members to complete full-time degrees and later undertake part-time graduate diplomas or masters degrees.

Between the ages of 17 to 24 inclusive, possible entry to Year 1 of part-time university is allowed to all of those with Year 12 completion who have either not attended full-time university or have dropped out of it. The probability of attendance is based on age and sex. SES is not included as an explanatory variable, first, because research has shown that it is less important for part-time than full-time study and, second, because the number attending part-time university before the age of 21, when SES is a particularly important factor, is relatively small.

From ages 25 to 40 inclusive, entry to Year 1 of part-time university is extended to those without a Year 12 certificate, to capture the impact of mature age entrants. At all ages, entry to the next year of part-time university is only allowed to those who were in part-time studies in the *immediately preceding* year. In other words, part-time university drop-outs cannot recommence their studies. However,

Figure 2.6: Structure of the Full-Time University Education Module



as many part-time students are only completing one or two year diplomas or postgraduate degrees this limitation is less significant than for full-time studies. The maximum number of part-time university years allowed is six.

For both full and part-time university studies no cohort members aged 41 or over are allowed to attend university, as the proportion of the cohort attending above these ages is so low that the random selection procedure becomes too unreliable.

The model produces results which appear plausible at younger ages, as summarised in Table 2.4 (there are no comparable data which can be used for validation at older ages). Williams results are for periods spanning some two to five years before 1986 and, given the increases in both secondary retention rates and university participation rates which occurred between the two periods and which particularly affected women, the model's results seem quite good. However, the model does result in about half of the cohort attending at least one year of full or part-time university/CAE at sometime during their life. In part this is due to a period effect, whereby those who were in middle to older age groups in 1986 went to university to gain the degrees which they did not have the

Table 2.4: University and CAE Attendance Rates Produced by the Model and By Williams

Percent of cohort ever attending university or CAE	Model		Williams (1987)	
	Males	Females	Males	Females
All Persons				
- by age 19	22	23	19 (1)	18 (1)
- by age 22	30	30	27 (2)	25 (2)
- all ages	49	48	n.a.	n.a.
Year 12 Graduates				
- by age 19	49	46	56 (1)	42 (1)
- by age 22	66	61	63 (2)	53 (2)

(1) Percent of 1982 sample in uni/CAE by age 19 (in year 1984)
(2) Percent of 1978 sample in uni/CAE by age 22 (in year 1983)

opportunity to gain when they were in their twenties and access to tertiary education was very limited, while those in their twenties in 1986 had high university participation rates and will presumably thus not need to return to university when they are middle-aged.

Despite this problem, it has been decided not to tamper with the data to adjust for this period effect in the initial version of the model. The magnitude of the adjustment which would be required cannot be accurately calculated, and it might well be that the continuing widening of access to those without Year 12 certificates might result in university participation rates at older ages remaining at the 1986 level, despite higher participation rates at younger ages. In addition, despite these higher rates, a significant number of academically talented teenagers from lower SES groups still do not attend university while young, and such groups might well wish to take up tertiary studies in later years. Finally, the overall aim of the model was to replicate Australian society just as it was in 1986: in every field which is modelled there will undoubtedly be major period and cohort effects like that discussed above, but attempting to correct for some but not others will simply raise questions about exactly what is being modelled.

Under plausible assumptions about how years of completed full and part-time university study correlate with completed degrees, an estimated 16 per cent of all men and women in the cohort graduate with 3 year bachelors degrees, around 4 per cent of men and women with masters degrees or postgraduate diplomas, and 0.5 per cent of men and 0.1 per cent of women with Phds. (These percentages show various types of graduates as a proportion of the *entire cohort* whereas the earlier figures, mentioned under full-time university study, showed various types of graduates as a proportion of all graduates.)

Part-Time TAFE Studies

From ages 15 to 19 inclusive, cohort members who have never attended university can enter the first year of part-time TAFE, irrespective of the number of years of secondary school completed. Males and females can complete up to four years of consecutive part-time TAFE (ie apprenticeships). The probability of attendance is based solely on age and sex. However, because those from lower SES families tend to leave school at 15 and 16 and enter TAFE while their higher SES compatriots are still attending school, attendance at TAFE varies strongly by SES. TAFE drop outs may re-enter TAFE at any time. The model results in 34 per cent of all male cohort members completing three years of part-time TAFE by age 19, which seems to accord well with the finding by Williams that 34 per cent of his cohort had ever undertaken apprenticeships by age 19 (1987:166).

From ages 20 to 50 inclusive, part-time TAFE attendance is only assigned for a single year, with the probabilities of attendance dependent upon age and sex, and all of those not actually studying at university in that particular year eligible for entry.

Full-Time TAFE Studies

Full-time TAFE study is assigned from ages 15 to 50 inclusive, and anyone not in another form of tertiary study in that particular year and not still at school is potentially eligible to attend. While it would be desirable to make the modelling of TAFE flows more sophisticated than that outlined above, there were no data on flows which could be used to supply the relevant probabilities, although they might become available during the next few years as TAFE information collection systems improve.

Only TAFE streams 1 to 5 are modelled. Stream 6 consists of adult education 'hobby' courses, in which costs are largely met by participants fees, and which are thus less relevant to the calculation of expenditure incidence.

Lifetime Educational Attainment of Pseudo-Cohort

After all education has been completed, about 19 per cent of both cohort males and females have attained a degree, while some 71 per cent of males and 68 per cent of females have gained some type of tertiary qualification (including a trade certificate) but not a degree (Figure 2.7). The remaining 10 per cent of males and 13 per cent of females only achieve secondary school qualifications. These educational achievement rates are, of course, much higher than those actually apparent amongst the population in 1986, but simply reflect the future educational position of the population if current patterns of educational participation continue.

Figure 2.8 traces the tertiary education profiles of eight pseudo-cohort members. For example, Male No 3 and Female No 2318 had both left school by the beginning of their sixteenth year, but subsequently went on to gain trade qualifications through part-time TAFE studies. Male No 25 left school at the beginning of his eighteenth year and immediately entered full-time university studies, completing four years of full-time university from ages 18 to 21 inclusive, and subsequently completing a part-time postgraduate qualification through three years of part-time university study at ages 23 to 25. Male No 1998 completed no further tertiary education after leaving school at the end of his seventeenth year, while Female No 2856 left school at the same age but gained a degree through six years of part-time university study from ages 20 to 25 inclusive. Finally, Female No 2484 was a mature-age university student, who completed no tertiary studies in the fifteen years after leaving school, but returned to full-time university studies at ages 33 to 35 and gained a degree.

Figure 2.7: Lifetime Educational Qualifications of the Pseudo-Cohort by Sex

MALES

FEMALES

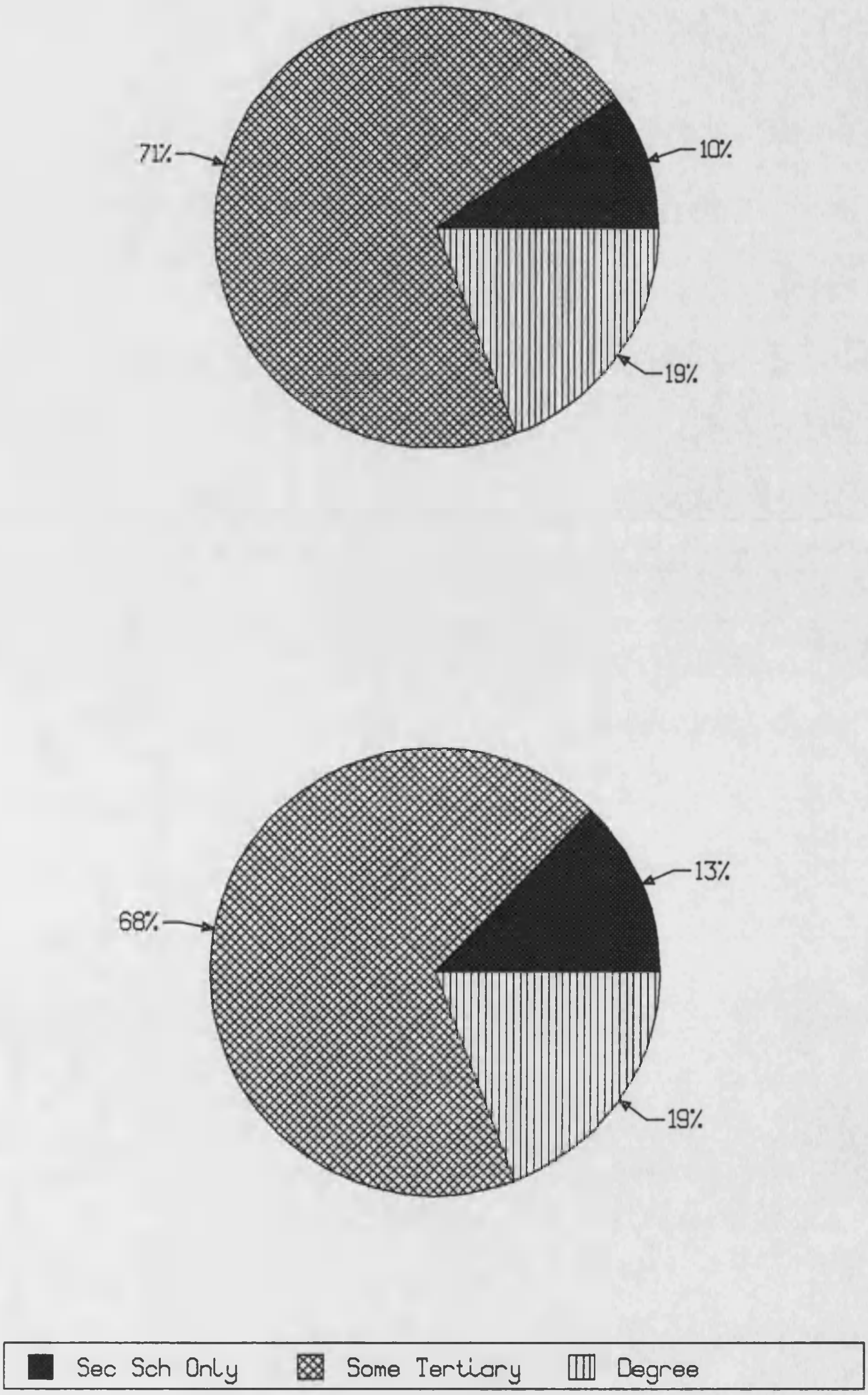
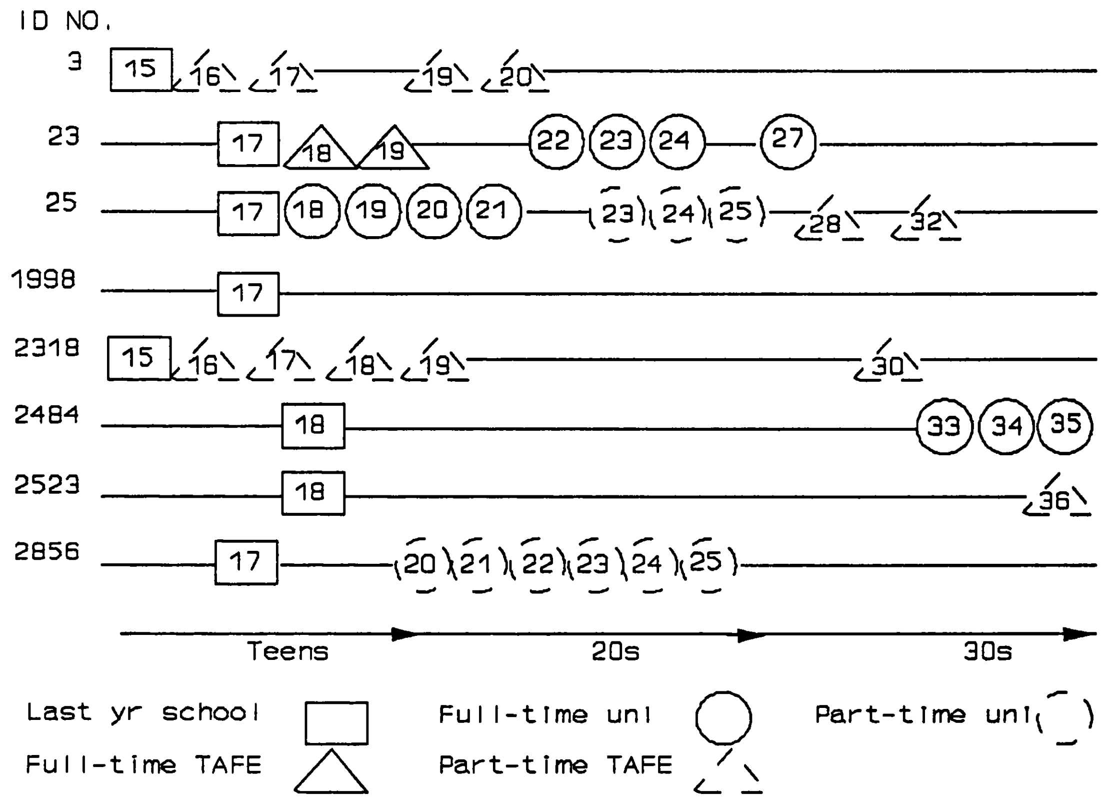


Figure 2.8: Tertiary Education Records of Eight Individuals in the Model



2.6 FAMILY FORMATION AND DISSOLUTION

The simulation of family formation and dissolution is extremely complex. Numerous factors influence marriage and divorce, age at first marriage, the likelihood of remarriage. Family formation and dissolution rates have changed continuously during the twentieth century. It is also not clear which is the most appropriate set of rates to use in modelling family formation. For example, in modelling the probabilitity of marriage, one option is to take the probabilities of marriage for women aged 25 in 1980, 26 in 1981, 27 in 1982 and so on: such rates accurately portray the experience of a real cohort but they are incomplete (eg. we don't know how women born in 1955 will behave once they reach the age of 40) and their experience might not be replicated by any other cohort because of major period or cohort effects.

Yet there are also major questions about the validity of using annual (ie. cross-section) marriage and divorce rates, as they are also likely to embody major period and cohort effects; for example, after the introduction of no-fault divorces in Australia, through the 1976 Family Law Act, divorce rates shot up, and any model based on divorce rates during this period would therefore incorporate a very strong but temporary period effect. Similarly, strong cohort effects could bias cross-section data with, for example, age at first marriage having steadily increased and first marriage and remarriage rates having steadily decreased since the early 1970s (ABS,1988b; Carmichael,1986a).

In the model no attempt is made to remove cohort or period effects from marriage and divorce rates and no estimates are made of how these rates might change in the future. The model simply uses the age and sex-specific marriage, remarriage and divorce rates for 1986 calculated by the ABS (1988b, 1988c). This means that the model replicates a world in which the 1986 rates apply for 95 years. It is, however, possible to change the various rates and examine the consequent impact.

Family Formation

There are essentially two main approaches to the simulation of marriage in dynamic microsimulation models. One approach is to synthetically 'create' a marriage partner for those simulated cohort members selected to marry, generating the characteristics of the new spouse in the same way as the characteristics of the original cohort member were progressively built up. Such an approach is used in the Canadian DEMOGEN and West German SFB3 models. The second alternative is to make males and females in the simulation marry each other; this method is the only one which can be used in dynamic population models, but in dynamic cohort models a choice remains.

One problem with creating new synthetic spouses is that additional computer storage space has to be found to store their characteristics; as the size of the data set comprising the output of the HARDING model was already very large and creating storage problems, it was decided to make the cohort men and women marry each other.

All those involved in constructing dynamic microsimulation models encounter the classic 'two-sex' problem in demography: because the probabilities of re/marriage are different for each sex at each age, it is difficult to decide what to do if more of one sex are selected to marry in any given year than the other. All models essentially solve the problem by averaging the rates or giving one sex's rates priority.

For example, in the DYNASIM model, the relevant marriage rates are applied to both males and females and those who are thus selected to marry form a pool of eligibles. Matches are then made by linking eligible partners of opposite sexes and if there is an excess of one sex in the pool of eligibles "those for whom no potential mate exists are considered to have been victims of a marriage squeeze and are returned to the population to await next year's lottery" (Orcutt et al, 1976:67). This procedure thus means that the correct number of men and women may not get married each year and that the difference between marriage and remarriage rates at any given age may not be maintained.

An alternative procedure is to apply the relevant re/marriage probabilties to either men or women, and then ensure that all of those selected to marry find a suitable partner. This appears to be the procedure adopted by the SFB3 model, in which the need to synchronize the probabilities of marriage for men and women has resulted in the biographies for men being initialised by women (Hain and Helberger, 1986:62). The Canadian DEMOGEN model solves the problem by making male first marriage rates dominant for half of the sample and female first marriage rates dominant for the other half, thereby effectively averaging the rates (Wolfson, 1989b:32).

A number of methods of modelling marriage were tested when building the HARDING model. The model follows the SFB3 approach, in that all those members of the 'initialising' sex who are selected to marry always find a spouse of the opposite sex. The next question was whether to make men or women the 'initialising' sex. When men's re/marriage and divorce rates were used to determine family formation and dissolution patterns, major problems were then encountered in modelling childbirth. Fewer men than women marry, while men also tend to marry later and remarry more frequently, and these different lifetime patterns meant that usage of men's rates led to too few married women during the critical peak childbearing years and thus to insufficient children.

On the other hand, when the option of using just women's rates was tested, too many men were married and had families, relative to men's situation in the real world. It seemed important that neither sex's lifetime patterns be more greatly misrepresented than the other sex's, so a decision was taken to use *average* rates. Given the two year age difference between marital partners which is maintained throughout the model, this means, for example, that the first marriage rate for men aged 22 is the average of the male first marriage rate at 22 and the female first marriage rate at 20 .

These 'averaged' rates were tested when first men and then women were used as the initialising sex. In the event the lifetime patterns created when men were used as the initialising sex were more realistic. For the sex which is not the initialising sex, marriage and remarriage rates at a given age are the same. Because the difference between marriage and remarriage rates is smaller for women than for men, the extent of error introduced is smaller when men are used as the intialising sex. In fact, the random selection procedure worked well, as it replicated the real world in resulting in more women than men getting married and a greater proportion of women marrying only once.

Spouses are matched in the model by sex, age and education level. The average age difference between spouses in Australia is two years and the model replicates this two year age difference. In later versions, it might be desirable to insert a probability matrix allowing a wider range of variation in spouse ages, but it is not clear whether this would make very much difference to the lifetime incidence results.

Cohort males are allowed to marry from ages 17 to 80 and cohort women from ages 15 to 78 (with the difference between the two being due to the standard age gap between partners). Above age 80 the probabilities of re/marriage are too low to model. As cohort members cannot be divorced in the first year of marriage or remarried in the same year as they were divorced, cohort males can divorce at age 18 and above and remarry at age 19 and above. There is no limit to the number of remarriages which can occur but, when the 1986 rates are applied to the cohort, about 1.5 per cent have three or more marriages.

There is a range of research which shows that people tend to chose partners who share very similar characteristics to themselves and that when they do not the risk of marriage breakup is greater (Dyer,1988; Mugford,1980). This is also a mechanism for the continuation of social inequality and is thus important to a lifecycle study. Accordingly, partners in the model are also matched by whether or not they have ever attended university or colleges of advanced education. It is assumed that 75 per cent of males with such attendance marry women who have also had at least one year at a university or CAE, while the remaining 25 per cent marry women who have not attended such tertiary institutions. Similarly, 25 per cent of males who have not attended university are assumed to marry women who have, and the remaining 75 per cent marry women who, like them, have never attended university.

If a 29 year old male is randomly selected for marriage, it is first checked whether or not he is destined to marry a university educated wife. If not, a mate is randomly selected from the pool of women who have not been to university and who are aged 26 and have the marital status of single, divorced or widowed. Thus, in the year the male is 29 he marries a wife who was single, divorced or widowed at age 26 and becomes married at age 27. The age, sex, disablity and education status of the wife are all known and the number and age of any children the woman brings to the marriage are recorded.

The marriage and remarriage rates used are the age and sex specific rates for Australia in 1986 (ABS, 1988b). While the remarriage rates of the divorced and widowed differ (King,1980) both are given the same probability of remarriage in the model. Similarly, while King also showed that 90 per cent of marriages in 1976 were between partners who had the same marital status (eg. both divorced or both never married), in the model the selection of wives for cohort males is not affected by the previous marital status of the cohort females. Both of these simplifying assumptions have been made to reduce the amount of complex programming required and could be areas for future improvement of the model.

A further major problem is created by the existence of de facto relationships, where the partners live together but are not legally married. As Table 2.5 shows, de facto relationships only comprise a significant proportion of all couple relationships below the age of 40. Not all de facto relationships are of great significance when modelling lifetime income. Relationships which only last for short periods of time or where the partners keep separate finances and do not share resources seem unlikely to significantly affect the lifetime income of either partner. However, it seems important to model longer term de facto relationships where the partners have very different incomes but do pool their resources (eg. because one partner is engaged in child care), because otherwise the lifetime welfare of both spouses is likely to be substantially misrepresented.

Table 2.5: Proportion of Legally Married and De Facto Couples, Australia 1986

Age of Male	Per Cent of Couples Who Are	
	Legally Married	De Facto Married
15-19	25	75
20-24	69	31
25-29	87	13
30-34	93	7
35-39	95	5
40-44	96	4
45-49	97	3
50-59	98	2
60-85+	99	1

Source: ABS 1986 Census of Population and Housing, unpublished microfiche (Table CX 0073).

There are, however, few data about the duration of de facto relationships. While the Australian National University's Australian Family Project will presumably publish such estimates in the future, after analysis of their 1986 survey responses, there are few data to substantiate the impression that de facto relationships are of shorter duration than legal marriages or to show what proportion of de facto relationships ultimately become legal marriages.

In constructing the model it has been arbitrarily assumed that one-third of the de facto relationships when the male is aged 15 to 19 and one-half of all de facto relationships at later ages are committed 'marriage-like' relationships likely to significantly affect the calculation of lifetime income. The probabilities of first marriage below age 40 have accordingly been slightly increased to achieve this result. This means that "married" cohort couples comprise both legally married couples and those living in marriage-like relationships. Upon the breakup of such couples, both groups are assumed to have the same probabilities of starting a second 'serious' relationship, so the probabilities of remarriage have not been changed.

All single and divorced cohort members who are not selected to marry in a given year retain their previous marital status for a further year. For those who are selected to marry the characteristics of the spouse are recorded and the number of marriages is increased by one.

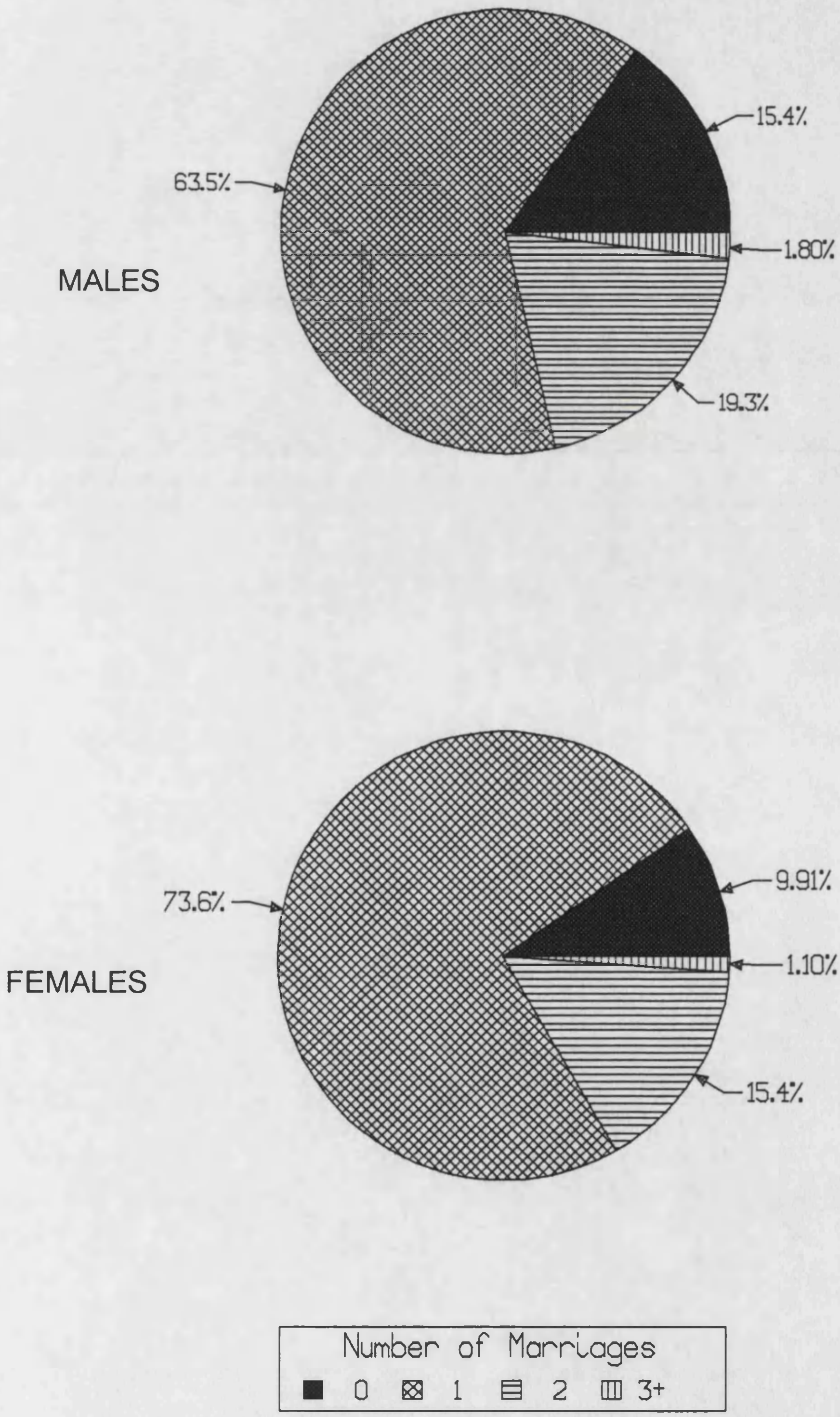
Despite the various limitations described above, the model appears to produce reasonable results. As in the real world, women's first marriage rates are higher than men's and a greater proportion of cohort women marry. Similarly, men's remarriage rates are higher than women's and more men thus have two or more marriages. About 15 per cent of cohort males never marry, while around 64 per cent marry only once, and a further 19 per cent marry twice (Figure 2.9). The remainder marry three or four times. For women, as Figure 2.9 also illustrates, about 10 per cent never marry, almost 74 per cent marry once, about 15 per cent marry twice and around 1 per cent marry three or more times.

Family Dissolution

Although union dissolution rates can be calculated, official divorce statistics tend to simply provide age and sex specific divorce rates. As a result, as with marriage, dynamic modellers face the problem that the male and female partners in a marriage are likely to have different age-sex specific divorce rates. Taking any married cohort couple, if his probability of divorce in a given year according to official statistics is higher than her probability in the same year, whose probability should be given precedence? In DYNASIM the problem is solved by using the male probability of divorce. Both the DEMOGEN and the SFB3 models avoid the problem, the former by applying dissolution rates to unions rather than to individuals and the latter by basing divorce probabilities solely upon duration of the marriage. Another option is to average the two rates and, given the type of Australian data which are easily available, this is the procedure which has been followed in the model.

Cohort couples who are not legally married but living in 'marriage-like' relationships

Figure 2.9: Number of Marriages During the Lifetimes of Males and Females in the Model



are assumed, in the absence of better data, to have the same probabilties of dissolution as legally married couples, and so the divorce rates have not been adjusted to take account of the inclusion of 'serious' de factos.

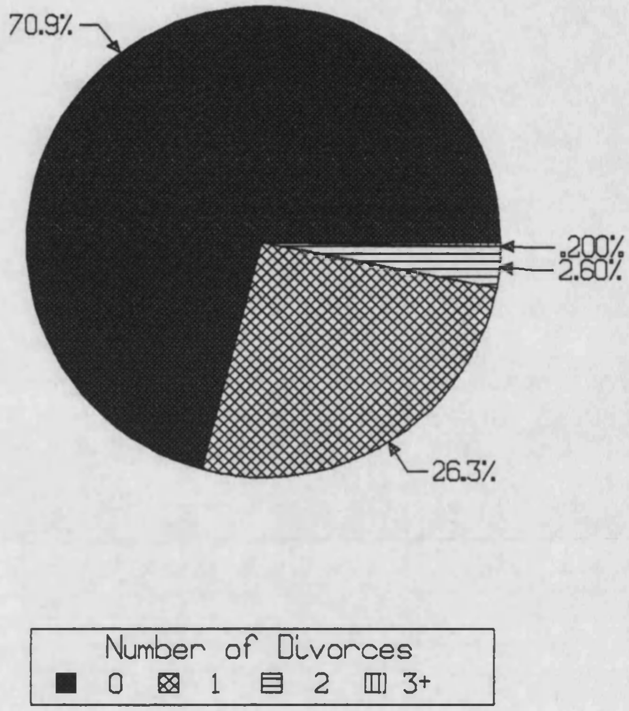
There are numerous factors affecting the probability of divorce (Carmichael and McDonald,1988). Divorce rates differ, for example, by previous marital status and religious conviction, and decline with increasing duration of marriage. However, in the model the divorce rates for the first married and remarried are the same, partly because of the difficulty of finding sufficiently accurate age-sex-marital status specific divorce rates and partly because modelling divorce is already very complex. Because of data deficiencies, the likelihood of divorce in the model also does not decline with marriage duration, but as divorce rates decline with increasing age this does not result in extraordinarily large numbers of divorces during late middle age. Nonetheless, it would be highly desirable to include duration of marriage as an additional explanatory variable in the next version of the model.

When cohort couples are randomly selected for divorce, any children remain with the mother. Couples not selected to divorce retain their married status for a further year. When tested, the model showed around one-third of all marriages ending in divorce. This seems to provide a realistic estimate of likely divorce rates for a cohort borne in 1986 (Carmichael and McDonald, 1988), and compares with the 38 per cent rate produced by the latest version of DEMOGEN (Wolfson, 1989b:38).

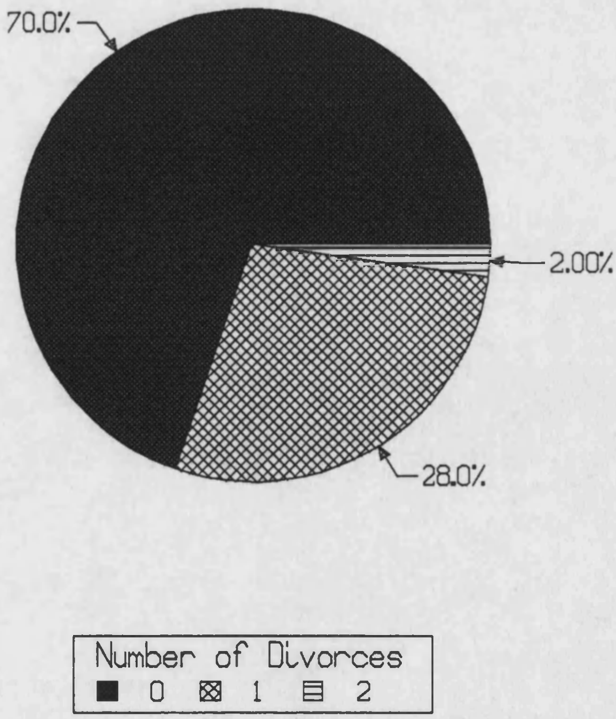
As Figure 2.10 shows, some 71 per cent of males never experience divorce in the simulation, with the proportion being slightly higher than that for women because more men never marry. However, men are more likely to divorce more than once (partly because they are more likely to remarry than women), so that about 2.6 per cent of males experience two divorces during their entire lifetimes and 0.2 per cent three divorces. Only one woman in the synthetic population experienced three divorces.

Figure 2.10: Number of Divorces During the Lifetimes of Males and Females in the Model

MALES



FEMALES

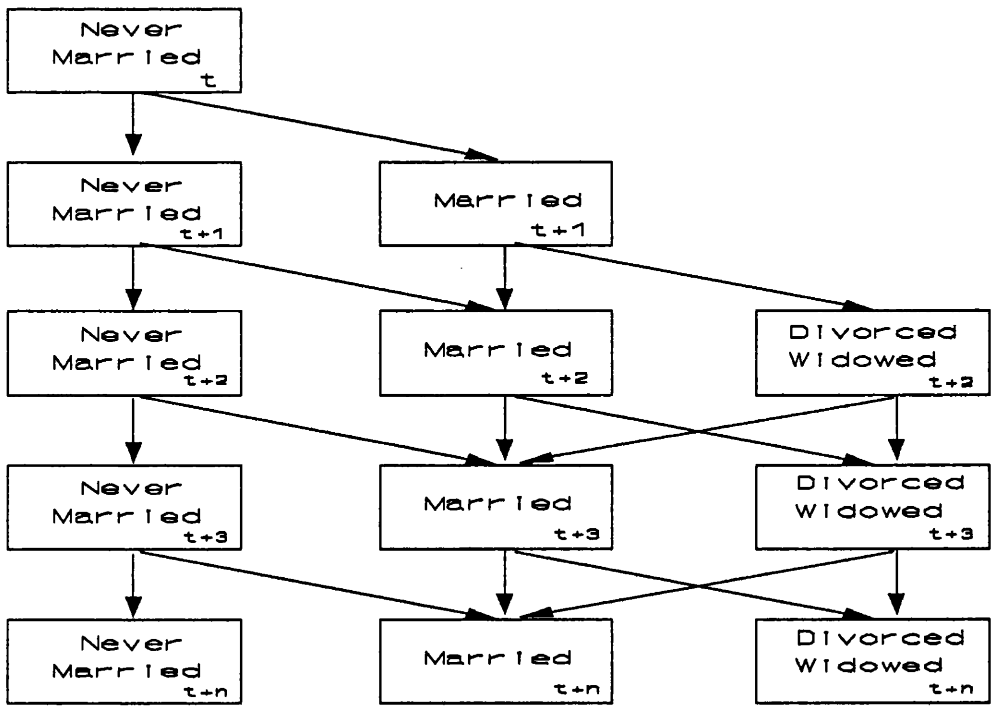


Another major cause of family dissolution is death. For married couples, upon the death of either spouse the surviving spouse is given the code of widowed and returned to the pool of potentially available marriage partners. Any children remain with the surviving spouse, so that a number of cohort males do become sole parents. Sole parents who die exit the model, along with their children.

Families also change due to children leaving home. Children are allowed to leave home from age 15 onwards, and all are assumed to have left home by age 25. Based on probabilities calculated from the 1986 IDS, children of the pseudo-cohort are categorised as being at home but not in full-time study and not dependent; at home, in full-time study and dependent; or away from home.

Figure 2.11 illustrates the steps followed when simulating the yearly changes in family formation and dissolution in the model.

Figure 2.11: Structure of the Family Formation and Dissolution Module



2.7 FERTILITY

A good model of fertility would contain the probabilities of giving birth by the age, marital status, parity and period since last childbirth of the mother (and additionally, by the duration of marriage for married women). However, the data do not exist to construct such an accurate model for Australia.

First, statistics are collected on the number of children already borne by married women when they register a birth, but these are only "previous issue to the current marriage". The children from previous marriages, earlier de facto relationships and so on are not counted (Carmichael,1986b), and accurate estimates of births by parity are thus not possible. Second, the lack of data is even more serious for ex-nuptial births, where no data are collected about the number of children a mother has already borne. Ex-nuptial births have formed an increasing percentage of total births, reaching 16.8 per cent in 1986. As a result of these data deficiencies the birth section of the model is not fully comprehensive, but can be easily amended when better data become available.

The ABS has published the number of confinements by age for both married and unmarried women in 1986 (ABS,1987e:10 and 13) and these are used as the basis of the model. To calculate the probabilities of confinement by age and marital status, accurate estimates of the number of married and unmarried women (ie. of potential mothers) by age are also required. As noted in the earlier description of marriage, de facto relationships pose a considerable problem in lifecycle modelling and in the model it is assumed that one-third of all de facto relationships between the ages of 15 and 19 and one half at all later ages are serious 'marriage-like' relationships. Partners in such 'marriage-like' relationships are given the marital status of 'married' in the model.

It is therefore important to adjust the births data, as a misleading impression would be created if all of the ex-nuptial births were assigned to sole parent mothers, when many were actually the product of two parents who lived in a marriage-like relationship. Table 2.6 shows the proportion of Australian ex-nuptial births by age of the mother in which paternity is acknowledged by the father (Choi and Ruzicka, 1987:131). British data for 1987 found that exactly the same proportion - 68 per cent - of UK ex-nuptial births had the father's name on the birth certificate and that in 70 per cent of these cases of joint registration the mother and father lived at the same address (CSO, 1989). It is therefore assumed in the model that 70 per cent of Australian fathers acknowledging paternity of ex-nuptial babies live with the mother in a 'marriage-like' relationship, and these ex-nuptial babies are thus reassigned to the 'married parents' category when calculating the probability of confinement by marital status in the model.

Table 2.6: Assumed Percentage of Ex-Nuptial Births With Parents in Marriage-Like Relationship in the Model, by Age of Mother

Age of mother	Percent of ex-nuptial births with paternity acknowledged in 1985 (Choi et al, 1987)	Assumed percent of ex-nuptial births with parents in 'marriage-like' relationship in simulation *
15 to 19	59	41
20 to 24	70	49
25 to 29	74	52
30 to 34	75	53
35+	74	52
All ages	68	48

* That is, second column is 70 per cent of first column.

A randomly generated number is assigned to every women every year between the ages of 15 and 44 inclusive. In the case of married women, when this number is less than or equal to the probability of confinement for a woman of her age, marital status and parity then she is selected for confinement. In the case of unmarried women, the probability of confinement is solely dependent on age and parity is thus not considered. As only around 10 per cent of all cohort babies are born to women who are not in 'marriage-like' relationships, the extent of error introduced by failing to model ex-nuptial births by parity seems likely to be minor.

Once a woman has been selected for confinement the probability of a multiple birth is assigned. The probabilities are taken from the DYNASIM model, with 98.12 per cent of all women selected for confinement giving birth to one child, 1.85 per cent to two and 0.03 per cent to three children (Orcutt et al, 1976:64). Higher multiple births are not modelled as the probabilities are too low. Although a proportion of women who experience confinement do not achieve a live birth, and a significant proportion of babies die within the first year of life, to simplify the model these factors have not been taken account of, and no children are allowed to die. This might result in a fertility rate which is slightly too high given current trends.

However, when tested the model appeared to provide a reasonable representation of reality. The total fertility rate for all cohort women was about 1.85, which compared well with the Australian total fertility rate of 1.87 children in 1986 (ABS, 1988e:1). The cohort women thus give birth to somewhat less than two children, below the population replacement rate, and in accord with the latest fertility estimates by Australian demographers (Choi and Ruzicka, 1987:136).

As Table 2.7 shows, the parity progression rates also appear to be quite realistic. As expected, progression rates are much lower for unmarried mothers. It is difficult to compare the lifetime distribution of families by family size with cross-section distributions but, during the lifetime of cohort mothers, about 30 per cent produce one child, 33 per cent two children, 17 per cent three, and 8 per cent four or more children (Figure 2.12). The birth order of children as a proportion of all babies born to all cohort mothers is also very close to that recorded for married women only by the ABS in 1986: for example, about 32 per cent of all cohort babies were second children, while for married women in Australia in the same age range the relevant proportion was 35 per cent (1987e).

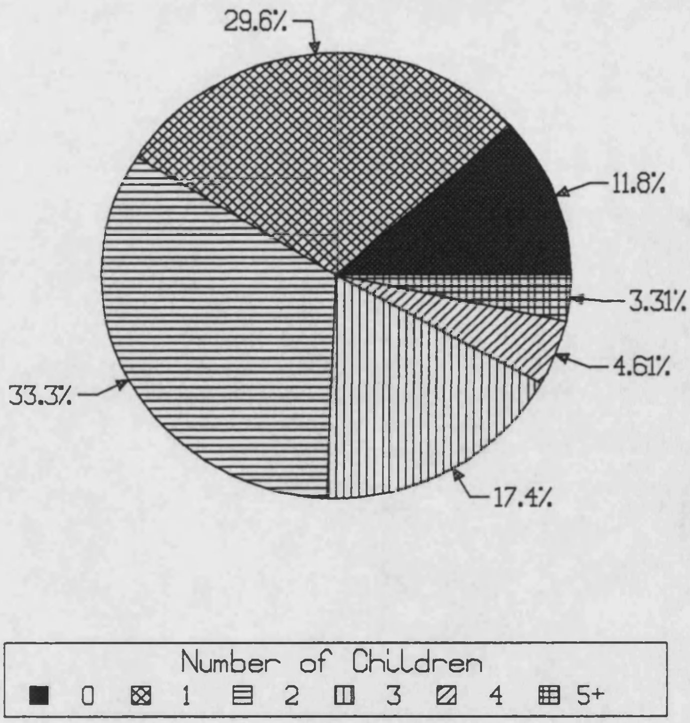
Table 2.7: Parity Progression Rates in the Model and in Australia

	Estimated percent proceeding from 1 to 2 children	2 to 3 children	3 to 4 children	4 to 5+ children
Australia				
Married women only, aged 15-44[1]	87	49	32	42
Married women within 10 yrs marriage duration[2]	80	39	22	*
Model				
Married women	76	44	32	42
Unmarried women	19	28	23	*
All women	66	43	32	42

* Not available

Notes: (1) Calculated from ABS (1987e). (2) Choi and Ruzicka (1987:133)

Figure 2.12: Number of Children Born To Cohort Females



Examples of Lifetime Family Records in the Model

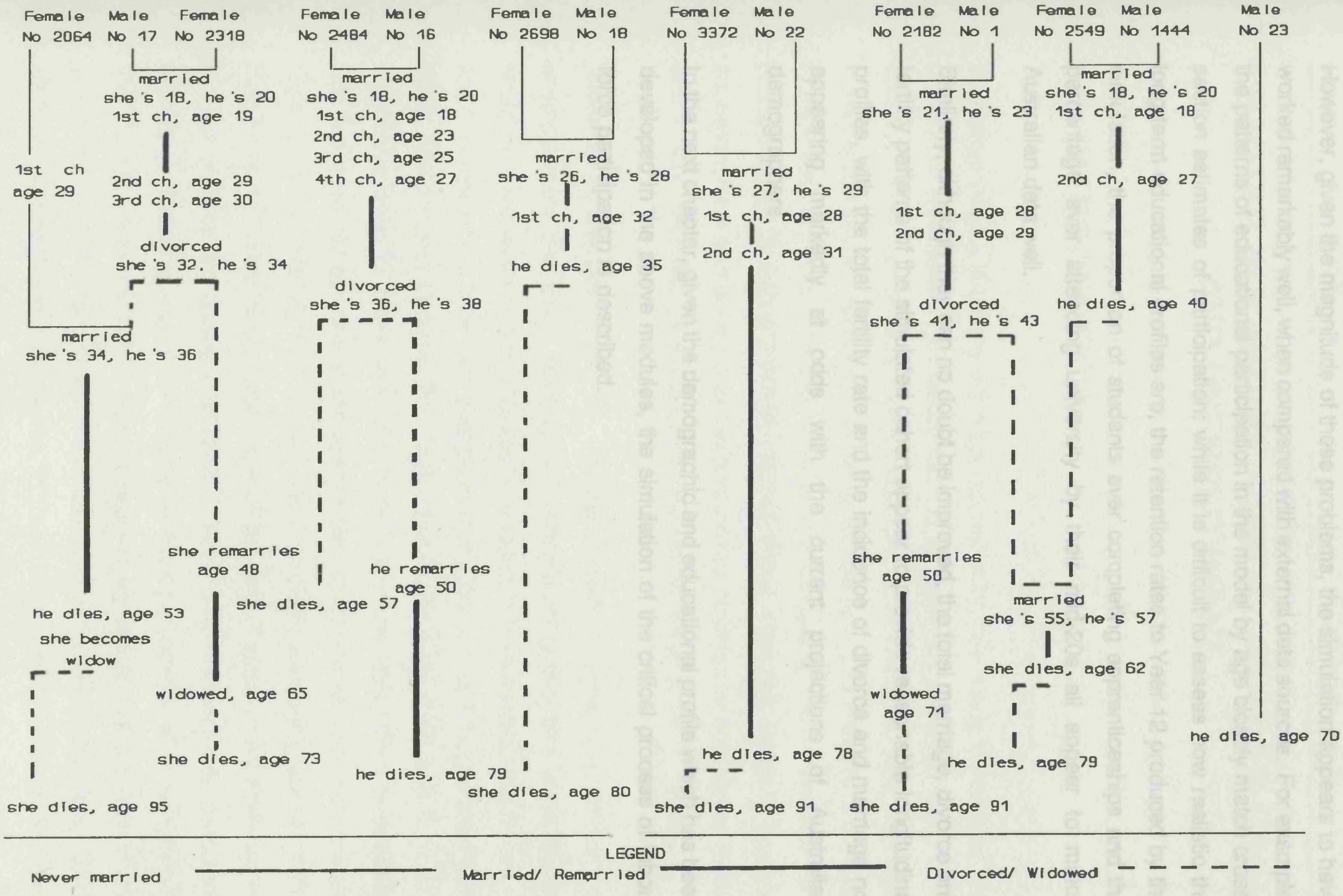
To illustrate how the family formation, dissolution and fertility modules work in practice, Figure 2.13 illustrates some sample family histories of individuals in the simulation. For example, Female No 2064, at the left of the graph, became a sole parent at the age of 29, but subsequently married Male No 17 at the age of 34. They had no children together, and she was eventually widowed when he died at the age of 53. She then lived for another forty years by herself, finally dying at the age of 95.

Similarly, Female No 3372 and Male No 22 married in their late twenties, and almost immediately started a family, with their first child being born when she was aged 28 and the second and last being born three years later. They then enjoyed a long marriage, until he died at the age of 78. In contrast, Male No 23 remained single for the whole of his life, finally dying at the age of 70.

2.8 CONCLUSION

Much of the data needed to simulate accurately the processes of demography, disability and education are not available in Australia, particularly data which deal with the probabilities of exiting and entering states, such as disability or full-time study. As a result, the relevant probabilities have to be inferred from cross-section data which show the percentage of a relevant group in a particular state, from overseas evidence, or from small and sometimes unpublished studies which happen to have examined the issue in question (such as the Victorian government data on secondary school student flows). Even the official demographic data available are inadequate for the purposes of dynamic microsimulation with, for example, no information about birth rates by parity for unmarried women, or about the probability of divorce by age, sex, education, previous marital status and duration of marriage.

Figure 2.13: Lifetime Family Formation, Dissolution and Fertility Records of Fourteen Individuals in the Model.



Note: The age attached to the birth of children is the age of the female.

However, given the magnitude of these problems, the simulation appears to have worked remarkably well, when compared with external data sources. For example, the patterns of educational participation in the model by age closely match cross-section estimates of participation; while it is difficult to assess how realistic the long-term educational profiles are, the retention rates to Year 12 produced by the simulation, the proportion of students ever completing apprenticeships and the percentage ever attending university by their mid-20s all appear to match Australian data well.

Similarly, although they can no doubt be improved, the total marriage, divorce and fertility patterns of the simulated cohort appear to provide reasonable longitudinal profiles, with the total fertility rate and the incidence of divorce and marriage not appearing markedly at odds with the current projections of Australian demographers.

In the next chapter, given the demographic and educational profile which has been developed in the above modules, the simulation of the critical process of labour force participation is described.

CHAPTER 3: LABOUR FORCE PARTICIPATION AND UNEMPLOYMENT

3.1 INTRODUCTION

As earned income is usually the major source of income during the lifetime the decision to participate in the labour force is an extremely important one. This decision is heavily dependent upon demographic characteristics, with Australian cross-section studies repeatedly showing, for example, that a woman's decision to participate is greatly affected by her marital status and whether she has very young children (Brooks and Volker, 1985:45; Volker, 1984:51). Similarly, age and education have also emerged as key explanatory variables for both sexes (Miller and Volker, 1983:83; Bureau of Labour Market Research (BLMR), 1985a).

Additional challenges arise in modelling labour force participation or unemployment *over time*. Although measuring mobility over time is not always straightforward, as a number of studies have found, there are substantial flows into and out of the labour force each year (Abowd and Zellner, 1985; Hogue and Flaim, 1986; Atkinson and Micklewright, 1990). For example, as Clark and Summers emphasise, even for prime age males in the US, whose labour force participation rate averaged 92 per cent in the year of their study and who are not normally regarded as particularly mobile, over one-third of employment entrances came from those not in the labour force while 28 per cent of employment spells ended in labour force withdrawal (1979:283). Yet, notwithstanding this undoubted mobility, available studies of dynamic labour force participation also demonstrate that there is a great deal of consistency between an individual's decisions in one year and the next (Nakamura and Nakamura, 1985; Picot, 1986; Joshi et al, 1981). As Nakamura and Nakamura observe, in constructing longitudinal microsimulation models it is not sufficient that the year-by-year distributions of earnings and employment "for various age-sex groups be correct. Rather, the observed continuity of the employment and earnings behaviour of individuals over time must be properly captured" (1985:9).

The inherent difficulties involved in modelling dynamic labour force supply are magnified in Australia by the lack of longitudinal data. There seem to be two possible publicly available sources for such modelling - the *Australian Longitudinal Survey*, which is a continuing annual study of two separate samples of people aged 15 to 24 in 1984, and the *1986 Income Distribution Survey* micro-data tape, which contains very detailed information on individual and family characteristics and provides details of labour force status during two separate periods. These are *previous* labour force status during the financial year 1 July 1985 to 30 June 1986 and *current* labour force status at a second point in time, which varied over the sample from September to December 1986.

While the ALS survey provides a rich longitudinal data source it only covers younger people and so, at least for the purposes of building the prototype of the HARDING model, the IDS data has been used, as it provides an entirely consistent data source for the whole lifecycle. However, this does mean that the possible modelling options are completely dependent upon the handful of labour force variables which are on the IDS tape and, as described below, this has affected the simulation in a number of important ways. In addition, while defining who is and is not in the labour force is not a straightforward exercise (for example, due to the phenomenon of 'hidden' unemployment - BLMR,1985a, Chap 2), it also means that the definitions of employed, unemployed, in and not in the labour force used in the module are the same as those used in the IDS (see Appendix 1).

The structure of the labour force participation module is very complex, and an overview is provided in Section 3.2. The remaining sections describe the individual steps of the simulation in more detail, with Section 3.3 outlining the simulation of labour force re/entry or of continuing participation in the labour force, Section 3.4 discussing the assignment of self-employment status, and Section 3.5 explaining the imputation of hours worked. Section 3.6 describes the simulation of unemployment and hours unemployed, while Section 3.7 details the separate procedures followed for modelling the labour force status of full-time students and invalids. Finally, Section 3.8 summarises key aspects of the dynamic labour force profiles generated by the model.

3.2 OVERVIEW OF THE MODULE

The modelling of labour force status is done through six discrete steps which are shown in Figures 3.1 and 3.2 and described more fully below for each sex. The two sexes are treated separately as their labour force participation patterns over the lifecycle are very different (BLMR, 1985a:46).

The general approach is similar to that developed by other researchers, in treating transitions between labour market states as a first-order Markovian process (eg. Clark and Summers, 1979:282) and, in particular, the labour market module is very similar in structure to that used in the DYNASIM microsimulation model (Orcutt et al, 1976). The first-order Markovian model means that it is assumed that each individual's labour force behaviour can be represented by a matrix of transition probabilities, in this case applied every year, in which an individual's transition decisions only depend upon their circumstances in the *immediately preceding year*, and thus do not depend upon how long they have been in a particular state. For example, all males of a given age and education level in the labour force are assumed to face a given probability of remaining in the labour force for a further year, and this probability is the same, irrespective of whether they have been in the labour force continuously for the preceding twenty years or for only two years.

The first step in the module is to assign whether the individual is *in the labour force* in the current year for an hour or more. For each year of life a randomly generated number is attached to an individual's record. For those who were not in the labour force in the preceding year, when this number is less than the relevant probability of labour force entry, the individual is selected to enter the labour force. Similarly, for those who were in the labour force last year, if the random number is less than the probability of leaving the labour force, then the individual exits the labour force. If the randomly generated number is greater than the applicable probability then the person's labour force status remains the same for a further year.

Both males and females can enter the labour force from the age of 15 onwards, with labour force participation ceasing completely at the age of 85. Those who are selected not to enter or to leave the workforce in any given year are coded as not being in the labour force, all the other labour force characteristic variables are set to missing, and the following five steps are skipped. For those selected to re/enter or remain in the labour force the following five procedures are followed.

The second step in the module is to assign *self-employment status* (as the self-employed and the non-self-employed have different labour force characteristics, especially during the later working years, and very different income patterns). Another random number is attached to each individual's record for every year of life and, for those who were self-employed last year, if this number is less than the probability of remaining in self employment for a further year then the individual stays self-employed. Otherwise they are re-categorised as a wage and salary earner. Using the same random number procedure, some people who were non-self-employed in the one year can enter self-employment the next year.

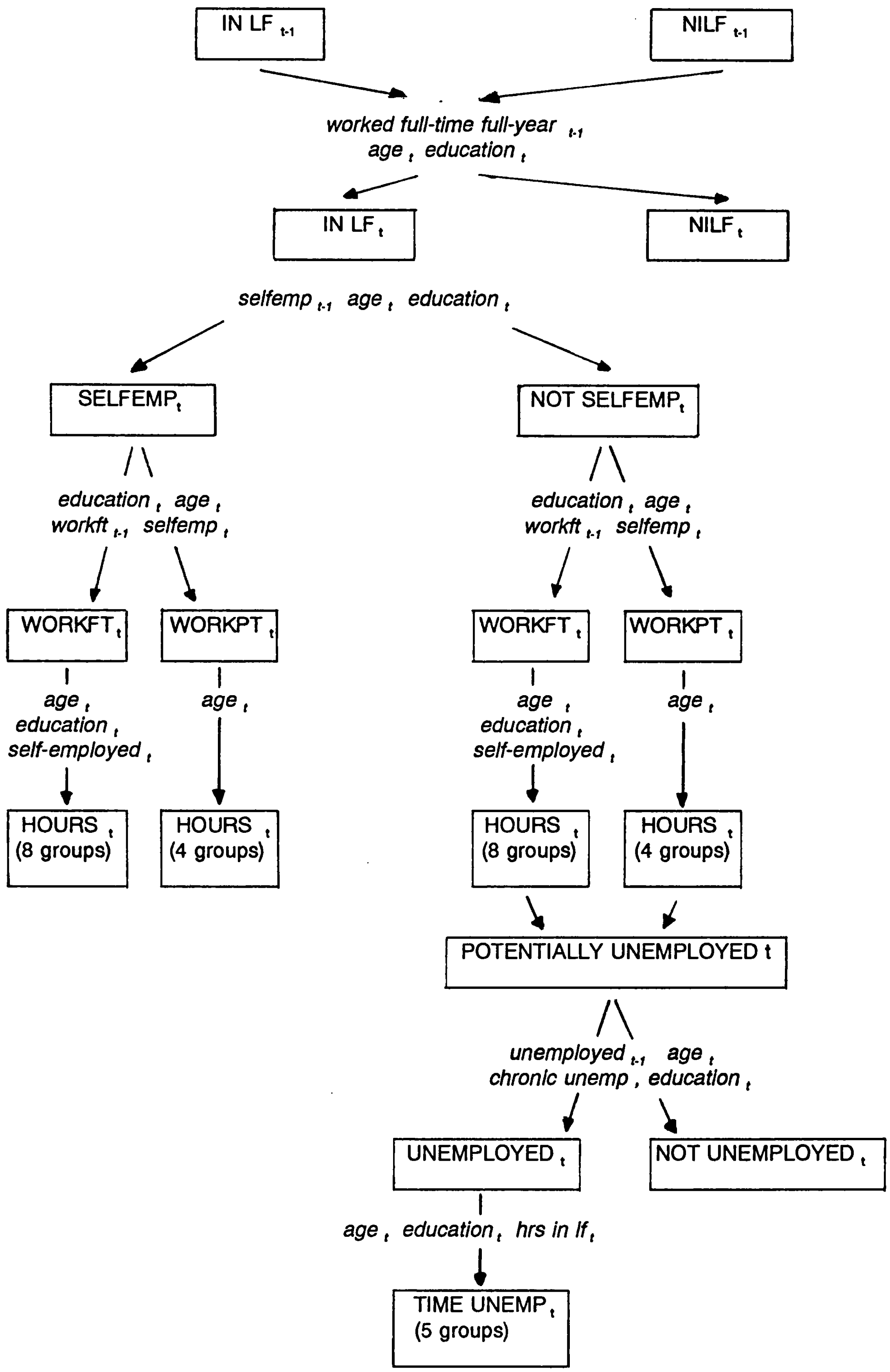
The third step is to determine the *number of hours* cohort members are in the labour force during the entire year. Because the 1986 IDS tape only provided labour force status at a single point in time during the 1986-87 financial year, rather than for the entire 1986-87 financial year, the calculation of hours worked per year is divided into two discrete stages. During the first stage, those cohort members selected to be in the labour force are divided into whether they are working full-time or part-time in the current year (based on the probabilities of being in each state recorded by respondents to the 1986 IDS at the single point in time in 1986 when they were interviewed). Secondly, the cohort are then assigned to one of up to eight 'hours in the labour force per year' categories, which are based on the probabilities of working different numbers of hours during an entire year for those IDS respondents who said they worked full-time and part-time respectively in 1985-86. This stage is again based on a simple probability table, as hours worked in the IDS was divided into ranges and a continuous 'hours worked' variable was thus not available.

The fourth stage is to determine whether the individual experiences *any unemployment* at all in the current year. If so, the fifth and final step is to calculate for the entire year the *percentage of time in the labour force which is spent unemployed.* The above procedures effectively hold the labour force participation rate, the unemployment rate, the distribution of full and part-time work, and the distribution of hours worked and hours unemployed fixed at the 1985-86 level for the entire lifetime of the pseudo-cohort. As in every other part of the model, such steady state assumptions provide a useful benchmark, but are obviously unlikely to replicate the actual fortunes of those born in 1986; for example, many would expect further substantial increases in female participation rates or a further shift towards part-time jobs during the coming decades (BLMR, 1985a:40).

Amending the benchmark assumptions is not a trivial matter however. For example, it would be relatively easy to inflate the labour force participation rates of each sex by a *uniform percentage* or deflate the various unemployment rates by equal amounts, either for all years of the pseudo-cohort's 'life' or just in the later decades of life (on the basis that, for example, current demographic trends suggested that unemployment rates would decline in the future).

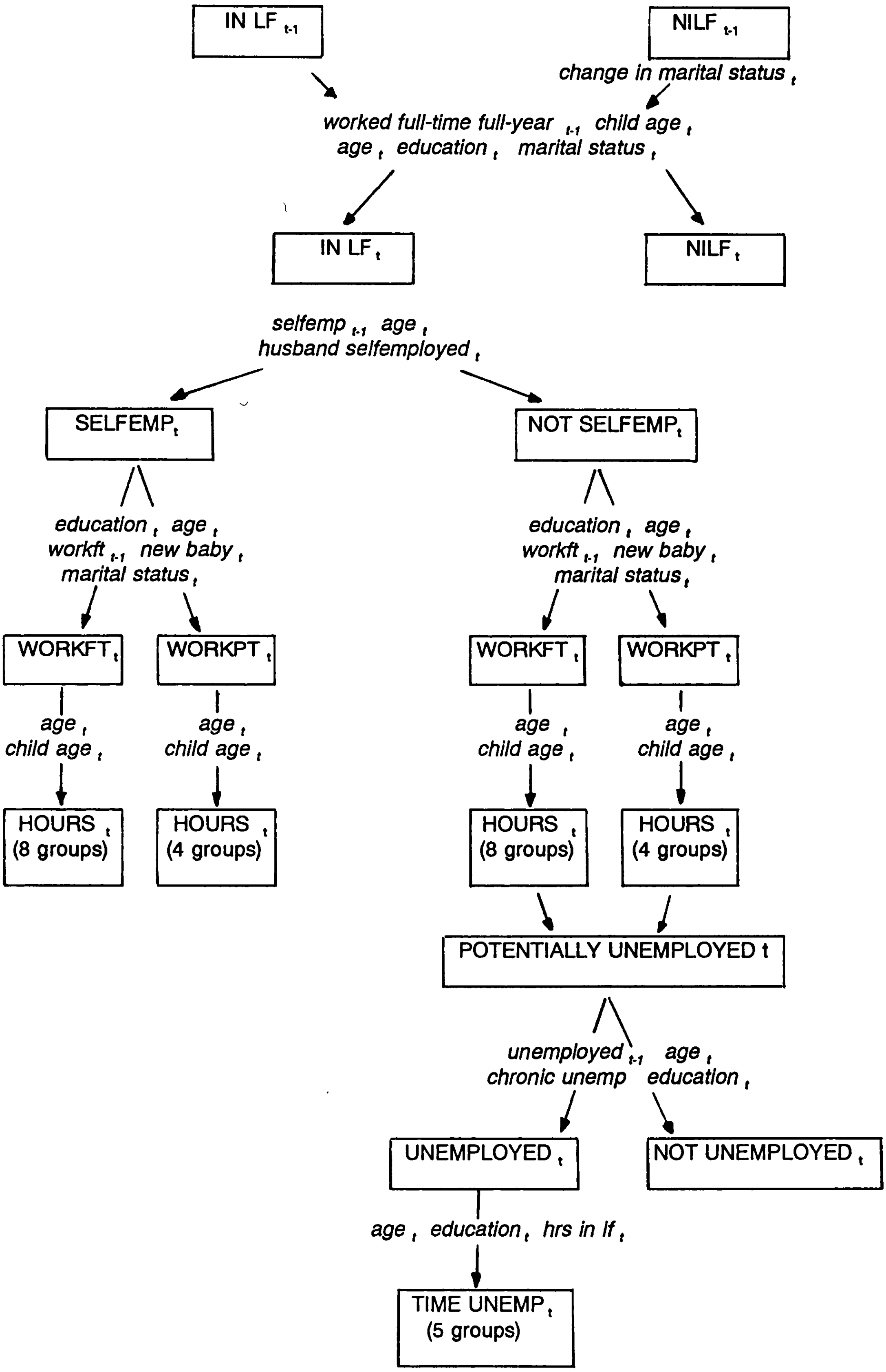
However, such simplistic procedures would seem unlikely to be very accurate. Research has shown that the participation decisions of women are more responsive to variations in labour market conditions than those of men (Eccles, 1984:8), indicating that different adjustments to the rates for men and women

Figure 3.1: Structure of the Labour Force Participation Model for Males



Note: Names written in italics are the explanatory variables which affect the relevant probabilities .

Figure 3.2: Structure of the Labour Force Participation Model for Females



Note: Names written in italics are the explanatory variables which affect the relevant probabilities .

would be necessary. Similarly, certain groups of men also seem more likely than others to be discouraged workers - in particular the over 55 year olds (BLMR,1983). This suggests that any attempt to change the benchmark assumptions of the 1985-86 status quo, in response to an assumed future improvement or deterioration in economic conditions, would require different adjustments to each of the dozens of separate probability cells upon which the labour market transitions are based.

Similar issues arise when attempting to model changes in labour supply due to changes in taxes or government transfers. The later assessment in this study of the distributional impact of taxes and transfers currently assumes no corresponding change in behaviour; nonetheless, it would clearly be desirable to incorporate behavioural change in the model in the future as, for example, studies have suggested that female labour supply is responsive to changes in transfer income (Killingsworth, 1983). However, as Hagenaars concluded after a survey of the available econometric evidence, "the variance of elasticities is currently too high to give one unanimous 'guesstimate' useful for microsimulation"(1989:31).

Equally importantly, little is known about how improved economic conditions or changes in the level of taxes and transfers would affect lifetime participation decisions (Altonji, 1986; MaCurdy, 1981). For example, using panel data, Heckman and MaCurdy found evidence that labour force participation decisions are made with a very long time horizon in mind, and that the future values of variables determined current labour supply decisions (1980:67). It is therefore possible that improved economic conditions and higher wages might lead to increased labour supply during the early to mid-years of working life, but earlier retirement during the later years. In conclusion, while sensitivity analysis of the results will be very interesting to conduct, freezing the various labour force rates at the 1985-86 level and assuming no behavioural change appears an appropriate starting point.

A final issue is that this model of labour force participation, like those in the

DYNASIM and SFB3 models, is based on a first-order Markov process - ie. the probability of being in or out of the labour force or of being self-employed simply depends upon status in the immediately preceding year (Orcutt et al, 1976). Such an approach will misrepresent lifetime labour force participation, hours and self-employment behaviour if behaviour during earlier years or decades significantly affects current decisions, and this effect is not adequately captured by reference to the immediately preceding year.

Some studies have found that the longer an individual is in the labour force the less likely he or she is to leave it. For example, using recall data from the Canadian Family History Survey, Picot found that "the probability of exiting the state after three years duration is only from one-third to one-half as large as after one year" (1986,14). Using data from the US National Longitudinal Survey of Labour Market Experience, Eckstein and Wolpin calculated that the predicted probability of working increased with the length of time spent in the labour force with, for example, the probability of working for married women aged 39 with no children in their household being 65 per cent if they had 10 years of labour force experience but increasing to 85 per cent if they had 20 years (1989:387).

Similarly, using data from the new German panel study, Merz found that the number of years of full and part-time work was positively correlated with the probability of being in the labour force (1987:19). Finally, an Australian study based on a 1980 survey of the work patterns of married women in Sydney found that each extra month of previous experience significantly raised the probability of participating in the labour force (Ross,1986:331).

The above evidence thus suggests that models based only on the labour force state in the preceding year could overestimate the likelihood of transtions between the various labour market states - ie. as Picot points out, "the result is too many transitions between states and a model which produces an employment pattern which is too sporadic" (1986:1). Such a conclusion has, however, been disputed by Nakamura and Nakamura. Using longitudinal data from the Michigan Panel

Study on Income Dynamics, they found that after controlling for work behaviour in the immediately preceding year, additionally taking account of work experience since the age of 18 only negligibly increased the accuracy of their predictions of current work behaviour (1985:291).

The Nakamuras' included both hours of work and wages earned in the preceding year as explanatory variables affecting labour force participation in the current year; these two variables were not included in the regression equations in the other studies cited above, which instead used years of experience. It is thus not possible to check in these studies the possible importance of state duration over and above work behaviour in the preceding year.

It is therefore very difficult to judge how accurate the lifetime employment patterns produced by the model are. Any potential misrepresentation seems likely to be less significant for men, as almost all are in the labour force. However, if any new Australian data are collected which suggest that the employment profiles are insufficiently consistent, the relevant probabilities can be amended.

3.3 LABOUR FORCE PARTICIPATION

For those who had and had not been in the labour force at any time during the preceding year, the probabilities of being in the labour force at any time during the current year were calculated. Both males and females were first divided into three groups who seemed likely to have very different patterns of labour force participation - full-time students, invalids, and the remaining majority, who were not in either of the above two categories. (The procedures used for invalids and full-time students are discussed in Section 3.7.) For the remainder, either the probability of remaining in the workforce for a further year or of re/entering the workforce was estimated, using Markov cell-transition probabilities. While the DEMOGEN and SFB3 models used econometric techniques to simulate the decision to enter or leave the workforce, and this remains an alternative way of modelling such decisions, the HARDING model currently follows the DYNASIM model in using simple tables of probabilities of participation.

The significance of a number of possible factors affecting labour force participation was tested, and, in particular, analysis was carried out to determine which of the various 1985-86 labour force variables available on the 1986 IDS tape provided the best predictor of still being in the labour force the following financial year. Ultimately, whether the individual worked full-time for 52 weeks in the preceding year emerged as the best predictor of current labour force status.

Males

For males generally, the probability of being in the labour force during a given year for those who were in the labour force in the preceding year was made dependent upon age, whether the individual worked full-time for 52 weeks in the preceding financial year and education. For those who had not been in the labour force in the preceding year the probability of re/entry was based upon age and education. As expected, labour force participation rates by age formed an inverted U, with the percentage participating increasing sharply in the teens and twenties, peaking in the forties and declining from the late fifties onwards.

Previous Australian cross-section research has shown that the higher the level of *education* the greater the likelihood of labour force participation (Brooks and Volker, 1985:47). Education has also emerged as an important factor in longitudinal profiles, with Picot, for example, finding that after controlling for other explanatory variables, "the higher the level of education the less likely a man or woman is to leave employment and the more likely they are to re-enter it" (1986:20).

The three education categories used in the model were 12 years or less of secondary education but no tertiary qualifications; trade or other diplomas and certificates; and bachelor degrees or higher. More detailed education breakdowns were examined but, because almost all men were in the labour force every year, there were, for example, minimal differences between the pattern for those with 12 years of secondary schooling and those with less than 12 years. Education made a slight difference to the labour force participation rates of prime age males; while about 95 per cent of males aged 25 to 49 with only secondary qualifications were in the labour force, the proportion rose to 98 per cent for those with some tertiary qualifications and 99 per cent for graduates.

For prime age males, about 99 per cent of those who worked full-time for 52 weeks in the preceding year were in the labour force the following year, irrespective of education level. For those who did not work full-time full-year in the preceding year, education made a significant difference to the likelihood of being in the labour force in the current year, with the anticipated differences between the three education categories becoming most pronounced at ages 50 to 64, as those with less education dropped out of the labour force earlier.

The second set of variables on labour force status in the 1986 IDS, as mentioned earlier, measured current labour force status *at a single point in time.* As other researchers have noted, the proportion of males who are in the labour force *during an entire year* is higher than that during a single month (BLMR, 1985:52). Similarly, the IDS data found that an additional 1.5 per cent of men were in the labour force at some point during financial year 1985-86, compared to those who were in the labour force at the time of interview in late 1986. While the discrepancy is more pronounced for females, because they tend to move in and out of the labour force more frequently, there is a slight difference between the two measures for men, with the magnitude varying by age and education.

This means that, if the relevant probabilities of exiting and entering the labour force are estimated by simply using the proportion of men in the labour force during the 12 months to June 1986 and the proportion of men in the labour force during a single month in late 1986, then too many men will be selected to leave the labour force each year. As a result, the explanatory variables discussed above were used to provide an indicator of the differences in risk faced by those of different age, education etc, and all the relevant probabilities were then inflated to produce the correct annual participation rates by age, sex and education level. The labour force participation rates of males by education status found in the 1986 IDS and simulated by the model are shown in Figure 3.3, and suggest that the model does a reasonable job of replicating differences in participation rates by age and education.

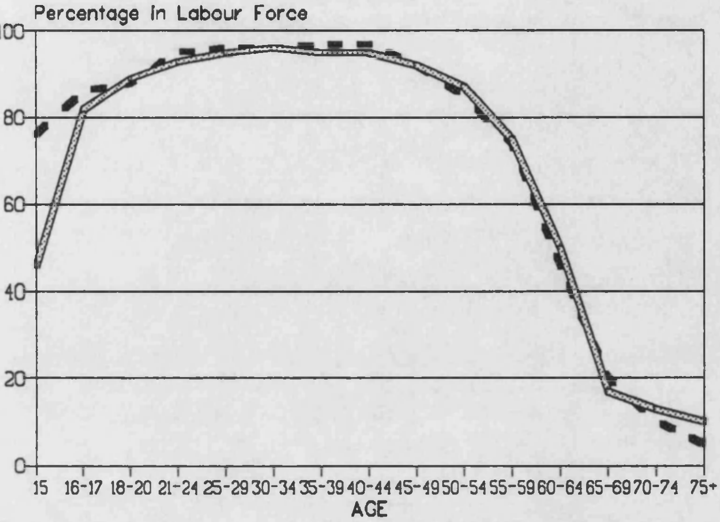
The impact of *marital status* upon the probability of remaining in the labour force for males was tested as a further explanatory variable, but it appeared insignificant once other variables had been controlled for as, during the prime working years, almost all males who were in the labour force one year remained in the labour force the next year.

It would have been desirable to have included a host of other explanatory variables in the model, including transfer income and non-earned income in the preceding year (negatively correlated with being in the labour force this year) and disability status (Orcutt et al, 1976). However, only some 8000 records for males were available on the 1986 IDS tape and, once more than the handful of explanatory variables described above were used, the size of the sample cells became unacceptably small with the results thus becoming correspondingly unreliable.

Females

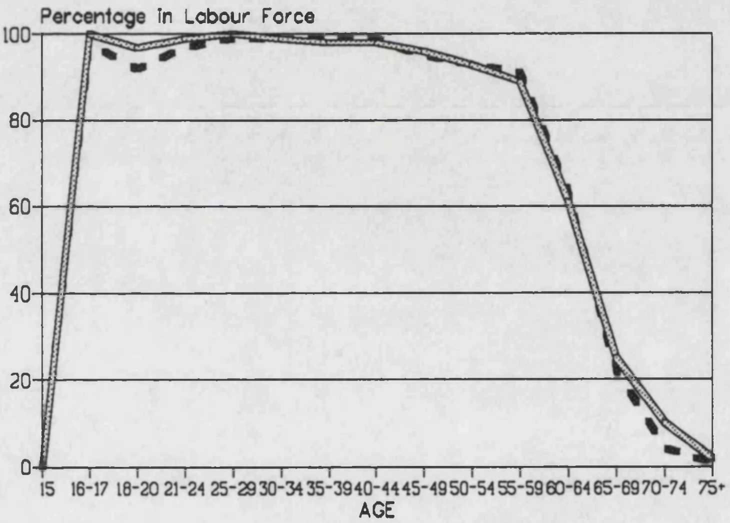
Examination of the 1986 IDS data showed, as expected, that marital status, age of youngest child and education all significantly affected labour force participation rates. The results confirmed the findings of other Australian studies showing that the labour force participation rates of women increase with greater education (Miller and Volker,1983:77); increase as the age of the youngest child increases (Volker, 1984:51) and are higher for non-married than married females (BLMR,1985a:55).

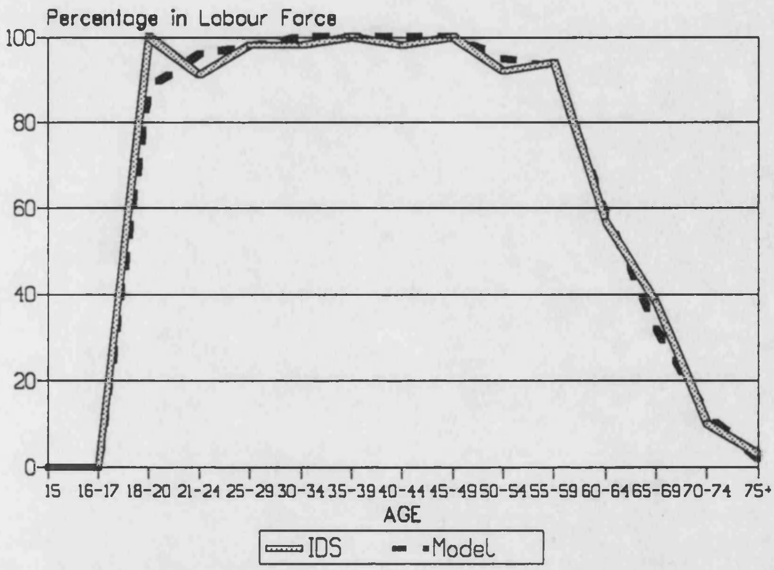
Figure 3.3: Labour Force Participation Rates of Males By Age and Education in the 1986 IDS and in the Model*



Secondary School Qualifcations Only

Some Tertiary Qualifications





Graduates

* Note that labour force participation is defined as spending one or more hours in the labour force.

The probability for women of staying in the labour force for a further year was thus made dependent upon:

- age;
- education (secondary qualifications only, some tertiary studies, bachelors degree or better);
- whether the woman worked full-time for 52 weeks in the preceding year;
- marital status (only married and not married, as sample size did not allow split of non-married into never married and divorced/widowed/separated); and
- age of youngest child (aged less than 1 year, between 1 and 4 years, and other ie. youngest child aged 5+ or with no children).

The explanatory variables used in calculating the probability of re/entering the labour force were the same as for the probability of remaining, with the exception that women aged 25 to 49 who were not in the labour force in the preceding year and who *changed marital status* were given a different probability of re/entry. This was because the IDS data showed that such women had a probability of re/entry which was about twice that of women who did not change marital status during the year (presumably reflecting the entry of newly divorced or separated women into the labour force).

Tests were carried out to determine whether marital status change was a significant factor influencing either the continuation of labour force participation or entry to the labour force at other ages, but the effects were either insignificant once the impact of the other explanatory variables had been controlled for or the sample size was too small to allow any reliable conclusions to be drawn.

As with men, it was clear that the probabilities of remaining in or entering the labour force derived from usage of the IDS data were too low. While the measurement of labour force participation rates during the 1985-86 financial year showed rates during an *entire year*, the second observation of labour force status in the following year simply showed status at a *single point in time*. For example, while some 54 per cent of all women were in the labour force during the 1985-86 financial year according to the IDS, only 51 per cent were in the labour force when they were actually surveyed for the IDS. Consequently, the probabilities of remaining in and entering the labour force again had to be inflated, so that the correct proportion of women by age and education level were in the labour force during the entire year.

The probabilities of labour force participation found in the 1986 IDS and those resulting from the simulation are shown in Figure 3.4. The profiles display the characteristic twin-humped pattern for female labour force participation rates, with the dip during the twenties and thirties caused by withdrawal from the labour force during the peak years of child bearing and raising. The twin peaks are much less pronounced for women graduates, due to their lesser likelihood of labour force exit upon marriage or the birth of children. As with men, the probability of participating in the labour force for an hour or more per year also rises with education.

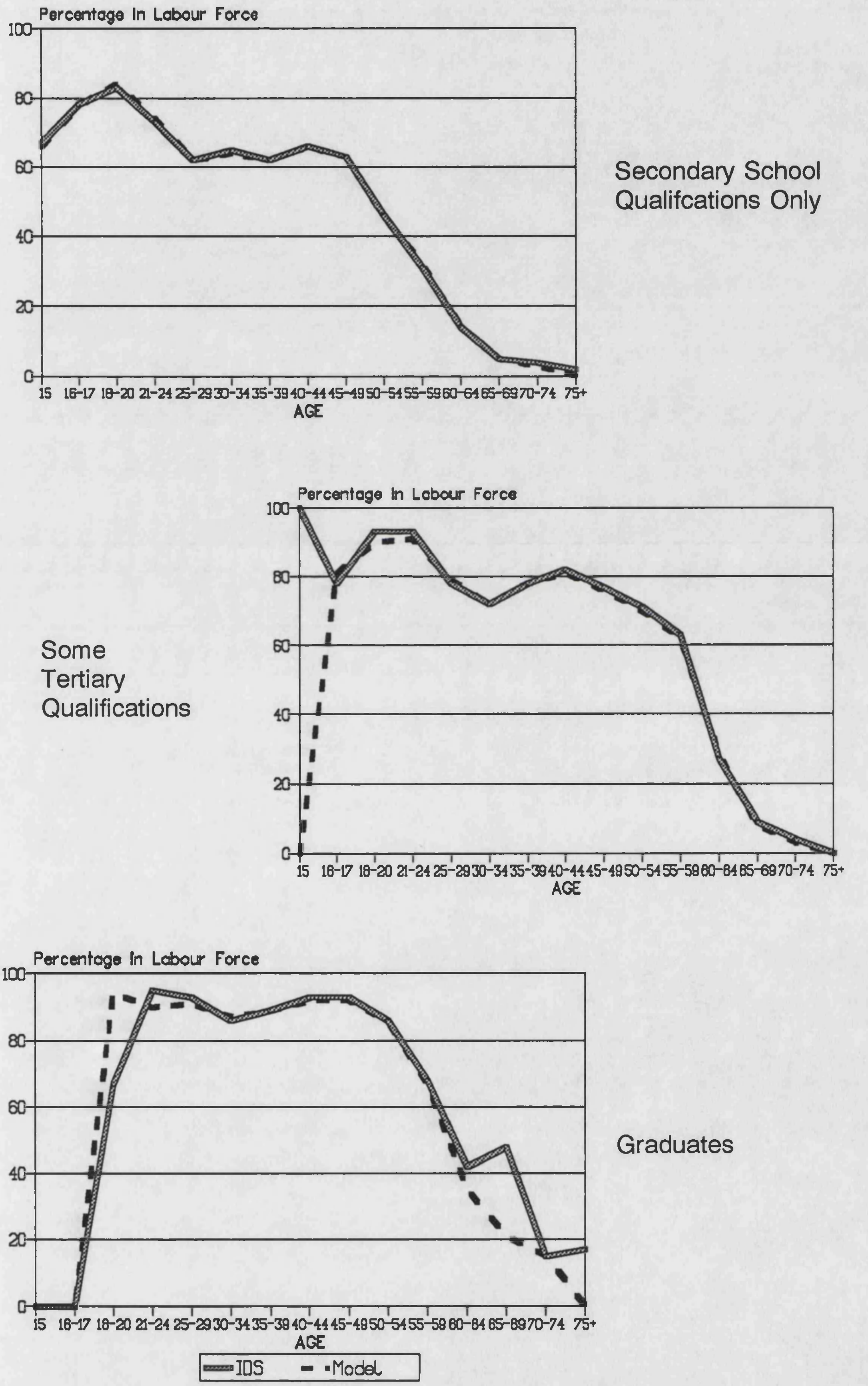
Once again, it would have been desirable to have included other variables known to potentially affect women's labour force status, such as husband's employment status and income (Ross, 1986; Merz, 1987), investment income and wealth (Heckman and MaCurdy, 1980), and so on, but either the sample size did not permit further differentiation or the information was not available. In particular, it would have been useful to have included separate probabilities by disability status, but disability status was not included as a variable on the 1986 IDS micro data tape.

3.4 SELF EMPLOYMENT STATUS

Males

After a male had been selected to be in the labour force in a given year, he was assigned a self-employment status, with the probabilities of being self-employed in the current year usually being based upon whether or not he was self-employed in the immediately preceding year and age. For the 25 to 49 year old age group

Figure 3.4: Labour Force Participation Rates of Females By Age and Education in the 1986 IDS and in the Model*



* Note that labour force participation is defined as spending one or more hours in the labour force.

the sample size was large enough to allow additional differentiation by education, but the results showed no clear trend, with the probabilities for both entering and remaining in self-employment being highest for those with some tertiary qualifications but not university degrees (perhaps reflecting tradespeople setting up their own businesses). The probability of *remaining* self-employed once a business had been started reached about 85 per cent for the 25-49 year olds, rising to peak at 100 per cent for those aged 65 and over (ie. the over 65 year olds left self-employment to retire rather than to begin wage and salary employment). The probability of *entering* self-employment in a given year for those who were not self-employed in the preceding year was around 3 per cent for those aged less than 65.

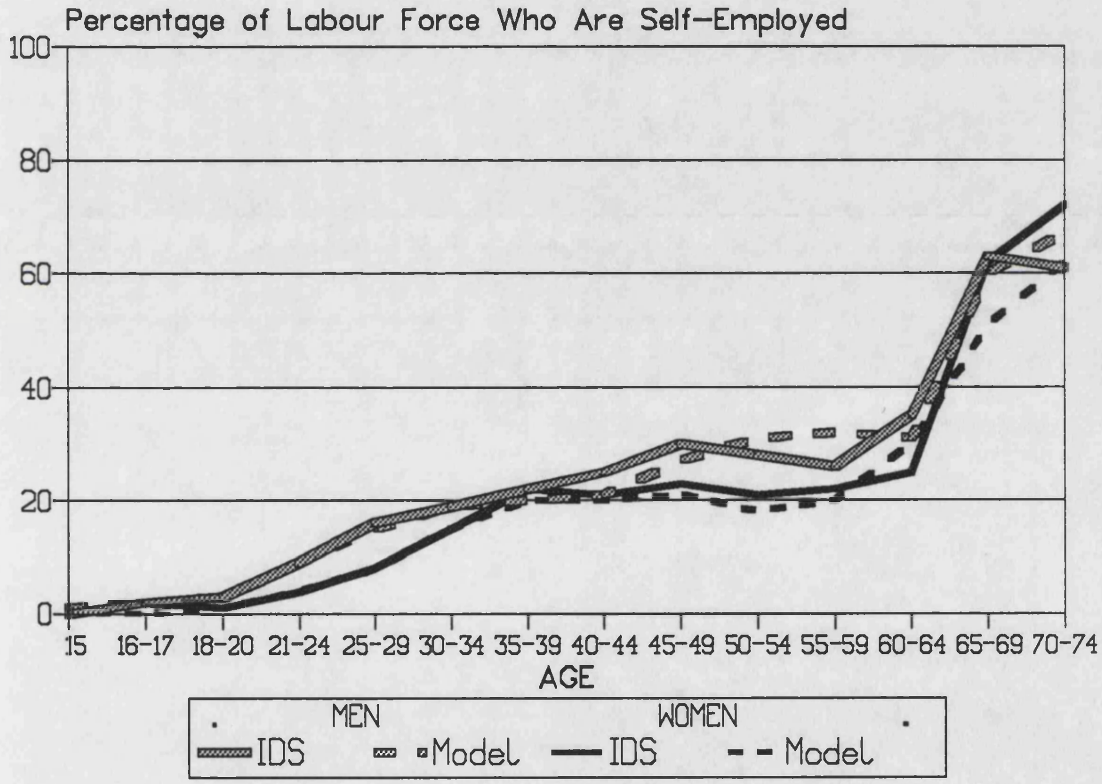
The proportion of males in the labour force who are self-employed in both the simulation and in the real world increases steadily to about 25-30 per cent during the forties and fifties, subsequently increasing sharply to sixty per cent or more once the legal retirement age of 65 is reached. On average, some 20 per cent of all males in the labour force are self-employed. As Figure 3.5 illustrates, the model captures these cross-sectional patterns of self-employment well, although whether the longitudinal profiles of self-employment generated are accurate is not certain.

Females

For a woman in the labour force, the probability of being self-employed was based upon whether her husband was self-employed (if married), whether she was self-employed in the preceding year, and age. As one might expect, married women have very much higher probabilities of entering self-employment and significantly higher probabilities of remaining in self-employment if their husbands are self-employed. The proportion of women in the labour force who are self-employed increases during the twenties and thirties, remains at about 20 to 25 per cent of the female labour force during the forties and fifties, and then increases sharply from age 65 onwards. The proportion of all women in the labor force who are self-employed is around 13 per cent, substantially lower than for men.

The proportions of females in the labour force who are self-employed found in the 1986 IDS and in the simulation are shown in Figure 3.5. The model again seems to replicate cross-section patterns of self-employment adequately.

Figure 3.5: Proportion of Those in the Labour Force Who Are Self-Employed by Age and Sex, in the 1986 IDS and in the Model



3.5 FULL AND PART-TIME STATUS AND ANNUAL HOURS WORKED

It is difficult to model adequately changes in annual hours worked from one year to the next, when data about the number of annual hours worked are not available for two entire consecutive years. However, whether respondents worked full-time or part-time was a variable which was available for both of the time periods captured in the IDS. Consequently, the dynamic simulation of hours worked was divided into two steps. First, the probabilities of shifting from full to part-time work or vice versa for those already in the labour force, or of entering full or part-time work for those not in the labour force in the preceding year, were calculated. Second, annual hours worked were then assigned, based on the probability of working different numbers of hours during an entire year for those respondents working full or part-time respectively in the 1986 IDS in 1985-86.

Males

The probabilities of working full and part-time were estimated separately for the self-employed and non-self-employed where the sample size was large enough to permit valid results. The *probability of working full-time* in the current year for males who *were in the labour force in the preceding year* was made dependent upon whether the individual worked full-time in the preceding year, education, self-employment status and age. Males who worked full-time generally continued to work full-time from one year to the next, with the IDS data indicating that about 98 to 100 per cent of prime aged males working full-time in one year continued to work full-time in the next year. Even during the later years of working life, the probability of continuing to work full-time for those who *remain* in the labour force is suprisingly high (although many drop out of the labour force); about 94 per cent of non-self-employed males aged 65 or more who worked full-time in the preceding year, and who were selected to remain in the labour force for another year, continued to work full-time.

Relatively few men were not in the labour force in the prime working years, so the probabilities of working full-time this year for those who were *not in the labour force last year* were simply based upon age, because the small sample size did not permit the use of additional explanatory variables. In the teens and early twenties, the probabilities of entering full-time work for those who had not worked in the preceding year hovered around 85 per cent, reflecting the transition from full-time study to the world of work. During the peak working years, men who had dropped out of the labour force in the preceding year were quite likely to re-enter full-time employment; for example, from the ages of 25 to 49, some 56 per cent of males who were not in the labour force one year but were selected to re-enter the next year worked full-time. After the legal retirement age of 65, the probability of re-entering the labour force and working full-time dropped sharply.

Males who *worked part-time in the preceding year* were also very likely to switch to full-time work in the current year, although the probabilities varied markedly by education. For example, for non-self-employed males aged 25 to 49 who worked part-time in the preceding year, the probability of working full-time if in the labour force in the current year was 37 per cent for those with secondary qualifications but 75 per cent for graduates.

After it had been determined whether the individual was to be a full or part-time worker in the current year, the *number of hours worked* during the entire year was calculated, based upon the distribution of hours actually worked by full and part-time workers respectively in 1985-86 found in the 1986 IDS. During the peak working years, about 90 per cent of prime age males working full-time worked full-time for 52 weeks, while even for the over-65 year olds, about 80 per cent of those still in the labour force and working full-time worked full-time full-year. Those with higher educational qualifications were more likely to work longer hours, while the self-employed were much more likely than the non-self-employed to work long hours. For part-time workers, the proportion of part-timers working fairly low numbers of hours increased as age increased.

Females

Tests upon the IDS data showed that having a baby aged less than one year dramatically affected the hours worked by women, so all women were divided into those with and without such babies. For those *without very young babies*, the probability of *working full-time* this year was based upon age, whether they worked full-time last year, education and marital status. Not suprisingly, for those women who remained in the labour force, between 90 and 100 per cent of those who *worked full-time last year* were working full-time this year, with those with higher educational qualifications being more likely to continue working full-time. For example, between the ages of 25 and 49, 90 per cent of women with secondary qualifications who remained in the labour force and worked full-time one year also worked full-time the next year, with the comparable figure for female graduates rising to 97 per cent.

While the above figures apply to those who worked full-time in the preceding year, many women also shifted from part-time work in one year to full-time work in the next year. At ages 15 to 24, almost three-quarters of women who worked part-time in the preceding year entered full-time work in the current year, reflecting the transition from part-time work while studying full-time at school or university to subsequent full labour force entry. From ages 25 to 49 just over one-third of those women who were working part-time in one year and who remained in the labour force switched to full-time work the following year. Interestingly, the proportion of women moving from part-time to full-time work increased over the 50 to 59 year age range to 64 per cent, presumably reflecting the return to full-time work as family responsibilities diminished.

For those women who were *not in the labour force* in the preceding year but had entered the labour force in the current year, the probablities of working full-time were much lower and, not suprisingly, showed great variation by marital status. For example, while 18 per cent of unmarried females aged 25 to 49 who were not in the labour force in one year but entered the labour force the next year moved into full-time work, the relevant probability for married females in the same age range was only about 7 per cent. Women who entered the labour force during this age range were thus much more likely to enter part-time rather than full-time work. Overall, women who were married were less likely to be working full-time than the unmarried, while unmarried prime age women with degrees had patterns similar to males, with about 97 to 100 per cent of those who worked full-time one year and who stayed in the labour force working full-time the next year.

For those *with very young babies*, education and marital status made relatively little difference to the probabilities of working full or part-time, as the effect of a young child was quite overwhelming; only about 60 per cent of those who worked full-time in the preceding year and who stayed in the labour force after the birth of their child continued to work full-time in the current year (and only about 10 per cent of these worked full-time full-year in the current year).

After allocating women to full or part-time status the next question was the total number of hours worked during the entire year. The IDS data suggested that marital status and education were less important than age of youngest child in determining total hours worked. For example, for women aged 25 to 49 who said they were working full-time, 42 per cent of those with a child aged less than one were working full-time for 52 weeks, with the proportion rising to 65 per cent for those with pre-school aged children and 82 per cent for those with no or older children. After standardising for age of youngest child there was little difference in the distribution of hours worked in an entire year between married and non-married women working part-time.

3.6 UNEMPLOYMENT STATUS AND HOURS UNEMPLOYED

Because there is a sizeable flow of people through unemployment, the proportion who experience some unemployment *at any time* during a year is usually about two to three times the number who are recorded as unemployed in any given month during that year. For example, while about 5 per cent of 25 to 49 year old males were unemployed during the month in which they were surveyed for the IDS in late 1986, some 10 per cent of such males experienced any unemployment during the 12 months to June 1986. The probabilities of experiencing unemployment used in the model may thus appear high at first glance, when compared to the standard estimates derived from cross-section surveys such as the Labour Force Survey. Examination of the 1986 IDS also showed that only an extremely small proportion of the self-employed experience unemployment during the course of an entire year, so in the model only the non-self-employed were allowed to be unemployed.

During construction of the model, the probability of experiencing any unemployment in any given year was initially simply made dependent upon whether the individual experienced any unemployment during the preceding year, education and age. However, this did not seem to result in consistent lifetime profiles, as almost all men were being randomly selected for a few years of unemployment during their working lives, whereas research suggested that dynamic unemployment was highly concentrated.

For example, Duncan et al found after analysis of 10 years of the PSID data that while about 10 per cent of their sample reported unemployment in any given year and almost 40 per cent experienced unemployment at least once in the decade between 1967 and 1976, only 5 per cent of the sample accounted for nearly half of the ten-year total unemployment (1984:96). This latter group of chronic unemployed averaged 96 weeks of unemployment during the 10 years and lost about 15 per cent of their expected 10 year earnings (1984:105). Such long-run unemployment was disproportionately concentrated among high school drop-outs, workers in blue collar occupations and those in the construction industry, with 60 per cent of the chronically unemployed not having completed secondary school.

Similarly, examination of Canadian unemployment insurance administrative data for the eight years from 1975 to 1982 showed that 60 per cent of the sample experienced unemployment at least once during this period; of those experiencing unemployment, 69 per cent had multiple spells of unemployment over the eight years and this group (ie. about 40 per cent of the entire sample) accounted for 90 per cent of total unemployment duration over the period. Approximately 35 per cent of those who experienced unemployment had four or more spells, while 7 per cent had more than eight spells of unemployment (OECD, 1985:106).

Data from the West German unemployment register for the six years from 1976 to 1982 showed that 48 per cent of those unemployed at any time during these six years experienced multiple spells of unemployment and accounted for 71 per cent of the total duration of unemployment. Fifteen percent of the unemployed had four or more spells of unemployment and this group suffered 37 per cent of the total weeks of unemployment (OECD,1985:106).

Finally, although there are not yet Australian longitudinal data spanning a large number of years, research using the Australian Longitudinal Survey has already suggested that unemployment is likely to be highly concentrated over time. Dunsmuir et al concluded that their results suggested that "a large proportion of the population is, post school, either solidly employed or solidly unemployed" (1988:21); Eyland and Johnson found that the slower the transition from school to work "the greater the likelihood of long-term unemployment at some later stage" (1987:18); and McRae found that the probability of transition out of unemployment from one year to the next was correlated with the duration of unemployment (1986:18). Using different data, Brooks and Volker also found that the probability of leaving unemployment in Australia decreased as the duration of unemployment increased (1986:296).

The evidence thus suggests that a significant proportion of the workforce will not experience any unemployment during their lifetimes, while for those that do, a minority will account for a substantial proportion of the total unemployment. Such concentrated unemployment over time appears to be due to a range of characteristics, with explanations ranging from those related to labour force disadvantage (such as low education level and working in industries where lay-offs are common or employment is seasonal) to the "scarring" induced by unemployment, the loss of valuable work experience while unemployed or being marked as a 'loser' by potential employers (Phelps,1972), disability (Orcutt et al, 1976:171) and a range of unobservable personal beliefs and characteristics.

To improve the accuracy of the model the cohort are therefore divided into three groups - those selected not to experience any unemployment at all during their lives, those selected to experience some unemployment and those selected to be chronically unemployed. The first step therefore involves working out what percentage of the population will be precluded from ever experiencing unemployment. The PSID's finding of 60 per cent is clearly too low as it occurred during a period of low unemployment; the German finding that 40 per cent of the population did not experience unemployment seems more appropriate, but still seems likely to be an underestimate as the period covered by the survey only spanned eight years (and one would expect more people to experience unemployment as the time period was lengthened) while, in addition, the unemployment rate was higher in 1985-86 than from 1975 to 1982.

It was therefore decided to make 50 per cent of all graduates (with graduates comprising around 20 per cent of the entire cohort), 30 per cent of those with other tertiary qualifications (comprising about 70 per cent of the total cohort) and 20 per cent of those with only secondary school qualifications (comprising only about 10 per cent of the well educated pseudo-cohort) experience no unemployment at all during their working lives. Given the education distribution of the cohort, this means that around one third are assumed never to experience any unemployment. This proportion can, of course, be amended to test other assumptions.

For the remaining two-thirds, the next issue was what proportion should be selected to be chronically unemployed. It was decided to make about 20 per cent of those experiencing unemployment accrue around 50 per cent of total lifetime unemployment. The probabilities of entering unemployment were thus scaled up for the 20 per cent of the cohort selected to be 'chronically unemployed' and down for the remaining 80 per cent of 'occasionally unemployed', with the relevant probabilities being set so that the total unemployment rates by age and education remained the same as those found in 1985-86 in the 1986 IDS Survey. In addition, the chronically unemployed were given higher probabilities of *spending more hours unemployed* each year than the occasionally unemployed.

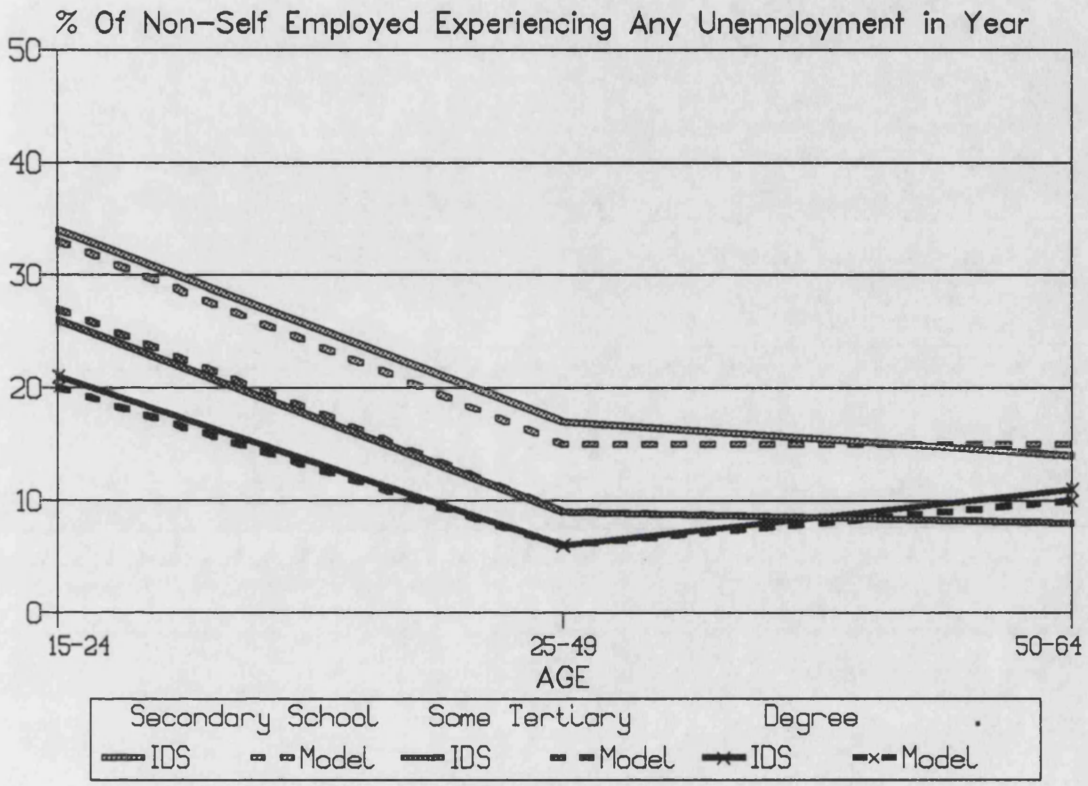
Males

For those males who were not excluded from experiencing any unemployment in their whole lives, the probability of experiencing any unemployment in a particular year depended upon age, education, whether or not they belonged to the chronically unemployed group, and whether any unemployment was experienced in the preceding year. At younger ages the probability of unemployment was much higher; about 30 per cent of all males aged 15 to 24 in the labour force suffered some unemployment, with the proportion dropping to 10 per cent for 25 to 49 year olds and around 7 per cent for 50 to 64 year olds (Figure 3.6).

Education made a significant difference, with the probability of experiencing unemployment this year for both those who did and did not have a spell of unemployment in the preceding year decreasing as education level increased. For example, amongst the non-self-employed aged 25 to 49 who belonged to the 'occasionally unemployed' group and who were not unemployed last year, the probability of a bout of unemployment this year was 8 per cent for those with secondary qualifications but only 4 per cent for those with degrees.

Whether unemployment *was experienced in the preceding year* emerged as the most important of the various explanatory variables, reflecting the highly concentrated nature of dynamic unemployment. For the 25-49 year old non-self-employed males mentioned above, the probability of experiencing some unemployment this year if they were unemployed in the preceding year was 65 per cent, about eight times greater than the probability if they were not unemployed in the preceding year. The probability of being unemployed this year for those not in the labour force last year was very high, but small sample size again prevented the derivation of accurate estimates by education and age, so this group were combined with those who were in the labour force in the preceding year and experienced unemployment at some point during that year. While a small fraction of males aged 65 or more are unemployed in the real world, unemployment was not modelled for this group, as all such males should have an entitlement to age pension.

Figure 3.6: Proportion of Non-Self-Employed Males in the Labour Force Experiencing Any Unemployment During Year by Age and Education in 1986 IDS and in the Model



After being selected to experience unemployment during a particular year, the next step was the *allocation of time unemployed.* Following the DYNASIM model, this was calculated as the fraction of time in the labour force spent unemployed. For most age ranges, small sample size meant that the relevant probabilities were simply based on age and the number of hours spent in the labour force. While a higher proportion of the young experienced unemployment in any given year, they were unemployed for *shorter periods of time* than the older unemployed, with only about one-fifth of 15 to 24 year olds being unemployed for 100 per cent of the time they were in the labour force. For the 25 to 49 year olds this figure rose to around one-third, while for the 50 to 64 year olds it increased further to more than one-half, reflecting the longer duration of bouts of unemployment for the older unemployed. For 25 to 49 year olds in the labour force full-year full-time, the larger sample size allowed an additional breakdown by education, with the better educated typically spending a lower fraction of time unemployed.

Females

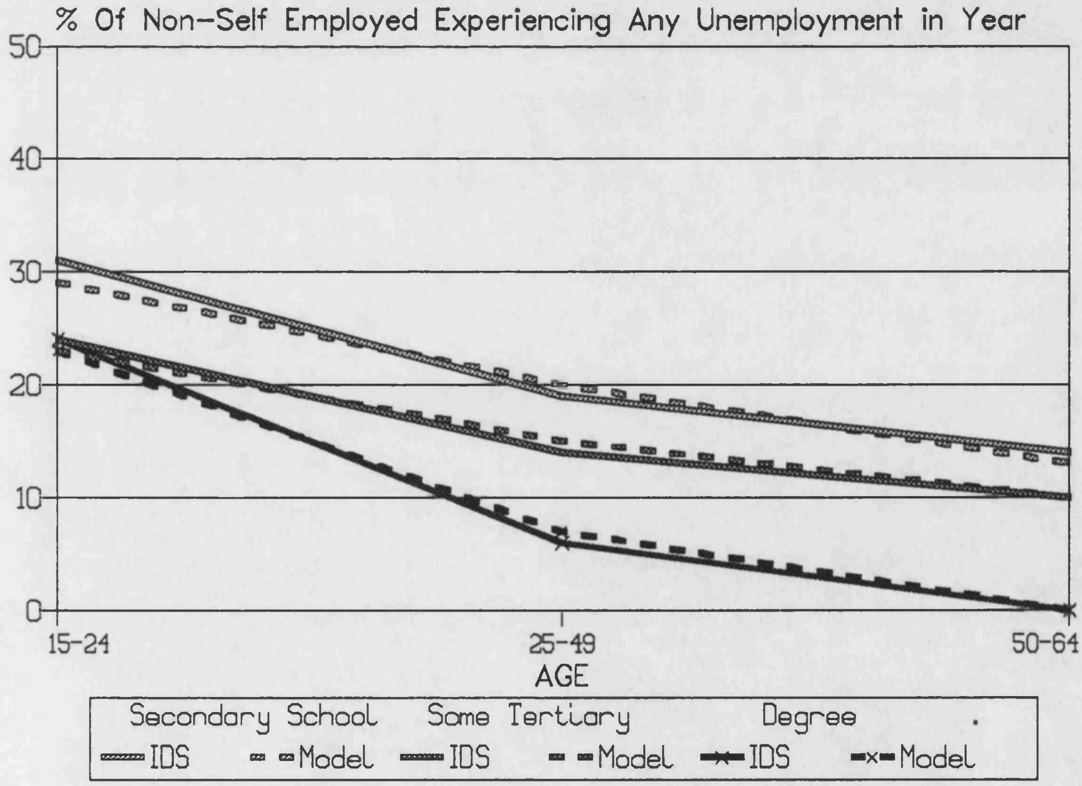
Tests using the IDS data showed that women's unemployment rates varied by age of children and marital status, with married women having lower recorded unemployment rates, probably due in part to their inability to claim for unemployment benefit due to the family income test. However, the dispersion in unemployment rates by education was higher than that for marital status, and as the sample size meant that only one of these variables could be included, education was selected. The probability of being unemployed in any given year for women was thus made dependent upon age, education, whether they were categorised as occasionally or chronically unemployed, and whether they experienced any unemployment in the preceding year.

The results were very similar to those for men, with the probability of being unemployed decreasing with age, decreasing with better education, and massively increasing if unemployment was experienced in the immediately preceding year. In the 1986 IDS the unemployment rates recorded for men and women were fairly similar, and this has thus been incorporated into the model's parameters.

Figure 3.7 shows the proportion of non-self-employed females in the labour force who experienced an hour or more of unemployment in any year by education and age found in the 1986 IDS and simulated in the model. It should again be emphasised that these unemployment rates appear very high in comparison to the cross-section estimates of unemployment at a single point in time; as mentioned earlier, the number of people who experience unemployment at some point during an entire year is two to three times the number who will report that they are unemployed at a single point in time during that year. Once again, the results of the model closely match those found in the IDS.

The probability of spending different fractions of labour force time unemployed for women was dependent upon age and hours in the labour force, with the exception of 25 to 49 year olds who were in the labour force full-time full-year, where the probability was additionally dependent upon education. As with men, the fraction of labour force time spent unemployed increased with age and decreased with education.

Figure 3.7: Proportion of Non-Self-Employed Females in the Labour Force Experiencing Any Unemployment During Year by Age and Education in 1986 IDS and in the Model



3.7 FULL-TIME STUDENTS AND INVALIDS

For both male and female *full-time students* the small sample size meant that the only explanatory variables used to determine the probabilities of remaining in the labour force were age and whether or not the student worked full-time full-year in the preceding year, with the age ranges being 15 to 24 and 25 to 49 years respectively. Students selected to be in the labour force were then assigned to one of five 'hours in the labour force categories', in line with the distribution of hours by age and sex.

A more complete model of *disability* would incorporate the impact of disability upon labour force status, hours worked and income, as a comprehensive UK study showed that the disabled and non-disabled have different labour force participation and earnings profiles (Martin and White, 1988). However, there were no disability variables on the IDS tape, which meant that disability could not be adequately modelled at the micro level. While in the future it might be possible to match-merge a unit record tape from the recently conducted Australian Disabled Persons Survey with the IDS tape (ABS, 1989), as an interim measure the best that could be done was to isolate those disabled who were receiving invalid pension, who were separately identified on the IDS tape.

The labour force characteristics of those identified as invalid pensioners on the IDS tape were therefore used to set the various probabilities for those classified as invalid in the simulation. For such invalids, the probability of being in the labour force was simply dependent upon age and sex. No invalids were assumed to be working after the age of 65 for men and 60 for women. The allocation of hours in the labour force was based upon age and sex.

3.8 LABOUR FORCE PROFILES OF THE COHORT

While estimates of the *aggregate* labour force participation rate or of the unemployment rate for the entire cohort will differ from those for the entire 1986 Australian population (for example, because the age and marital status distributions of the pseudo-cohort are different from that of the 1986 population), the estimates *within* each age range should be similar. As discussed above, the model does appear to do a reasonable job of matching cross-section estimates of labour force participation, unemployment and self-employment rates in Australia by age. However, whether the dynamic profiles generated are realistic is a matter of conjecture, given the lack of Australian longitudinal data.

The results below show the labour force profiles generated for a sub-sample of the cohort. They include the records of only those 1816 females and 1540 males who lived until at least the legal retirement age (age 60 for females and age 65 for males), and show their labour force records only up until and including the year they became eligible for age pension. In other words, the results show labour force status for every year between the ages of 15 and 60 inclusive for females and 15 and 65 for males. After the commencement of age pension age, many retirees recommence part-time work or have sporadic labour force profiles, so that including such post-retirement activity could distort perceptions of labour force participation during the prime working years.

Those men who live until at least the age of 65, average 45 years of participation in the labour force for an hour or more per year, of which 41 years are spent in full-time work and the remaining four in part-time work (including, for example, part-time work undertaken whilst in full-time study). Only 6 years are spent out of the labour force on average by men between the ages of 15 and 65 inclusive (eg. in full-time study).

There is, however, great variation in the labour force profiles of men. About 0.5

per cent of males spend only between 5 and 29 years in the labour force (eg. because they are invalid), while a further 10 per cent spend between 30 and 39 years participating in the labour force (Figure 3.8). Almost 30 per cent spend 40 to 44 years in the labour force, while half of all men spend 45 to 49 years participating in the labour force between the ages of 15 and 65.

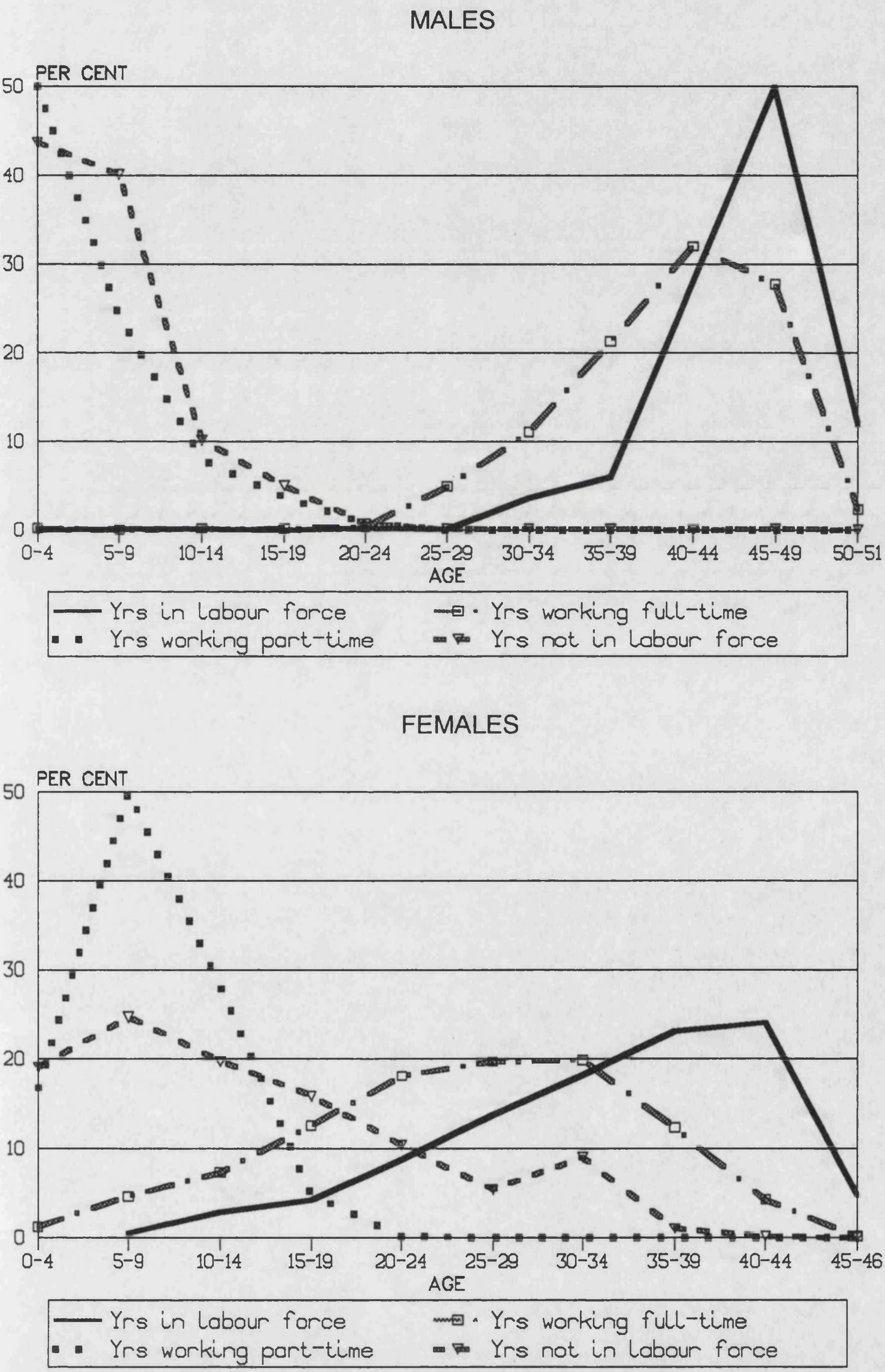
Men are unlikely to spend these years working part-time, as Figure 3.8 also demonstrates. Almost 65 per cent of men spent less than five years working part-time between the ages of 15 and 65, while a further 24 per cent spent between five and ten years working part-time. Only about five per cent of men spent fifteen or more years working part-time. In contrast, sixty per cent of men spent forty or more years working full-time, although almost six per cent spent less than 30 years working full-time.

Men also do not spend many years out of the labour force during their prime working years. About 44 per cent spend less than five years out of the labour force (including those years spent in full-time study with no part-time work) and a further 40 per cent spend between five and nine years out of the labour force. Only 10 per cent spend 10 to 14 years being economically inactive.

Those women who live until at least the age of 60 average 33 years of participation in the labour force for an hour or more per year. Of these, 25 years are spent working full-time and the remaining eight years working part-time. The remaining 13 years between the ages of 15 and 60 inclusive are spent out of the labour force in, for example, full-time study or family duties.

While this is the average picture for women, this average disguises major variations in labour force profiles, to a far greater extent than for men. Although many women spend fewer years in the labour force than men, as a comparison of the following two figures illustrates, nonetheless only about three per cent of women spend less than 15 years in the labour force, which emphasises the importance of labour force participation during the lifetimes of females outside the

Figure 3.8: Labour Force Participation Profiles Produced by the Model During the Prime Working Years, by Sex



peak child-raising years. Half of all women spend 35 or more years participating in the labour force between the ages of 15 and 60.

Women are much less likely to work full-time than men, with about one-fifth of all women spending between 20 to 24 years working full-time, a further fifth spending 25 to 29 years and another fifth spending 30 to 34 years working full-time. Only some five per cent of women work full-time for more than 40 years, while the majority of men fall into this category.

Similarly, the distribution of years of part-time work was also strikingly different for females than for males. While just under two-thirds of men spent less than five years working part-time, 17 per cent of all women did so, while half of all women spent 5 to 9 years working part-time during their peak working years. Women were also more likely to spend years out of the labour force than men, with one-quarter of all women remaining outside the labour force for five to nine years, and a further fifth spending 10 to 14 years out of the labour force.

Of the average 44 years spent participating in the labour force for an hour or more each year by males aged 15 to 65, unemployment was experienced during four of those years on average. Women also experienced an hour or more of unemployment during four of their prime working years. Just over one-third of all males and females experienced no unemployment during their peak working years and about 60 per cent experienced an hour or more of unemployment in less than five years (Figure 3.9). Only five per cent of both males and females experienced an hour or more of unemployment in 14 or more years.

As Figure 3.10 illustrates, men spent more years self-employed than women. One third of all women never entered self-employment of any sort, while about two-thirds spent less than five years being self-employed. About one-fifth of men never tried self-employment, while about two-fifths spent less than five years in their own businesses. About 15 per cent of all men spent 20 or more years in self-employment, in comparison to only three per cent of women.

Figure 3.9: Frequency Distribution of Years Unemployed by Sex

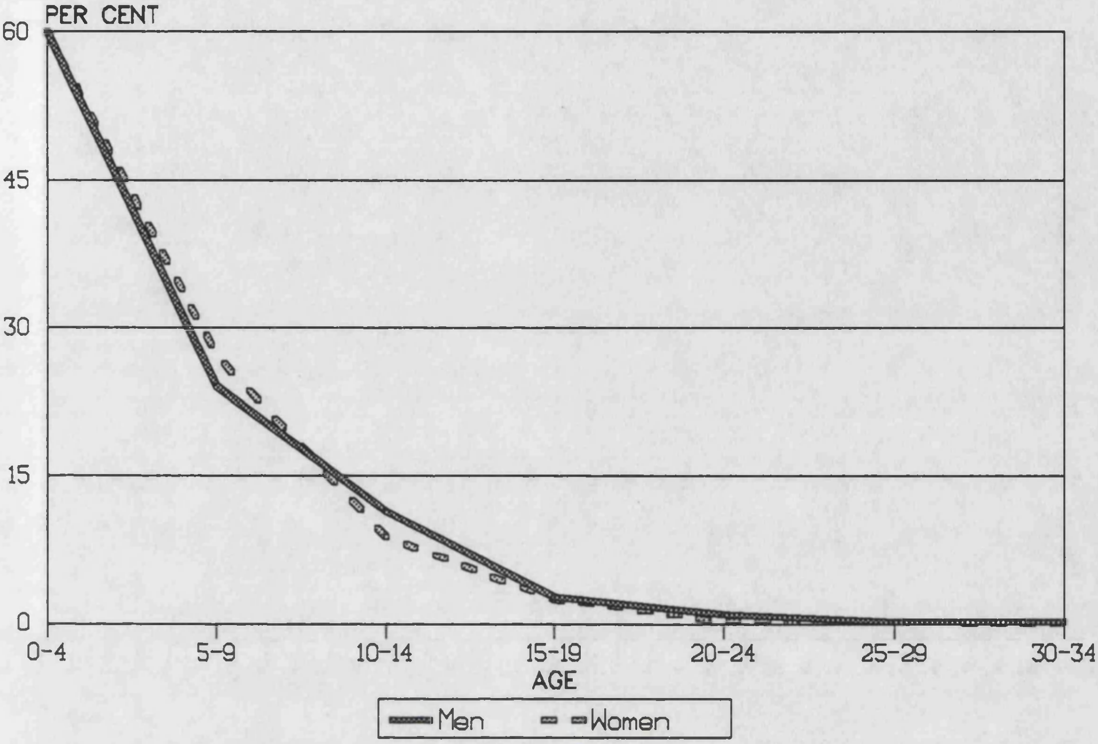
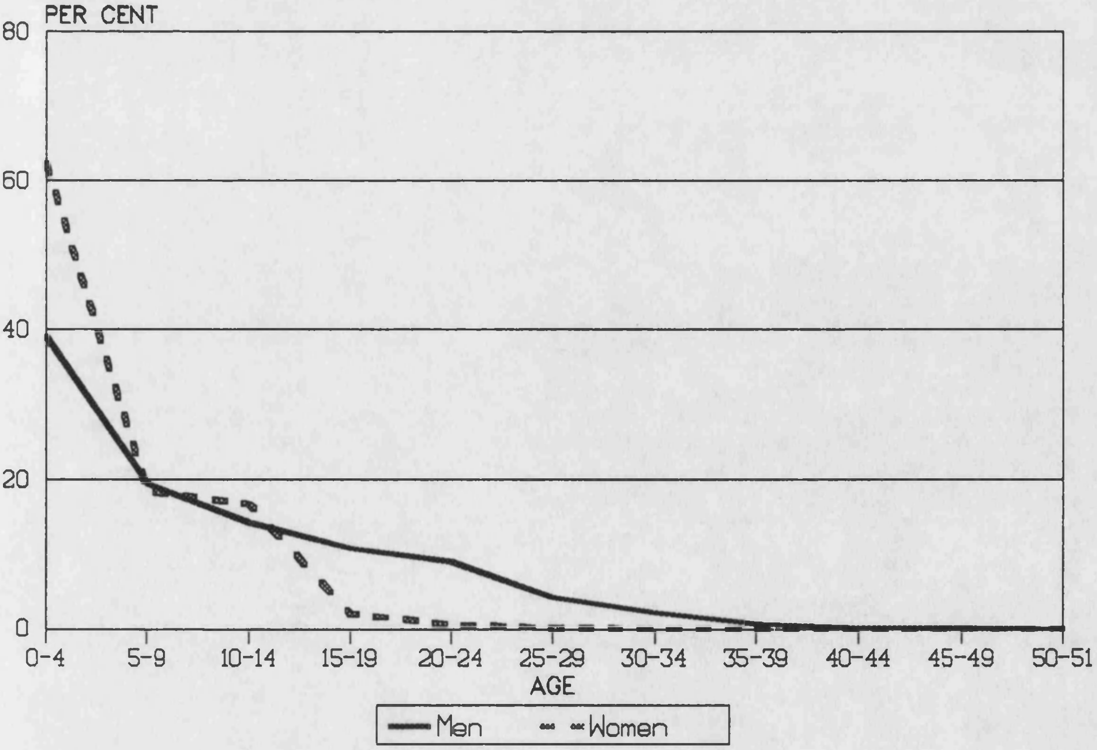


Figure 3.10: Frequency Distribution of Years of Self-Employment by Sex



Finally, it is also possible to isolate the last year in which males and females participate in the labour force during their entire lives. This is not exactly the same as the year of formal retirement, as many of those who formally retire at 60 or 65, for example, subsequently do minor amounts of part-time work or set up small businesses and become self-employed. The sample below thus still only includes those cohort members who lived until at least the legal retirement age, but additionally takes account of any labour force participation after that age.

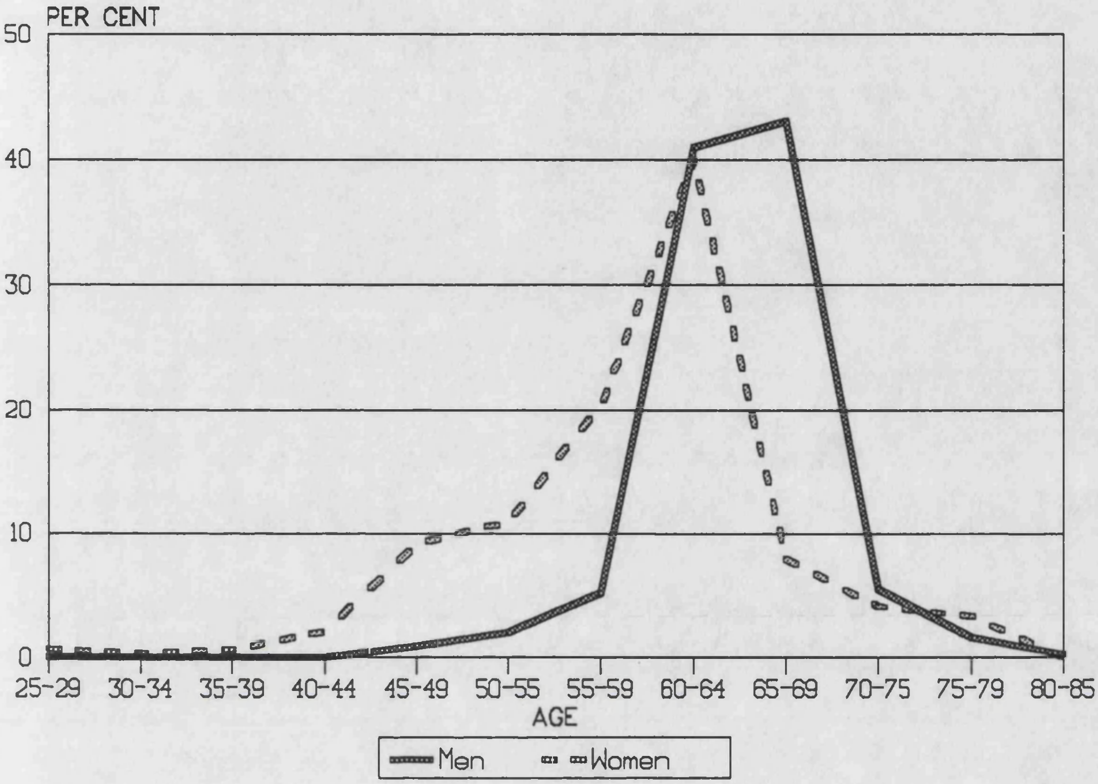
Women are more likely to exit the labour force at an earlier age than men, with about one per cent of women leaving the labour force never to return before the age of 35, and about another three per cent departing between the ages of 35 and 45. As Figure 3.11 demonstrates, about 10 per cent of all women in the pseudo-cohort leave the labour force for ever between the ages of 45 and 49, and a further 11 per cent drop out for good at ages 50 to 55. Nonetheless, at the end of their 59th year, more than half of all women have still not left the labour force for ever, although 40 per cent drop out in the five years after the legal retirement age of 60 is reached.

Most men defer their final labour force exit until a later age, with only three per cent having left the labour force by age 55. However, the impact of early retirement begins to show up after age 55, with five per cent departing from the labour force between the ages of 55 and 59 and a further 40 per cent leaving at ages 60 to 64. Once the age pension age of 65 is reached, some 43 per cent of men drop out at age 65 or during the following four years and never re-enter paid employment.

3.9 CONCLUSION

Due to the lack of longitudinal data in Australia, attempting to simulate the labour force participation and unemployment patterns of individuals over time is a hazardous exercise. It must be emphasised that data deficiencies necessitated the making of a number of major compromises and assumptions in the module,

Figure 3.11: Frequency Distribution of Age of Final Labour Force Exit, by Sex



including the attempt to introduce a realistic dynamic component into the simulation of unemployment. While the proportions of individuals in the labour force or unemployed at different ages in the model all closely match the actual cross-section picture revealed on the 1986 Income Distribution Survey, this does not necessarily mean that the profiles of individuals *over time* are accurate. However, the lifetime profiles of years in the labour force, years unemployed, years of self-employment and ages of final labour force exit described above all appear believable. Nonetheless, while the dozens of assumptions made in the simulation appeared reasonable given existing knowledge, the extent to which the resulting simulation reflects actual dynamic labour force patterns in Australia remains unknown.

CHAPTER 4: EARNED AND UNEARNED INCOME

4.1 INTRODUCTION

This chapter describes the simulation of earnings, investment income, superannuation income and maintenance income in the model. The simulation of earnings is dealt with in Section 4.2. The first part of this section describes the procedures used to simulate hourly wage rates, principally through the use of multiple regression. A multiple regression model can be used to calculate the expected hourly wage rate of a person with particular characteristics, eg. to predict what the expected wage rate of a forty-year old married male graduate will be. However, in the real world, there is enormous variation in the wage rates of such male graduates, and this variation has to be recreated in the model, or the simulated world will appear too equal.

To do this, a stochastic term has to be added to the equations predicting wage rates. The treatment of this error term depends upon how the difference between the predicted expected wage rates and actual wage rates in the real world is interpreted. There are many factors which underlie the presence of these residuals. The most important of these is often the exclusion from the regression equations of factors which are likely to affect wage rates but which are not easily measurable or about which data are not available (such as personal attitudes or parental social class). The discrepancy may also be due to such factors as sample bias, measurement error in the sample surveys upon which the econometric estimates are based, and so on (Atkinson et al,1989:9).

When simulating the earnings of individuals *over time*, a critical question is whether these error terms are correlated from year to year. In other words, if one individual has a wage rate in one year which is very much higher than the average wage rate for someone of their age, sex and education, how likely are they to still have a much higher than average wage rate the next year and the year after that? If panel data for Australia were available, the importance of this fixed effect could be directly estimated from the data. Because such data are not available, the significance of such permanent effects in Australia has to be guessed at. Consequently, the second part of Section 4.2 discusses available overseas evidence on earnings dynamics.

The third part of Section 4.2 then explains the assumptions made in the model about error terms, given this overseas evidence. The procedures used to try to recreate plausible patterns of earnings dynamics are explained in detail. The final part of Section 4.2 summarises some of the results of the simulation of wage rates and tries to assess whether the dynamic patterns created in the model appear realistic.

Section 4.3 details the enormous problems encountered when trying to simulate the receipt of investment income, while Section 4.4 describes the simulation of superannuation income. Finally, Section 4.5 explains the procedures used to model the receipt of maintenance income by women.

4.2 EARNINGS

There are no longitudinal data on earnings for a representative sample of the population in Australia, which creates enormous difficulties when attempting to simulate lifetime earnings profiles for the pseudo-cohort. In modelling earnings and other income, the standard assumption used for the entire model - that the cohort live in a world which is the same as that existing in 1986 - has been followed. This effectively means it has been assumed that the earnings and income received by the many different age cohorts captured in the 1986 Income Distribution Survey

(IDS) can be linked together to provide a picture of the lifetime income of the pseudo-cohort. Given that earnings tend to increase over time at about the rate of economic growth (Moss, 1978:124), it is possible to modify the wage rates etc derived from the IDS, to allow for assumed future productivity growth. It is also possible to select a discount rate, to allow for income received late in life being of less value than that received early in life. For reasons explained in detail in Chapter 5, the rate of economic growth and the discount rate have been assumed in this first version of the model to be the same, so that the two effectively cancel each other out. (The same assumption is also made in the West German and Canadian dynamic cohort models - Wolfson, 1988:233; Hain and Helberger, 1986:63.)

To calculate log hourly wage rates, multiple regression equations using ordinary least squares were estimated separately for men and women and for the different education categories within each sex for each of the following groups;

- the non-self-employed working full-time;
- the non-self-employed working part-time; and
- the self-employed.

There was much greater variance of part-time earnings, which is why part-time workers were treated separately.

Non-Self-Employed Males and Females

For non-self-employed males, who were aged less than 65, were not invalid and were not at school, the log of the hourly wage rate was made dependent upon education, full or part-time status, age, whether the individual worked full-year full-time in the preceding year, whether they were married or divorced and the number of hours worked per week (Table 4.1). The independent variables used for women were the same, with the sole addition of a dummy variable testing for the presence of dependent children (Table 4.2).

The use of hours of work as an independent variable explaining wage rates is unusual, as labour supply theorists usually approach the problem from the other direction and use wage rates as an independent variable which helps to predict labour supply (Brown, 1983; Killingsworth, 1983). However, the direction of causality is not certain. The expected wage rate could not be used as an explanatory variable in the simulation of hours worked (described in the preceding chapter), because hours worked was not a continuous variable, and the use of simple probability tables made usage of the wage rate as an independent variable problematic. However, as in the 1986 IDS data, hours worked emerged as an important predictor of wage rates (being significant at the one per cent level in all cases), it was decided to retain it as an explanatory variable in the simulation.

Self-Employed Males

The independent variables used for the self-employed were similar to those for the non-self-employed, with the exception that they were not divided into those working full-time and part-time. In addition, data on total hours worked and total earnings during the financial year 1985-86 (rather than at a single point in time in late 1986) were used to estimate the hourly wage rate. (This was because the weekly earnings of the self-employed seemed likely to suffer major fluctuations, making the data available at a single point in time in late 1986 unreliable.) This meant that no information was available about earnings in the preceding year, and that the self-employed's wage rate was affected by the total number of hours worked in 1985-86, rather than by weekly hours as for the non-self-employed.

Major difficulties were presented by the 15 per cent of self-employed males declaring zero income for the entire financial year (with the percentage reporting zero income showing almost no variation by education level). It seemed probable that those who had only recently set up their own businesses would be more likely to report zero income than those who had been self-employed for a number of years. However, the IDS data showed that the hourly wage rate declared by the self-employed during the single week of the IDS survey in late 1986 was *lower* for those who had been self-employed during the preceding financial year than for those who had only recently become self-employed. This indicated that imputing lower earnings for the first few years of self-employment might not be the most appropriate course. It was finally decided to simply randomly select the correct proportion of self-employed men each year to have zero income, and to use multiple regression to impute earnings to the remainder.

Self-Employed Females

Women who were self-employed were divided into three groups;
- those with a self-employed husband whose husband reported zero income;
- those with a self-employed husband whose husband had positive earnings; and
- those without a self-employed husband (including single women).

The probability of women in each of these three categories themselves reporting zero income was then calculated, and the relevant proportion were randomly selected each year to receive zero income. This probability was made dependent upon education, as the IDS data showed that women of higher education levels were less likely to report zero income than women of lower education levels. For the remainder with positive earnings, the hourly wage rate was calculated, and made dependent upon the husband's income where both partners were self-employed, because of the likelihood of income splitting.

Fitted Log Hourly Wage Rates

Figures 4.1 and 4.2 show the fitted log hourly wage rates, for non-self-employed males and females working full-time, produced in the model using the above regression co-efficients. Earnings for males peaked at about age 45, and peaked at a later age for those with higher educational qualifications. For those with only secondary school qualifications, the age-earnings profile was almost flat, while the better educated experienced significant increases in their hourly earnings rate between labour force entry and their late 40s. Hourly earnings for females showed a similar pattern.

Table 4.1: Regression Coefficients Used for Estimating Log of the Hourly Wage Rate for Males[1].

	COEFFICIENT						
α	Age	Age^2	Work FT FY_{t-1}^*	Married	Divorced	Hours p.w.*	Variance of residual
1. NON SELF-EMPLOYED WORKING FULL-TIME							
- *secondary school qualifications only*							
0.85	0.077	-0.0009	0.1096	0.0638	0.0263	-0.00614	0.116
(0.003)	(0.0002)	(0.02E-4)	(0.0007)	(0.0008)	(0.001)	(0.00005)	
- *trade qualifications*							
2.12	0.0189	-0.0002	0.0502	0.0358	-0.029	-0.007	0.080
(0.004)	(0.0002)	(0.02E-4)	(0.0009)	(0.0009)	(0.002)	(0.0006)	
- *other tertiary qualifications, not degrees*							
1.58	0.056	-0.0006	0.110	0.119	0.130	-0.012	0.131
(0.009)	(0.0004)	(0.05E-4)	(0.002)	(0.0018)	(0.003)	(0.0009)	
- *degrees*							
1.62	0.057	-0.0006	0.264	0.112	0.088	-0.012	0.098
(0.009)	(0.0005)	(0.06E-4)	(0.002)	(0.001)	(0.004)	(0.00009)	
2. NON SELF-EMPLOYED WORKING PART-TIME							
- *secondary school qualifications only*							
1.23	0.065	-0.0009	-0.140	0.273	-0.034	-0.013	0.279
(0.014)	(0.0009)	(0.01E-3)	(0.006)	(0.006)	(0.011)	(0.0002)	
- *trade qualifications*							
1.73	0.051	-0.0008	0.279	0.052**	0.913	-0.015	0.472
(0.049)	(0.003)	(0.04E-3)	(0.013)	(0.021)	(0.913)	(0.0005)	
- *other tertiary qualifications, not degrees*							
1.79	0.033	-0.0005	0.354	0.378	0.793	-0.001	0.219
(0.035)	(0.002)	(0.02E-3)	(0.011)	(0.009)	(0.018)	(0.0004)	
- *degrees*							
-2.68	0.290	-0.0033	0.034*	-0.179	-1.093	-0.016	0.315
(0.076)	(0.004)	(0.05E-3)	(0.019)	(0.013)	(0.029)	(0.0005)	

All coefficients significant at the 1 per cent level except for those marked with **, which indicates significant at the 5 per cent level, or #, which indicates not significant at 5 per cent level. Standard errors in brackets.

Table 4.1 cont

	COEFFICIENT						
α	Age	Age^2	Work FT FY_{t-1}*	Married	Divorced	Hours p.w.*	Variance of residual
3. SELF-EMPLOYED							
- *secondary school qualifications only*							
1.93	0.009	-0.0002	0.182	0.141	0.539	-0.0003	0.879
(0.021)	(0.001)	(0.01E-3)	(0.005)	(0.006)	(0.008)	(0.03E-4)	
- *trade qualifications*							
1.57	0.042	-0.0005	0.191	-0.207	0.074	-0.00027	0.476
(0.018)	(0.0009)	(0.0001)	(0.005)	(0.005)	(0.007)	(0.03E-4)	
- *other tertiary qualifications, not degrees*							
0.99	0.012	-0.0002	0.411	0.871	1.250	-0.0002	0.885
(0.044)	(0.002)	(0.03E-3)	(0.012)	(0.013)	(0.018)	(0.07E-4)	
- *degrees*							
1.54	-0.037	0.0008	-0.022#	0.029**	1.455	0.0002	1.469
(0.075)	(0.004)	(0.04E-3)	(0.014)	(0.013)	(0.032)	(0.07E-3)	

All coefficients significant at the 1 per cent level except for those marked with **, which indicates significant at the 5 per cent level, or #, which indicates not significant at 5 per cent level. Standard errors in brackets.

* For the self-employed the Work FT FY variable is whether worked full-time full-year in the current year, rather than in the immediately preceding year and the Hours variable is total annual hours rather than hours worked per week.

(1) The above coefficients are for males who are not school students, not invalid pension recipients and are aged less than 65 years. The small sample size of students, invalids and over 65 year olds meant that their imputed hourly wage rate was simply a function of the average rate received by each group, with the addition of the permanent error term (multiplied by the variance of the residuals applicable to each of these groups) plus a stochastic error term. School students who worked part-time were divided into three age groups - 15, 16-17 and 18-20 years - as average wages increased with age. Those aged 65 and over who were still in the labour force were divided into the self-employed and the non-self-employed.

Table 4.2: Regression Coefficients Used for Estimating Log of the Hourly Wage Rate for Females (1)

	COEFFICIENT							
α	Age	Age_2	Work FT FY_{t-1}*	Married	Divorced	Children	Hours p.w.*	Variance of residual
1. NON SELF-EMPLOYED WORKING FULL-TIME								
- *secondary school qualifications only*								
1.60	0.058	-0.0007	0.137	0.072	0.132	-0.061	-0.0189	0.112
(0.005)	(0.0002)	(0.03E-4)	(0.0008)	(0.001)	(0.002)	(0.001)	(0.09E-3)	
- *other tertiary qualifications, not degrees*								
1.29	0.066	-0.0008	0.098	-0.023	0.012	-0.0332	-0.0098	0.077
(0.006)	(0.0003)	(0.04E-4)	(0.0009)	(0.001)	(0.012)	(0.001)	(0.09E-3)	
- *degrees*								
1.76	0.039	-0.0004	0.071	0.062	0.085	-0.0279	-0.0053	0.068
(0.011)	(0.0006)	(0.08E-4)	(0.002)	(0.002)	(0.003)	(0.002)	(0.11E-3)	
2. NON SELF-EMPLOYED WORKING PART-TIME								
- *secondary school qualifications only*								
1.87	0.016	-0.0002	0.189	0.136	0.042	0.009	-0.0135	0.174
(0.007)	(0.0005)	(0.06E-4)	(0.003)	(0.003)	(0.004)	(0.002)	(0.08E-3)	
- *other tertiary qualifications, not degrees*								
1.88	0.039	-0.0006	-0.174	0.131	0.049	-0.213	-0.0142	0.229
(0.013)	(0.0008)	(0.01E-3)	(0.005)	(0.004)	(0.006)	(0.003)	(0.0001)	
- *degrees*								
3.89	-0.100	0.0012	-0.125	0.804	1.219	0.065	-0.0152	0.414
(0.062)	(0.004)	(0.05E-3)	(0.019)	(0.014)	(0.023)	(0.011)	(0.0005)	

All coefficients significant at the 1 per cent level except for those marked with **, which indicates significant at the 5 per cent level. Standard errors in brackets.

* For the self-employed the Work FT FY variable is whether worked full-time full-year in the current year, rather than in the immediately preceding year and the Hours variable is total annual hours rather than hours worked per week.

Table 4.2 cont

3. SELF-EMPLOYED WOMAN WITH SELF-EMPLOYED HUSBAND,BOTH HAVE EARNINGS

	COEFFICIENT						
α	Age	Age_2	Work FT FY	Husband's Hrly Rate	Children	Hours p.yr.	Variance of residual
- *secondary school qualifications only*							
2.33	-0.026	0.0003	0.263	0.763	0.089	-0.0008	0.688
(0.03)	(0.002)	(0.02E-3)	(0.007)	(0.002)	(0.005)	(0.04E-4)	
- *other tertiary qualifications, not degrees*							
2.31	-0.024	0.0002	-0.029	0.597	-0.266	-0.0004	0.399
(0.052)	(0.0028)	(0.04E-3)	(0.008)	(0.003)	(0.008)	(0.04E-4)	
- *degrees*							
-9.02	0.525	-0.0077	0.200**	1.458	-0.074**	-0.0002	0.299
(0.266)	(0.012)	(0.0002)	(0.096)	(0.027)	(0.034)	(0.35E-4)	

4. SELF-EMPLOYED WOMAN WITH NO SELF-EMPLOYED HUSBAND

	COEFFICIENT							
α	Age	Age_2	Work FT FY	Married	Divorced	Children	Hours p.yr.	Variance of residual
- *secondary school qualifications only*								
2.29	-0.045	0.0006	0.634	-0.401	0.346	0.631	-0.0001	1.271
(0.068)	(0.003)	(0.04E-3)	(0.015)	(0.020)	(0.023)	(0.013)	(0.07E-4)	
- *other tertiary qualifications, not degrees*								
-4.24	0.367	-0.0042	1.259	-1.133	0.332	0.534	-0.0010	1.136
(0.10)	(0.006)	(0.07E-3)	(0.033)	(0.027)	(0.035)	(0.018)	(0.02E-3)	
- *degrees*								
-7.13	0.392	-0.0045	-0.116	-	-0.074	0.349	0.0005	0.035
(0.117)	(0.005)	(0.05E-3)	(0.005)	-	(0.008)	(0.008)	(0.06E-4)	

All coefficients significant at the 1 per cent level except for those marked with **, which indicates significant at the 5 per cent level. Standard errors in brackets.

(1). The above coefficients are for females who are not school students, not invalid pension recipients and are aged less than 65 years. See note under Table 1 re imputation of wages of students, invalids and over 65 year olds. In addition, the number of married self-employed women who had positive earnings themselves when their self-employed husband had zero earnings was so small that only the average hourly wage rate for these women was imputed (with the appropriate variance reinserted).

Figure 4.1: Fitted Log Hourly Wage Rates For Non-Self-Employed Males Working Full-Time by Education and Age

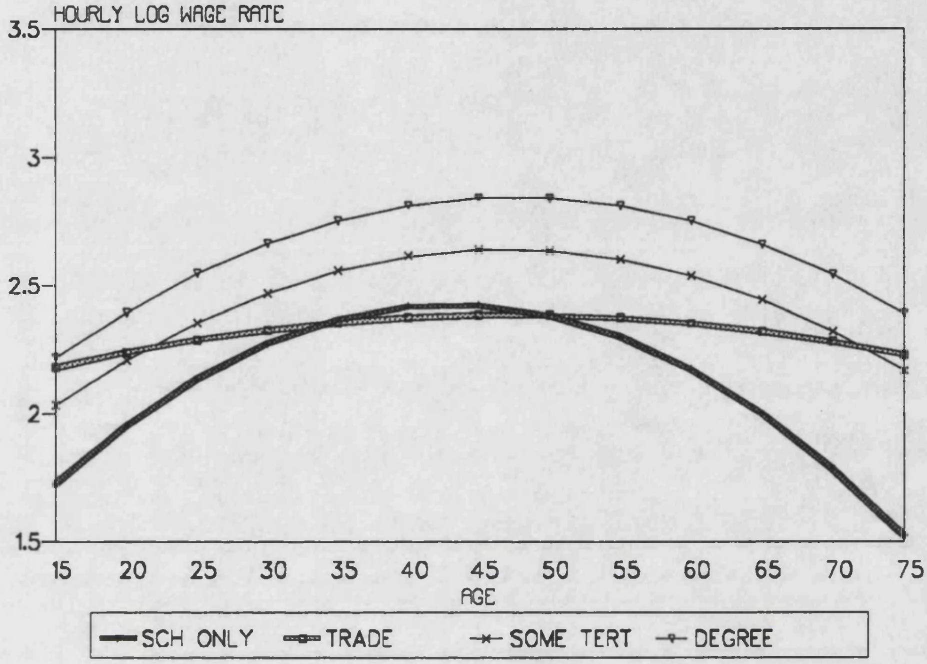
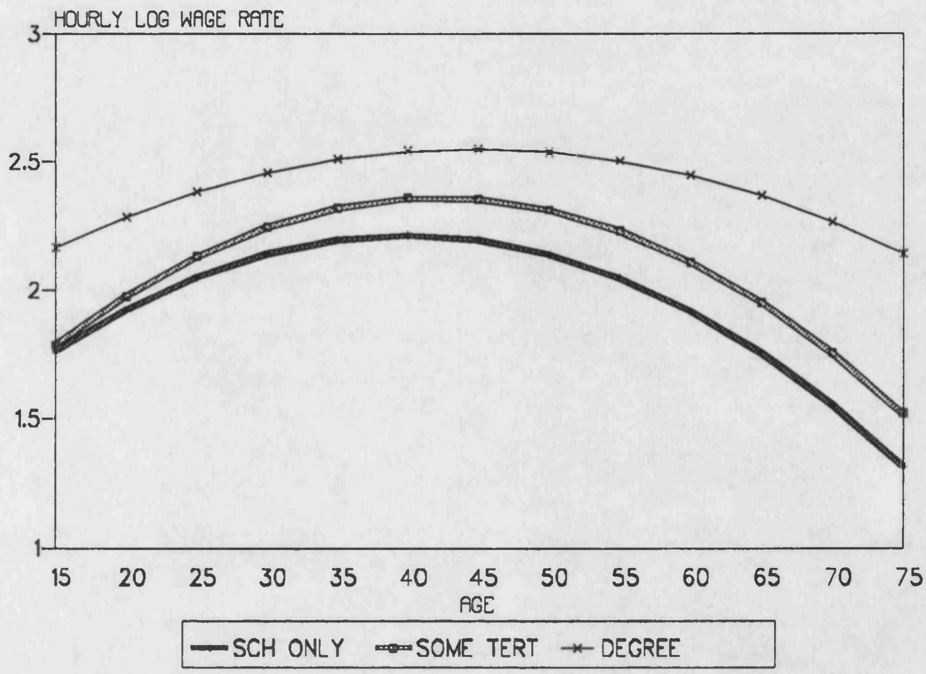


Figure 4.2: Fitted Log Hourly Wage Rates For Non-Self-Employed Females Working Full-Time by Education and Age.



As mentioned earlier, one drawback with simply using the coefficients produced by multiple regression to calculate the hourly wage rates used in dynamic microsimulation models is that this eliminates much of the dispersion in wage rates present in the real world. That is, the technique of multiple regression shows the *average* wage rate received by, for example, married male graduates aged 35 working 40 hours a week. In the real world, some of these male graduates would be earning three or four times this average wage rate, while others might be earning half of the average rate. Some of this apparent variance in earnings may be due to measurement error in the samples upon which the surveys were based eg. due to respondants incorrectly reporting their hours worked or their wages (Atkinson et al, 1990:92).

The problem is also due to actual wage rates being based upon a wide range of personal and other characteristics about which there is no information in the IDS and which are therefore excluded from the regression equation (eg. upon ability, motivation, background etc). Yet it is important to try to recreate the major differences in earnings apparent in the real world, otherwise there will be insufficient inequality in the model.

There are a number of ways in which the variance apparent in the real world can be reinserted into the simulated earnings distribution in the model. As noted above, the application of the relevant regression coefficients for each group results in the simulation of the average hourly earnings of those of a particular education level, hours worked, self-employment and marital status etc (called the fitted wage rate). To recreate the dispersion of hourly wage rates apparent in the real world, an *error term* has to be added to this fitted wage rate for each individual each year. The magnitude and dispersion of the error term is estimated from the 1986 IDS, and is calculated by subtracting the *fitted* hourly earnings produced using the regression equation from the *actual* hourly earnings recorded by individuals in the survey.

For example, when the fitted log hourly wage rate for non-self-employed tradesmen working full-time is calculated, using the multiple regression coefficients estimated from the 1986 IDS, this fitted wage rate is, on average, 28 cents above or below the actual wage rate of such tradesmen in the sample. In around 5 per cent of cases the *fitted* wage rate is likely to be more than 56 cents above or below the *actual* wage rate. Adding an error term which has a mean of zero and a variance of 0.08 (ie. 28 cents squared) to the fitted wage estimated in the model then results in the variance of the simulated wages in the model matching that in the real world - that is, in both the 1986 IDS and the model the mean hourly log wage for this group of tradesmen is $2.30 an hour and the variance of this hourly wage rate is 0.09.

It is not, however, sufficient just to assign randomly these error terms to each simulated individual in the model every year; the factors which cause one individual to have a wage rate three times the average for comparable individuals in one year are likely to be still present the next year, so that in the next year the individual is still likely to be earning well above the average for his or her cohort.

For example, if a person is earning higher than average wages in one year because they are particularly clever or their father owns a merchant bank, these factors are likely to still be affecting their wages the following year. A way therefore has to be found in the model to capture the relative permanence of the error term over time, whilst also allowing for the random shocks and fluctuations in earnings which panel data demonstrate exist.

If Australia had a panel survey, the importance of the permanent error term and of the stochastic error term could be directly estimated from the data. However, when all that exist are cross-section data, a guess has to be made at the relative importance of the two effects.

Evidence On The Dynamics Of Earnings

A critical consideration when simulating lifetime income is the degree of relative earnings mobility. Previous research has suggested that the size distributions of income and earnings in developed economies are fairly fixed, showing relatively little change over time (Schiller,1977:926; Thatcher, 1971:374). Yet a critical issue when assessing long term inequality and poverty is how mobile individuals are *within* this relatively rigid size distribution. Do individuals remain in the same position relative to others in their birth cohort or is there substantial relative earnings mobility over time ? Or, put another way, what percentage of those in the bottom decile of earnings for 20-30 year olds in one year are still within the bottom decile of earnings for 30-40 year olds ten years later?

As Hart points out, "How long the average person stays in a particular income size class is just as important a characteristic of a society as is the degree of inequality of incomes at any point of time... the degree of 'income mobility' or movement between income size classes may be more important than the static measures of inequality at one point of time in determining incentives to work, social justice and other qualities of life" (1976a:108).

Available evidence suggests that there is earnings mobility within industrialised countries. Using the US Longitudinal Employer Employee Data file, Moss compared the relative earnings positions in 1959 and 1969 of US workers born between 1925 and 1929, and found that about two-thirds were in a different earnings decile in 1969 (1978). Schiller used the same LEED data file, but included only those males who were aged between 16 and 49 in 1957 (the first year of the observation period), who had at least $1000 of earnings in 1957 and had positive earnings in 1971. He assigned each male within a five year age cohort to a ventile of earnings (5 % bands) in 1957 and in 1971, and then compared the two to find out whether individuals of approximately the same age and experience exchanged relative earnings positions over time. He found that about 30 per cent of workers stayed in the same ventile and that they tended to be at either the top or bottom of the earnings distribution (not suprisingly, because those at the top and bottom find it hard to move up and down respectively), while the remaining 70 per cent changed ventiles, with the average move spanning four ventiles (ie about one-fifth of the earnings distribution) (1977).

In the UK, Thatcher compared Department of Health and Social Security data on the earnings of employees who paid national insurance contributions in at least 48 weeks in both 1963-4 and 1964-5 and, after dividing them into age cohorts, again found movements in relative earnings positions between the two years (1971). Similarly, also using DHSS data, Hart found major changes in the relative position of males born in 1933 between 1963 and 1970 - for example, only 16 per cent of those males in the fifth earnings decile in 1963 were still in the fifth decile in 1970, with the original sample having moved as far as the top decile and as low as the bottom decile of earnings in 1970 (1976a:123).

Using a shorter time frame, the UK Department of Employment, using a constant sample of the earnings of individuals in one week in 1970, 1971 and 1972, found that only 4.6 per cent of the sample were in the lowest decile of earnings in each of the three years, suggesting that spells in the bottom decile were a transitory experience for many (1973).

Numerous other studies have examined the extent to which *earnings in one year are correlated with earnings in the next*, and have found that there is greater mobility while workers are younger. After an exhaustive survey of the literature, Atkinson et al concluded that "the results in general support the view that correlation rises over the life-cycle, from values around 0.75 in the mid-20s to around 0.90 to 0.95 in the 50s" (1990:101).

Such mobility in relative **total earnings** is perhaps not unexpected, given the PSID finding that the work hours of even prime age males fluctuate markedly from year to year, due to changes in the length of the standard week, in overtime hours and second jobs, short spells of unemployment and illness, etc. Duncan and Hoffman found that "the average difference in hours worked from one year to the next amounted to more than six 40-hour weeks for women and, suprisingly, even more for men" (1984:122). Under these circumstances, one would expect total annual earnings to fluctuate markedly and thus produce major changes in relative earnings positions from year to year.

However, the PSID data also revealed that the **hourly wage rate** also fluctuated greatly from one year to the next, by an average of 25 per cent for prime-age men (Duncan and Hoffman,1984:122). Comparing the hourly wage rates of white male household heads (who were aged 25 to 50 in 1969) showed that 56 per cent of these males were in a different wage quintile in 1978 than that they had occupied in 1969 - and that one person in five had changed position by two quintiles or more (1984:116). (These transition rates are not, however, cohort specific, and, given the strong relationship between age and hourly wages, one would expect major shifts in quintile position).

Reflecting the "remarkable volatility" in hours worked and hourly wage rates, Duncan and Hoffman found that there "is a tremendous amount of year-to-year fluctuation in earnings both upward and downward. No identifiable group - not the more educated, not union members, not even higher-income persons - seems to be immune from these changes in year to year income" (1984:119). While part of this apparent mobility may be due to measurement error (Bound et al, 1989), if such error is correlated over time the magnitude of the problem may be reduced. It should also be recognised that much apparent mobility reflects systematic factors rather than random forces, such as increasing age, movement in and out of full-time jobs and of the labour force, and so on.

Is Mobility Transitory ?

A second important issue in simulating lifetime earnings, given this apparent mobility, is whether upward mobility in one period is reversed in the next period, thus rendering mobility a transitory phenomenon. For example, one could imagine a society where there were major changes in relative earnings position in one year which were fully reversed in the next year. In such a society, if relative earnings positions in one year were compared with those in the immediately preceding year then an impression of substantial mobility would be created - yet if the relative earnings positions were compared to those of two years earlier then there would appear to be no mobility. Whether or to what extent mobility is permanent or transitory makes an enormous difference to how lifetime earnings should be simulated.

Shorrocks argues that "since those who have recently received a significant income increment due to promotion are unlikely to be considered for further promotion in the near future, they will tend to experience lower income changes than the average of their contemporaries, some of whom are being promoted" (1976:571). In other words, individuals who move ahead of their cohort in one year through promotion, shifting jobs etc, are likely to find that in the next year or two many of their contemporaries catch up, even though the high fliers might then move ahead again with their next promotion.

Shorrocks found that the process governing income mobility was not first-order Markov, because the "probability of a positive [earnings] class change in one period is inversely related to the past transition and vice versa" (1976:576). Similarly, Hart found that "higher than average increases in income in one period are followed by lower than average increases in income in the following period, and vice versa" (1976b:560).

However, Schiller argued that while improvements in relative position in one period *were* often offset in the next, nonetheless most of the mobility observed was 'permanent' (1977:934). Support for this view is provided by studies which have tracked cohorts for long periods and have found that earnings mobility increases with the length of the measurement period. Both Bourguignon and Morrisson (1983) and Soltow (1965) found that the correlation between earnings 30 years apart was below 0.40 per cent - so that, as Atkinson et al explained, this "means that, well after entry in active life, intial earnings explain only 16 per cent of the variance of earnings 30 years later" (1988:625).

Permanence in Earnings Relativities

Nonetheless, despite this undoubted mobility, available evidence also suggests that there is also marked permanence in the relative earnings positions of individuals. Kennedy analysed the earnings of 262 males born in 1930 who had positive earnings every year from 1966 to 1983 and contributed for each of these years to the Canada Pension Plan. He found that "following an unstable period of earnings 'adolescence', few mature individuals make large long-term gains or losses in earnings relative to those of their cohort. Permanent differences between individual levels of earnings, rather than transitory fluctuations, account for the bulk of the earnings differences evident in cross-sectional data" (1989:385). He found that 68 per cent of the variation in relative earnings observable across these individuals at a given point in time was explained by *permanent* differences between their level of earnings.

After an extensive survey of the literature, Atkinson et al also concluded that "all of these results point to strong permanent forces - ie. associated with constant individual observed or non-observed attributes - for earnings mobility, which may dominate purely transitory phenomena" (1990:143).

On balance, it appears that permanent differences between individuals account for the majority of earnings variance; that there are nonetheless substantial fluctuations from year to year around an individual's long term relative position; that such transitory fluctuations contribute greatly to the apparent shifts in relative earnings positions revealed in surveys of earnings at two or more points in time, but that some component of the relative earnings mobility revealed by such surveys is caused by permanent changes in the position of some individuals vis a vis their cohort. However, given the marked variation in the findings of the various studies, as Atkinson et al observe, "it is not possible to draw definite conclusions about the extent of earnings mobility" (1990:151).

Modelling Earnings Dynamics For Australia

Given the dearth of Australian panel data and the lack of definitive overseas evidence (including the absence of many results on the dynamic profiles of women), the extent of mobility in earnings in Australia over time remains uncertain. It is therefore not clear to what extent the following procedures used to generate the permanent and stochastic variance in hourly earnings apparent in the real world are accurate.

The Permanent Error Term

Given the permanence of much of the earnings differentials found by Kennedy and others, all of the variables available in the model were examined to see which might help in generating the degree of institutionalised inequality in earnings apparent in society. First, all cohort members were given a 'socio-economic score' which was based upon a range of personal and socio-economic characteristics which could be expected to influence whether they earned more or less than similar members of their cohort.

They were thus first assigned four points if their parents belonged to the top SES quartile, three and two points respectively for the middle quartiles and one point if their parents were in the lowest SES quartile, on the assumption that family background might have some influence on future relative earnings rates (Duncan and Hoffman, 1984:110). Those who went to a private school for their final years of secondary schooling were assigned another 4 points, those at Catholic schools 3 points, those at government schools 2 points and those who left school before the final two years of secondary schooling only one point, on the assumption that extra years of schooling in good schools might help to create the confidence, contacts, etc which might later be associated with higher earnings. Finally, those selected never to experience any unemployment in their whole lives were awarded another four points, those selected to be occasionally unemployed 2.5 points and the chronically unemployed one point, on the assumption that such unemployment might be associated with personal characteristics, 'scarring' or intermittent work patterns which could affect relative earnings position. The maximum score on the socio-economic variable was thus 12.

While environmental influences are thus assumed to affect the relative earnings positions of individuals in the pseudo-cohort, it also seemed likely that personal qualities would also make a difference to relative positions. To capture this, a second uniformly and randomly distributed 'ability' variable was created, designed to capture such unmeasurable personal characteristics as intelligence, ability, motivation, efficacy, and willingness to work very long hours, all of which might be expected to affect relative earnings. The pseudo-cohort were then divided into eight 'ability' groups of equal size, with the top group being awarded 16 points and the bottom group two points.

The ability and total socio-economic scores were then added together to derive the *'relative earnings advantage'* score, producing a maximum score of 28 for those who were endowed with the personal characteristics and social and environmental advantages likely to ensure that they earned a higher wage rate than other comparable members of their cohort.

After being divided at age 45 into the groups for whom separate regression equations were estimated, the individuals within each group were ranked by their 'relative earnings advantage' score and were then each assigned a number from a normal distribution with a mean of zero and a variance of one, with the highest ranking members within each of the groups being given the top positive numbers from this distribution and the lowest ranking members being given the bottom negative numbers.

This procedure ensured that a normally distributed 'permanent' error term was attached to each simulated individual in each of the groups for whom regression equations were used to impute hourly wage rates. The variance of the residuals (ie. the difference between the *actual* log hourly wage rates received by the real individuals recorded in the 1986 IDS and the *fitted* hourly wage rates imputed to them using the appropriate regression equation) was then calculated. To recreate the correct degree of variance in wage rates in the pseudo-cohort, all that was then required was to multiply the 'relative earnings advantage' score of each individual by the square root of the appropriate variance of the residuals. An individual with a high lifetime 'relative earnings advantage' score, for example, might have a wage rate which was consistently 50 per cent higher than the average wage rate of other comparable individuals in the simulation.

The Stochastic Error Term

In addition, in order to produce the random shocks to wage rates which the PSID and other data suggest exist, a further *'transitory' error term* was added to the wage rate of each simulated individual each year. This error term was drawn from a normal distribution with mean zero and variance 0.0025, and was changed every year for every individual. This meant that, on average, the actual wage rate in any given year was five per cent higher or lower than the 'permanent' wage rate, and that every year about five per cent of the pseudo-cohort received an hourly log wage rate which was about 10 per cent higher or lower than their permanent wage rate.

While this second error term might appear too low, given the average 25 per cent fluctuation in hourly wage rates from one year to the next found by the PSID, it should be noted that there is significant change in wage rates from year to year for simulated individuals. Hourly wage rates change greatly, not only due to the stochastic error term, but also due to increasing age, changes in marital status and hours worked (both currently and in the preceding year), switches from full-time to part-time work and vice versa, entries or exits to self-employment, the attainment of additional educational qualifications and so on.

In a small number of cases, when the applicable hourly wage rate for self-employed individuals was multiplied by the number of hours worked in the year, the resultant total annual earnings far exceeded the highest annual earnings for the self-employed revealed in the IDS. It is entirely conceivable that some self-employed do occasionally earn extraordinarily high earnings, and that their absence from the IDS is simply due to this relatively rare event not occurring to any of the IDS sample.

During development of the model these very high self-employed incomes were therefore originally left untouched, but this was later found to cause major problems when simulating investment incomes. Because earned income was originally used as one of the independent variables affecting investment income receipt, those with extraordinarily high earned income were subsequently assigned extraordinarily high investment income in some of the techniques tested for simulating investment income. Eventually, a decision was taken to truncate the extremely high self-employed earned incomes, so that those self-employed with an earned income of greater than $150,000 a year were simply given an earned income of $150,000 a year (the maximum earned income for self-employed found in the IDS was $120,000 for women and $130,000 for men). This modification only affected some 0.001 per cent of the observations of males and 0.0005 per cent of observations of females. It is possible to change the assumption to retain the original simulated earnings.

Evaluation of the Earnings Simulation

Mean and Variance of Earnings for Different Groups

There are two reasons to expect divergence between the mean log hourly wage rates recorded in the 1986 IDS and those simulated in the model. First, while one would expect the distribution of hours worked to be the same in the model as in the IDS (because the labour force module was based upon the IDS data) in other respects the pseudo-cohort do not look exactly like the population captured in the IDS. For example, wage rates are affected by marital status and the presence of children, and in the model a different proportion of the population are married or have children compared to the IDS population. This is because the marital and child status of the real individuals recorded in the IDS are a result of the marriage and fertility rates applying during the last 100 years, while the marital and child status of the simulated individuals result from the use of the marriage, divorce and fertility rates applying in 1986.

Apart from the simulated population not exactly replicating the demographic characteristics of the IDS population, a second reason to expect divergence between the simulated wage rates and the real wage rates recorded in the IDS is the random nature of the permanent error term used in the model. In a model of 100,000 simulated individuals, the normal distribution of error terms generated within SAS (the computer language in which the model was written) for each of the 24 groups for whom multiple regression equations are estimated would probably have a mean of exactly zero and a variance of exactly one for each group.

However, in a model of only 4000 simulated individuals, it would be exceptionally good luck if, for example, the small number of people selected to be self-employed each year had attached to each of them a permanent error term which coincidentally resulted in a normal distribution of error terms with a mean of zero and a variance of one for this small sub-group as a whole. Yet, when this condition is not met, the variance apparent in the real world cannot be accurately reinserted into the model. This appears to be one of the reasons why the results are less satisfactory for smaller groups, such as the self-employed and non-self-employed males working part-time. The much greater dispersion of wages for these groups, particularly for the self-employed, also makes it more difficult to fit a satisfactory regression line and to accurately reproduce their earnings rates.

Nonetheless, despite these potential problems, on the whole the earnings module appears to perform very well in reproducing a realistic distribution of wage rates. Table 4.3 shows the mean and variance of log hourly earnings rates for various groups found in the 1986 IDS and compares them with the results produced by the model. In most cases, the mean and variance produced by the simulation appear very close to the IDS estimates.

Table 4.3: Mean and Variance of Log Hourly Earnings Rates for Various Groups Found in 1986 IDS and in the Model

Category	IDS SURVEY Mean	IDS SURVEY Variance	SIMULATION MODEL Mean	SIMULATION MODEL Variance
NON SELF-EMPLOYED, AGED LESS THAN 65 YEARS				
- working full-time				
Males				
- secondary sch only	2.15	0.17	2.05	0.18
- trade quals	2.30	0.09	2.30	0.09
- other tertiary	2.45	0.16	2.45	0.16
- degree	2.60	0.14	2.65	0.13
Females				
- secondary sch only	1.95	0.15	1.90	0.16
- some tertiary	2.15	0.10	2.20	0.10
- degree	2.40	0.08	2.40	0.07
- working part-time				
Males				
- secondary sch only	2.10	0.32	2.10	0.33
- trade quals	2.25	0.65	2.20	0.58
- other tertiary	2.60	0.31	2.55	0.30
- degree	2.35	0.44	2.35	0.64
Females				
- secondary sch only	2.10	0.18	2.05	0.19
- some tertiary	2.20	0.25	2.25	0.19
- degree	2.50	0.41	2.40	0.55
SELF-EMPLOYED, AGED LESS THAN 65 YEARS				
Males				
- secondary sch only	1.50	0.88	1.40	0.79
- trade quals	1.75	0.48	1.75	0.54
- other tertiary	1.70	0.88	1.58	1.00
- degree	2.05	1.47	2.25	1.94
Married Females with Self-employed Husband, Both Have Earnings				
- secondary sch only	2.00	1.29	2.15	1.39
- some tertiary	2.00	0.83	1.95	0.76
- degree	2.70	0.89	2.65	0.59
Females Without Self-employed Husbands				
- secondary sch only	1.60	1.21	1.75	1.44
- some tertiary	1.40	1.28	1.60	1.96
- degree	2.00	0.56	1.95	0.34

Table 4.3 cont

Category	IDS SURVEY Mean	IDS SURVEY Variance	SIMULATION MODEL Mean	SIMULATION MODEL Variance
AGED OVER 65 YEARS				
Self-employed men	1.40	2.77	1.85	1.35
Self-employed women	1.45	2.78	1.60	2.61
Non-selfemployed men	2.05	0.38	2.00	0.41
Non-selfemployed women	1.95	0.33	1.90	0.36
SCHOOL STUDENTS				
Male	1.55	0.31	1.50	0.29
Female	1.60	0.40	1.60	0.36

Year to Year Fluctuation in Hourly Wage Rates

The model also appears to capture well the fluctuation in hourly wage rates from year to year, which was found in the PSID data. Table 4.4 shows the average absolute change in hourly earnings at ages 35, 45 and 55 of the pseudo-cohort males and females compared to those earned in the preceding year. For example, it shows that for males, the hourly wage received at age 35 was, on average, 19 per cent higher or lower than that received at age 34. The hourly earnings of women show greater variation than those of men, but this is to be expected, given the greater volatility in their labour force behaviour.

Relative Earnings Mobility

The *annual earnings* of the simulated individuals in the model also vary greatly from year to year. As they are calculated by simply multiplying the hourly wage rate by the number of hours in the labour force in a given year, they not only reflect fluctuations in wage rates but also the impact of changes in working hours due to unemployment, illness, pregnancy and birth, of changes in marital status and the presence of young children, extended leave or absences from the labour force etc. One partial test of the model is to examine whether it appears to simulate a realistic degree of mobility and immobility in total earnings.

Table 4.4: Average Absolute Change in Hourly Wage Rates Produced by the Model and Found in PSID Data.

Age	Absolute Percentage Change in Hourly Wage Rates Compared to Those Earned in the Preceding Year
1. PSID (1)	
- white male household heads aged 25-50	0.25
2. MODEL	
Males	
- 35 years	0.19
- 45 years	0.23
- 55 years	0.19
Females	
- 35 years	0.32
- 45 years	0.28
- 55 years	0.20

Note: The table shows the absolute percentage increase or decrease in hourly wage rates at the given age, compared to those earned one year earlier. Only those with positive earnings in both years are included.
(1). Source: Duncan and Hoffman (1984:122).

A number of longitudinal studies have sampled the same groups of males at two different points in time. Such studies have composed transition matrices, by allocating the males to an earnings decile in the base year of the sample (eg. in 1960), and then reallocating the same males to an earnings decile some years later, based on their earnings in the latter year (eg. in 1970). It is then easy to see how many of the males have shifted from one decile to another or, conversely, have remained in the same decile, thereby providing a clue of the degree of earnings mobility in the society.

In Table 4.5, the proportion of males remaining in the same aggregate earnings decile or quintile at two different points in time found in a number of longitudinal studies is shown, and compared with the results produced by the model. For example, when pseudo-cohort males in the labour force at both age 35 and age

45 are allocated to earnings quintiles in each of those years, about 45 per cent are in the same earnings quintile in both years. Conversely, some 55 per cent either move up or down the relative earnings distribution. As expected, the relative earnings mobility of pseudo-cohort females is greater, with only 39 per cent remaining in the same earnings deciles at ages 35 and 45. These results appear to compare well with the findings of longitudinal studies, and suggest that the model generates an appropriate degree of mobility.

Table 4.5. Proportion of Those in Labour Force Remaining in Same Total Earnings Decile or Quintile in Other Data Sources and in the Model

Country, Study and Year	Time Period, Group Covered, and Age of Sample in Base Year	Percent of Sample Remaining in the Same Total Earnings	
		Quintile	Decile
1. Studies			
- UK - Hart (1976)	7 years, adult males aged 30	44	28
- US - Schiller (1977)	14 years, males aged 16-49 earning $1000+	-	29 *
- US - Moss (1978)	10 years, white males aged 30-34	-	33 **
- US - Duncan et al (1984)	9 years, white males aged 25-50	44	-
2. Model #			
Males	-10 years, males aged 35	47	28
	-10 years, males aged 45	45	26
	-20 years, males aged 35	40	23
Females	-10 years, females aged 35	36	21
	-10 years, females aged 45	39	21
	-20 years, females aged 35	32	18

** Percent of males remaining in the same ventile (ie. 5 per cent band) rather than decile.*
*** Per cent of white males remaining in the same decile of earnings for all males (both white and black). ie. 33 per cent of white males remained within the same aggregate earnings decile.*
 # Sample is those in the labour force at ages 35, 45 and 55 (ie. those not in the labour force in one or more of these years are not included).

4.3. INVESTMENT INCOME

The 1986 IDS contained information about personal investment income, comprising income from interest (on bank accounts, government bonds, loans, debentures etc), dividends, net rent, taxable profit from sale of property, and interest from property, cash management and unit trusts. In addition, a small number of individuals on the tape were designated as receiving income from 'own non-limited liability business/trust', were recorded as working for 52 weeks in their own 'non-limited liability business or trust in 1985-86', yet said that they worked zero hours per week in this non-limited liability business/trust. Most also appeared to be working 52 weeks for wages and salaries, and so it was decided to treat this kind of income as unearned income rather than earned income. Hence it was reallocated to investment income and is included here.

The accurate simulation of investment income is extremely difficult, as some 45 per cent of Australians receive no investment income, a large proportion of those who do receive investment income receive fairly small amounts of only a few hundred dollars a year, while a further very small proportion receive very high investment incomes of over $100,000 a year. These characteristics make it more difficult to use econometric techniques to satisfactorily simulate investment income and a number of different approaches were tried.

In the first approach tried, a tobit model was estimated to impute annual investment income (a tobit model is a technique which allows one to deal with situations where the dependent variable - in this case investment income - is zero for a significant proportion of the sample). The first attempt was estimated by a maximum likelihood tobit model (Maddala, 1983:151-162). The explanatory variables used in the tobit equation were age (investment income increased with age), self-employment status (the self-employed had significantly higher investment income than the non-self-employed), education (investment income increased with additional education), the presence of any children aged less than 15 (associated with lower investment income), whether divorced (lowered income), and the amount of earned income (higher earned income was correlated with higher investment income).

However, when the relevant tobit parameters were used in the model to simulate investment income it became clear that either the parameters were biased or the data was not normally distributed, as the mean investment incomes for discrete groups in the simulated population were two to three times higher than the real mean investment incomes for comparable groups in the 1986 IDS. Truncating simulated investment incomes which were very high had little effect upon this problem.

A second attempt utilised an alternative two-step tobit procedure used by Heckman (1976). Because at the second stage this procedure used ordinary least squares it was hoped that it would be less sensitive to distributional misspecifications (caused by the few very high observations for investment income in the IDS). However, the predictive power of the resulting estimates was also poor; in attempting to capture the long investment income tail the mean was biased upwards, again leading to unusable predictions. It was decided that the results produced using a tobit model were too inaccurate to use as, for example, investment income levels which were double or triple the real levels would make large numbers of retirees in the model ineligible for means-tested age pensions.

Finally, the best that could be done was to simply divide the population into major sub-groups and then select the correct proportion within each sub-group to have zero investment income and impute the relevant mean and variance of the log of investment income for the remainder. Figure 4.3 summarises the procedures followed in assigning investment income, which are described more fully below.

The first step was therefore to devise a method of determining which cohort members would receive zero investment income in a given year. For both sexes, the probability of having zero investment income was calculated from the 1986 IDS and was based upon age, education, self-employment status and marital status.

A *lifetime propensity to save* was then imputed to each simulated individual at birth. The value of this variable ranged between zero and one, and was made 75 per cent dependent upon parental SES (with those with higher SES parents being more likely to receive investment income) and 25 per cent dependent upon chance (ie. thereby imputing personal preferences for saving or spending). This ratio can be changed. When the value of the lifetime propensity to save was less than the probability of receiving zero investment income in any year, then the individual was assigned zero investment income.

The remaining cohort members were thus selected to have positive investment income in that year. The second step was therefore to work out *how much investment income* these individuals would receive in that year. Cohort males were assigned investment income in accord with their age, self-employment status, and education. Females were stratified by their age, marital status, education and, where sample size on the IDS tape provided valid results, by their self-employment status. No doubt reflecting the highly skewed distribution of investment income in the IDS which made the econometric techniques unsatisfactory, even just imputing the mean and variance of investment income found in the IDS resulted in investment income levels in the simulation which were too high for some sub-groups.

In such cases the maximum log investment income allowed was truncated, usually to the maximum observation found on the IDS for that sub-group, but sometimes to somewhat lower levels. In other words, when the choice was between imputing the correct variance and then facing a mean which was too high, or imputing a variance which was lower than that found in the real world but resulted in the correct mean, the latter course was followed. This approach was taken to ensure that artificially high numbers of the pseudo-cohort would not be precluded from receipt of social security cash transfers. However, alternative approaches could easily be modelled.

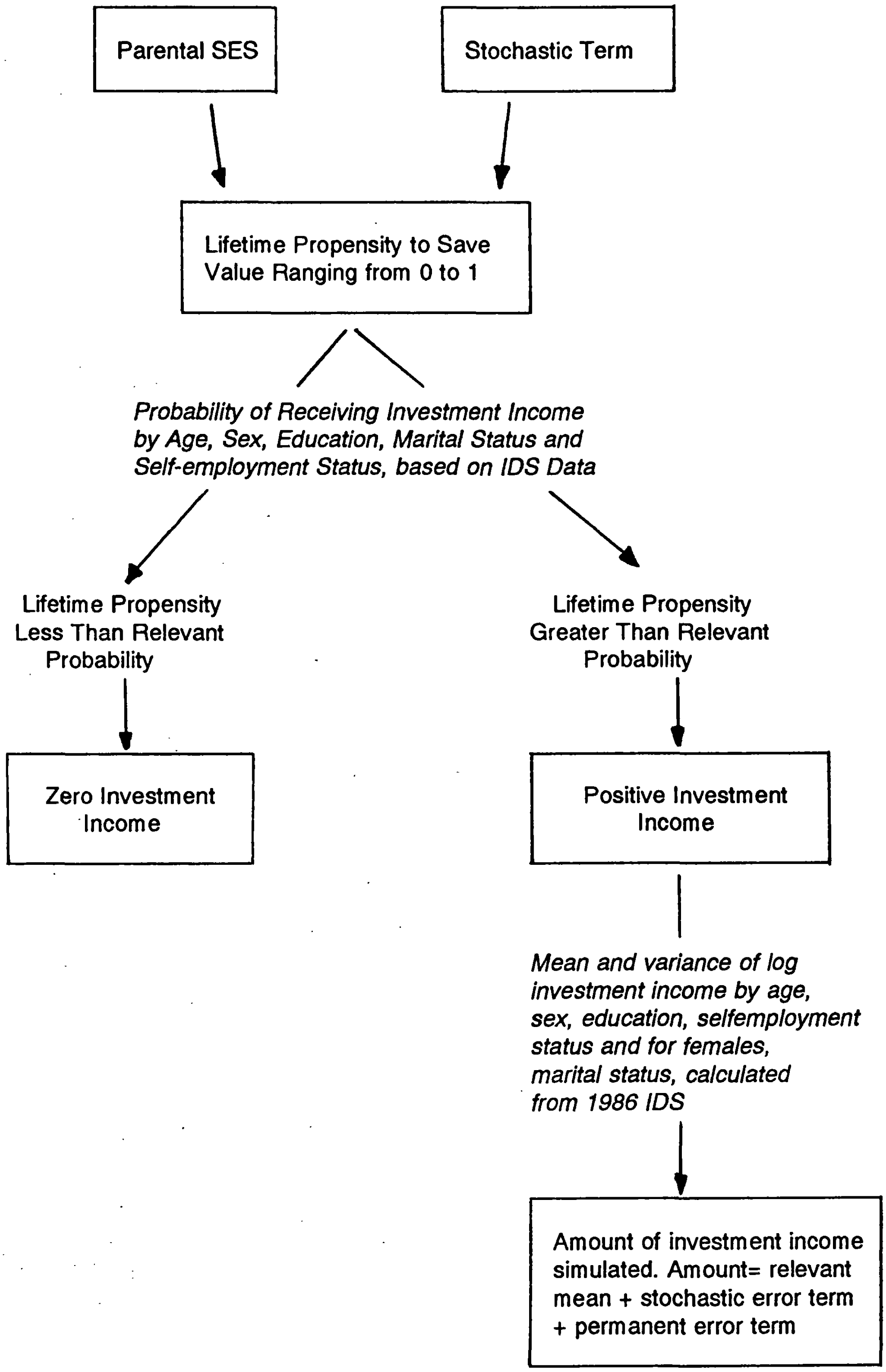
As with earned income, an error term was added in order to recreate the dispersion of investment income apparent in the real world. Randomly reassigning this error term for every individual every year would have caused wild fluctuations in investment income. While it seems likely that there are major fluctuations in investment income over time, it also seems probable that some individuals save persistently more or less than individuals with apparently similar characteristics in their cohort.

For example, individuals who have high investment incomes in one year due to rich parents giving them assets or trust income are likely to still be benefiting from these factors the following year. Similarly, it seems likely that some individuals have a lifetime tendency to save more, while others in their cohort prefer to spend all of their income, and thus accrue less assets and subsequently investment income.

If one had genuine longitudinal data on investment income, the importance of the permanent and stochastic error terms could be directly estimated from the longitudinal data. However, when all that is available is cross-section data, like that in the IDS, the relative magnitude of the permanent error term (capturing long-run individual tendencies to save more and receive more investment income than others with similar characteristics) and the stochastic error term (capturing fluctuations in investment income from year to year, due to changes in interest rates, stock market crashes, sale of assets etc) have to be imputed.

Given these factors, the error terms were created in the following way. Two error terms were added to the relevant means. The first, which amounted to one-third of the observed variance of investment income within each sub-group, was allocated stochastically and varied from year to year, thus producing random fluctuations in investment income. The second, amounting to two-thirds of the observed variance in investment income, was a permanent error term, which determined whether the individual normally received more or less investment income than apparently comparable invididuals.

Figure 4.3: Structure of the Investment Income Module



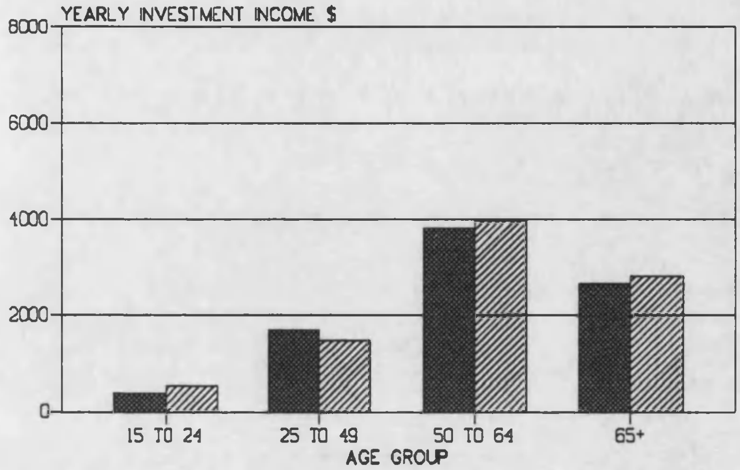
This permanent error term could have simply been randomly allocated at birth. However, as both the tobit and multiple regression results had shown that higher investment income was positively correlated with higher earned income, such a procedure would have created an income distribution which was artificially equal. Instead, a more complex procedure was followed, which created a link between earned income and investment income and effectively involved re-using the 'relative earnings advantage score' error term (which, as discussed earlier, was a major factor determining whether each simulated individual earned more or less than their cohort). Tests showed that the procedure had introduced a positive correlation between simulated earnings and simulated investment income.

Figures 4.4 and 4.5 show the mean investment incomes by age, education and, for females, marital status, found in the IDS and produced by the model. About 40 per cent of all cohort males and females receive investment income. This is somewhat higher than the proportion found in the IDS, because the pseudo-cohort have higher educational qualifications than the IDS population and the proportion receiving investment income increases as education level increases.

4.4 SUPERANNUATION INCOME

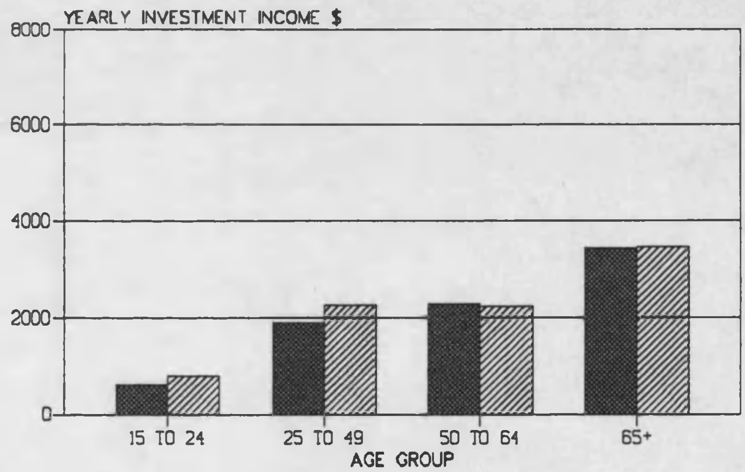
The 1986 IDS contained information about regular income from superannuation pensions, any amount of superannuation lump sum received, and whether such a lump sum was rolled over or transferred. No attempt was made to explicitly simulate the receipt of lump sums in the model, although the interest income etc from invested lump sums is implicitly captured in the investment income module, while the income from lump sums rolled over to deferred annuities is captured as superannuation income.

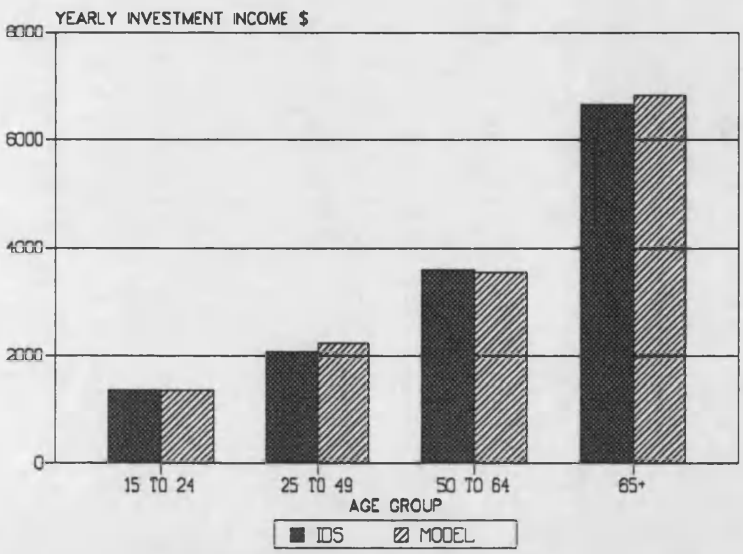
Figure 4.4: Mean Yearly Investment Income by Age and Education for Males in the 1986 IDS and in the Model



Secondary School Qualifications Only

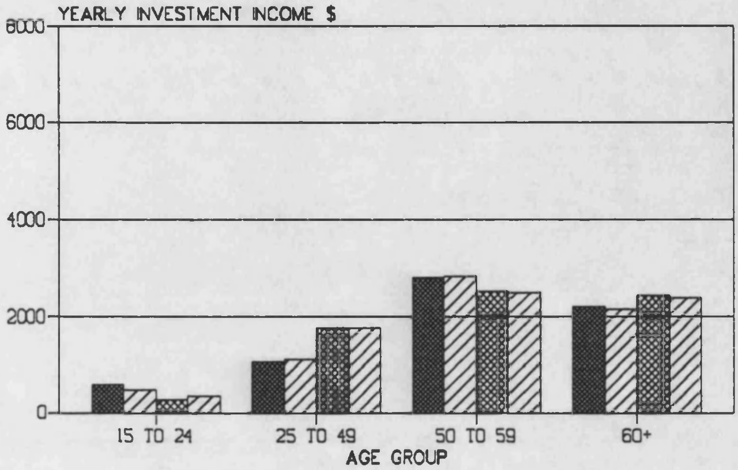
Some Tertiary Qualifications



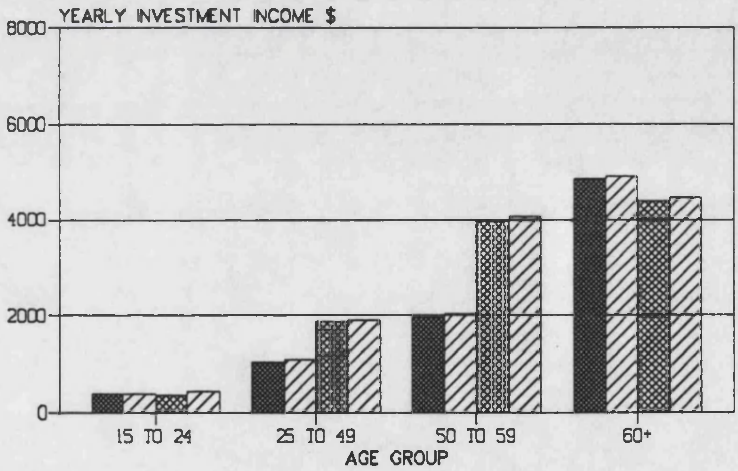


Graduates

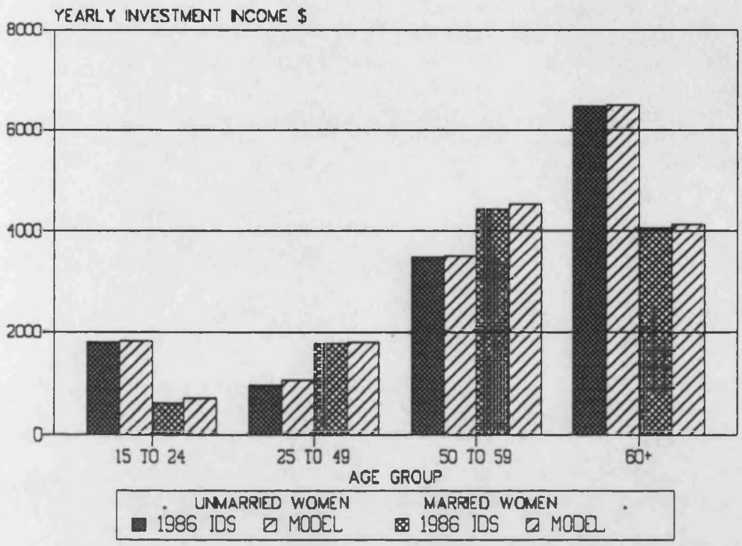
Figure 4.5: Mean Yearly Investment Income by Age, Education and Marital Status For Females in the 1986 IDS and in the Model



Secondary School Qualifications Only



Some Tertiary Qualifications



Graduates

Males

The 1986 IDS showed that the receipt of superannuation income by males became significant after the age of 50. About five per cent of all 50-54 year old males in the IDS said they received superannuation, with the proportion increasing sharply after age 60 to about 12 per cent of the total. Tests on the IDS showed that receipt of superannuation was not limited to males out of the labour force, suggesting that some males received their superannuation entitlements and subsequently re-entered or remained in the labour force in a different job.

A tobit model was used to simulate receipt of the *first year of superannuation income* for males (Table 4.6). Superannuation reciept was made dependent upon age, education level and whether the individual was divorced. Other possible explanatory variables, such as whether the individual was single or married, were tested but were found not to be significant.

Table 4.6: Tobit Parameters Used to Estimate Male Superannuation Income

	Coefficient					Sigma
Constant	Age	Age^2	Some Tertiary	Degree	Divorce	
-5650 (1010)	141 (30.1)	-0.967 (0.224)	280 (43.6)	397 (57.7)	-96.3 (52.5)	427

Note: Standard errors in brackets.

For the first year of retirement after the age of 49, the tobit model was used to simultaneously select the correct proportion of males to receive superannuation income and to set the amount of superannuation income received. Once cohort males were selected to receive a certain amount of pension income, this amount was then assumed to be received every year until death. In the IDS data, due to cohort/period effects, the amount of occupational pension received actually declined sharply for males aged 75 or more. However, given the prevalence of index-linked pensions by 1986, it seemed unlikely that in the real world real pensions would decrease as an individual became older. Consequently, in the simulation the assumption was made that after the first year of pension was received it would remain at that level for the rest of life. This is thus the single area of the model where an attempt has not been made to replicate exactly the situation actually existing in 1986.

This provision also meant that private pension income did not cease with re-entry to the workforce so that, as in the real world, a small proportion of simulated males in the workforce receive occupational pension income.

As before, an error term was used to ensure that rather than all males receiving the mean pension income for someone with their characteristics, pension income varied in line with the dispersion apparent in the real world. With real longitudinal data, the likelihood of receiving a pension by such characteristics as occupation and industry (Altmann, 1981), level of earned income received during working life and duration in different types of jobs could be estimated. Unfortunately, the IDS simply records pension income received in late 1986 and does not contain any data about current retirees during their earlier working years.

Although superannuation receipt varies by industry and occupation, these variables are not included in the model. However, superannuation income is also highly correlated with previous earned income, as most pensions are multiples of final average salary. Rather than making the error term used in imputing superannuation income directly dependent upon final average salary, which would have involved very complex programming, the error terms finally used in the simulation were the same as those used for imputing the permanent part of the variance of earnings, thereby introducing a linkage between earnings and superannuation receipt via another means.

In effect this means that simulated males who had a high 'relative earnings advantage score' also had a greater likelihood of both receiving superannuation and receiving higher amounts of private pension income than those with a low 'relative earnings advantage score'. Because this relative earnings advantage score is not perfectly correlated with earnings (which also depend upon other characteristics and upon chance) a 'chance' or 'luck' element is introduced into the simulation of superannuation income, designed to capture the effect of unknown factors such as industry of employment.

Females

Modelling the receipt of superannuation income for women was extremely difficult, because so few women received superannuation in 1986. There were insufficient observations on the IDS tape to estimate a tobit model. The small number of observations did not even allow subdivision by more than one explanatory variable, so after tests to compare the importance of factors such as marital status and education, eventually education was selected as the most important factor. According to the 1986 IDS, only 4 per cent of women with secondary school qualifications aged 60 and over were receiving superannuation income; this rose to 11 per cent for those with some tertiary qualifications and to 23 per cent for those with degrees.

In the simulation, the correct proportion of women by education level were randomly selected in the first year of retirement to receive superannuation income. The amount of pension imputed consisted of the average amount for women of each education level plus an error term. As with men, the permanent earnings error term was simply multiplied by the degree of variance in superannuation income apparent in the IDS data, so that those women with high 'relative earnings advantage scores' who were selected to receive superannuation also received higher superannuation pensions.

When a married cohort member who was receiving superannuation died, the surviving spouse was given 0.67 per cent of the superannuation entitlements of the deceased spouse. This figure was based upon Department of Social Security estimates and can be varied if desired.

The proportion of men and women receiving superannuation in the IDS and in the model is shown in Table 4.7. Substantially more individuals receive pension income in the model than in the IDS. This is in large part due to the higher education levels of the pseudo-cohort, as for both men and women education level directly affects the probability of receipt. In addition, these higher receipt levels also increase the number of surviving spouses who begin to receive superannuation income after the death of their partner, thereby further increasing the proportion receiving superannuation. For men, average superannuation payments received decline after taking account of the income they receive from the pensions of their deceased wives, because women receive lower occupational pensions on average than men. Conversely, for women, average occupational pensions increase after taking account of the higher payments they receive from the entitlements of their deceased husbands.

Table 4.7: Proportion of Males and Females After Retirement Age Receiving Superannuation Income and Average Income Received by Education

Group	IDS		MODEL: Before Including Spouse's Pension*		MODEL: After Including Spouse's Pension*	
	%	$ p.w.	%	$ p.w.	%	$ p.w.
Males						
- sec sch only	7	200	4	180	6	160
- some tertiary	10	210	12	240	13	230
- degree	24	270	24	285	25	275
Females						
- sec sch only	4	100	4	85	9	135
- some tertiary	11	120	9	120	12	140
- degree	23	170	27	150	31	160

*That is, before and after including any pension received by a person due to the death of a spouse who was receiving an occupational pension.

4.5 MAINTENANCE INCOME

To simulate maintenance income the passage of the children of the pseudo-cohort through secondary education and the process of leaving home had to be simulated. The probabilities of children remaining in full-time education and/or living at home were estimated from the IDS data on the characteristics of 15 to 24 year olds. It was assumed that the children for whom a mother could potentially receive maintenance comprised children still living at home aged less than 18 and full-time students living at home aged 18 to 24.

The IDS data were used to isolate important factors affecting the probability of receiving maintenance and the amount of maintenance received, such as the age of the youngest child and the number of dependent children. However, many of the factors which seemed likely to have a major impact on maintenance receipt, such as the length of time since the family split up, were not recorded in the IDS and could therefore not be included in the model. Accurate simulation was also hindered by the relatively small number of people receiving maintenance recorded in the IDS, which restricted the number of explanatory variables which could be used.

In the model, the year of family break up was identified and a proportion of the new sole parent mothers were selected to receive maintenance (no fathers were paid maintenance, as upon family dissolution all children were assumed to remain with the mother). These proportions were set so that the percentage receiving maintenance in the simulation was about the same as that in the 1986 IDS. The amount of maintenance imputed was the mean received by sole parents in the IDS with the same number of children and same age of youngest child, with an error term which was related to the earnings of the former husband. This meant that high income ex-husbands paid more maintenance than low income ex-husbands.

After the amount of maintenance paid in the first year of family breakup was imputed, it was retained at the same level for the next five years (unless all children eligible for maintenance left the family home during that period in which case it was reset to zero in the year the last child left). One third of all the sole parents selected to receive maintenance in the model were arbitrarily selected to receive it for a maximum of five years, a further one-third received it for a maximum of ten years and the final third received it for up to 15 years. Again, maintenance was terminated if all eligible children left home.

In the absence of an Australian panel study with longitudinal data on maintenance it is difficult to know how accurate the above simulation is. All that can be said is that the proportion of sole parents receiving maintenance in the simulation and the average amount of maintenance received are very similar to that recorded in the 1986 IDS (Table 4.8).

Table 4.8: Percentage of Sole Parents Receiving Maintenance by Age of Youngest Child and Average Maintenance Received in the 1986 IDS and in the Model

	1986 IDS	Model
Per cent of sole parents receiving maintenance, youngest child aged		
- 0 to 4	14	14
- 5 to 9	28	28
- 10 to 14	31	32
- 15 to 20	36	33
Average amount received - $ pw	42	41

4.6 CONCLUSION

The data available in Australia to estimate dynamic income profiles are woefully inadequate. The attempts made in the simulation to impose realistic linkages between various types of income over time only represent reasonable guesses at the importance of permanent and transitory effects, and different assumptions would produce quite different results. In the future, other assumptions can be tested and, if a panel study is ever conducted, the resulting data can be incorporated in the model and used to estimate dynamic profiles.

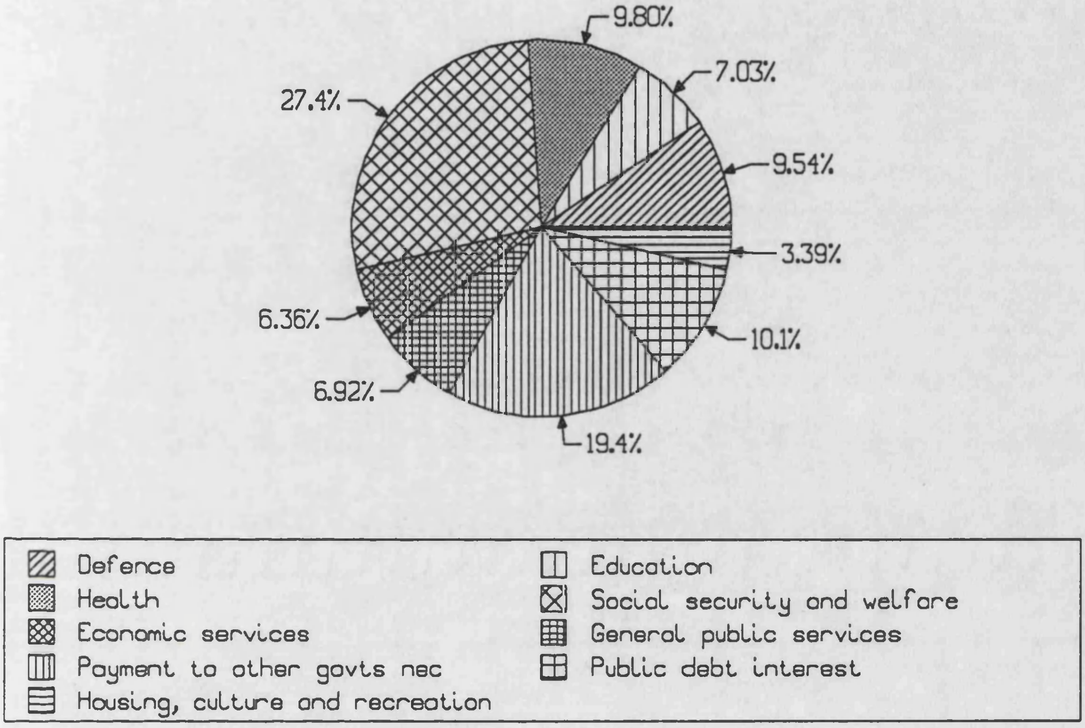
CHAPTER 5: GOVERNMENT EXPENDITURES AND TAXES

5.1 INTRODUCTION

This chapter describes the simulation of various federal government expenditures and taxes in the model. Ultimately, it would be desirable to include all federal government taxes and expenditures, to derive a comprehensive picture of the impact of government upon lifetime income distribution and redistribution. The major social security cash transfers, federal education cash transfers and other education outlays, and income tax are currently included in the model. Other major areas of government expenditure, such as housing and health outlays, and indirect taxes, will be added in the future.

Figure 5.1 shows total federal government outlays by function in 1985-86. Outlays on *social security and welfare* were about $19 billion, and comprised about 27 per cent of the total outlays of $69.9 billion. However, such outlays included expenditure on a range of social services, such as aged person's homes and hostels and the home and community care program, and all such services are currently excluded from the scope of the model. Assistance to veterans is also not included as, unless there is another war, a cohort born in 1986 will not include any veterans. In total, almost 77 per cent of total social security and welfare outlays are 'allocated' in the model (although, as the cohort only consists of 4000 individuals, expenditure totals obviously do not equal those for the entire Australian population).

Figure 5.1: 1985-86 Australian Federal Government Budget Outlays by Function

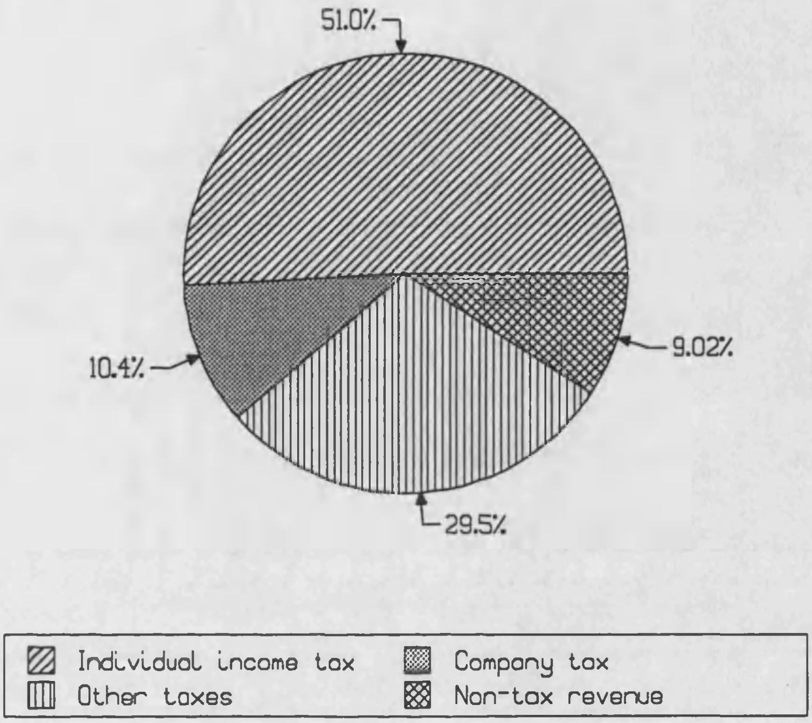


Source: Treasurer (1986:75)

Outlays on *education* totalled some seven per cent of all outlays. Of these, about 95 per cent are allocated in the model, with the excluded expenditures including those on special groups, such as aboriginals, migrants and veterans' children. In all, about one-third of budget outlays are currently included in the simulation.

Federal government receipts in Australia in 1985-86 reached about $64 billion, with income taxes from individuals comprising just over $32 billion (Figure 5.2). As income tax is the only tax currently included in the model, about half of all government revenues are taken account of in the simulation.

Figure 5.2: 1985-86 Australian Federal Government Receipts by Source



Source: Treasurer (1986:295)

Section 5.2 describes in detail the *social security cash transfers* included in the model, and explains the assumptions made in modelling transfers with lower take-up rates, such as Family Income Supplement. Section 5.3 outlines the simulation of *education services and cash transfers*, while Section 5.4 examines the imputation of *income tax*. Section 5.5 describes the various *income and tax measures* used in the model. Because lifetime incomes can only be calculated on an individual basis, but family status has to be taken account of in any assessment of lifetime standard of living, some of the measures are quite different to those normally used in the analysis of income distributions. The difficult question of discounting and of the treatment of economic growth in the model is also tackled in this section.

5.2 SOCIAL SECURITY OUTLAYS

The social security system *existing at June 1986* was simulated in the model. Many changes have been made to the social security system since that date, following a major review of the system by the government. Some of the most important changes have been identified below, but these amendments have not been incorporated in the social security parameters in the model, although modelling the changes and then estimating the impact upon lifetime income remains a high priority for the future.

In the simulation, the recipients of cash transfers are assumed to derive all of the benefits from these cash transfers - in other words, the benefits of the transfers are assumed not to be shifted to third parties, with the transfers thus being 100 per cent incident upon their initial recipients. One could, however, envisage circumstances where part of the actual benefit was shifted to third parties. For example, the benefit of increases in rent assistance to social security recipients may be partly shifted to private landlords, who increase rents to what the new market will bear (Groenewegen, 1979:51). Similarly, cash transfers to the elderly might reduce the support offered by children to their elderly parents, with the benefits of such transfers thus being at least partially incident upon the children rather than the nominal recipients. However, in the case of cash transfers, the no-shifting assumption is usually considered reasonable, and has been employed in the major incidence studies (eg. CSO, 1990; Reynolds and Smolensky, 1977:39).

Social Security Transfers Simulated

The following transfers were simulated in the model;

- *age pension*, available to women aged 60 or more and men aged 65 or more, subject to residence requirements and a test on current income and assets (unlike the European social insurance systems, the receipt of age pension and all the other pensions and benefits does not depend upon previous labour force status and earnings, but only upon *current* economic status). In 1986 age pensioners aged 70 and over could elect to be income tested under a more generous income test but with a lower maximum payment rate if this provided them with higher pension than the standard income test; however, by 1990 this provision had been abolished;

- *invalid pension*, available to people aged 16 and over who are permanently blind (on a non-income/assets tested basis) or permanently incapacitated for work to the extent of not less than 85 per cent (on an income/assets tested basis);

- *wife's pension*, payable to the wife (not husband) of an age or invalid pensioner who is not eligible for a pension in her own right;

- *carer's pension*, payable to a person who is not entitled to another pension but is providing long term care to a severely handicapped relative receiving age or invalid pension (in the model imputation of this pension was restricted to the husbands of female invalid pensioners);

- *Class A and B widow's pension and supporting parent's benefit*, payable to sole parents with dependent children (these payments were replaced by a single *sole parents pension* in March 1989). A Class B widow's pension was payable in 1986 to older widows who did not have dependent children but who were not expected to participate in the labour force; by 1990 this pension was being phased out. Class C widow's pension (of whom there were only 102 recipients in June 1986), payable to low income women without children in the 26 weeks following death of a husband, was not modelled.

- *unemployment benefit*, payable to women aged 16 to 59 and men aged 16 to 64 who are unemployed (in January 1988, unemployment benefit for 16 and 17 year olds was replaced by Job Search Allowance);

- *sickness benefit*, payable to people in the same age ranges as unemployment benefit who are temporarily incapacitated for work because of sickness or accident and have suffered a loss of income as a result of the incapacity;

- *special benefit*, designed to meet cases of special need and payable to people who are not eligible for a pension or unemployment or sickness benefit but who are unable to earn a sufficient livelihood for themselves and their dependents and are in hardship;

- *family income supplement (FIS)*, payable to low income families with dependent children not receiving any other form of Commonwealth income support (the payment was revamped in 1987 and renamed *family allowance supplement-FAS*);

- *family allowance*, payable monthly to people with dependent children aged less than 16, full-time dependent students aged 16 and 17 not receiving education transfers, or similar students aged 18 to 24 in low income families. In 1986 the allowance was not income-tested, but by 1990 it was income-tested on the taxable income of parents, although the income test was much more generous than that for FAS; and

- *multiple birth payments*, a non-income-tested payment payable to parents of triplets or quads aged under 6.

In addition to basic rates, pensioners and beneficiaries could receive a number of additional allowances, of which *additional pension and benefit* paid for dependent children and *mother's/guardian's allowance* paid to sole parent pensioners were included in the model. (By 1990 the definition of dependent children which qualified parents for these additional allowance - and for sole parents pension - had changed). *Rent assistance*, which could be paid to pensioners and beneficiaries who were private renters, was not included in the model; the suppression of housing data by the Australian Bureau of Statistics on the 1986 IDS tape made the imputation of housing status problematic. Eligibility for *fringe benefits* was also calculated, although no value has currently been imputed for these benefits.

It should be noted that, in married couples, all *benefits* and supplements are paid to the husband, while *pensions* are split equally between partners but any additional payments for the children of pensioners are paid to the wife. Family allowance, multiple births and FIS are all expressly paid to the mother in married couples. These provisions have been fully incorporated in the model.

The Assets Test

In 1986, all of the pensions listed above and supporting parent's benefit were both income and assets-tested, while the remaining benefits were simply subject to an income test. By 1990 all pensions and benefits and FAS were both income and assets-tested. It has not, however, been possible to model the assets test adequately - a problem which is also shared by those constructing Australian static microsimulation models. To do so requires simulation of the distribution of assets, and no recent and adequate data on wealth in Australia exist. One could simulate a distribution of assets based upon the amount of investment income received by families (which is captured in the model), and this approach was followed by Dilnot, based upon data in the 1986 IDS (1990). However, while such an approach is useful for providing aggregate estimates of wealth in Australia, it seems less likely to be useful for microsimulation purposes, as one of the major functions of assets tests is to exclude those who have substantial assets but low investment income - who, in other words, have investment incomes which are not commensurate with their asset holdings.

Despite these difficulties, the assets test upon age pension could not be ignored. When only the income test was applied to those of age pension age in the model the proportion eligible to receive age pension was higher than would be expected in the real world. A method of reducing take-up therefore had to be developed. Ultimately, the amount of investment income received by each cohort member during their entire lifetime was calculated, and all were then ranked by the amount of lifetime investment income received. About the top 15 per cent were then excluded from receipt of age pension, with the 15 per cent figure being selected to ensure that around 70 per cent of both males and females of age pension age actually received age pension (many of the top 15 per cent were in any event excluded by the income test).

It is difficult to judge whether this is an appropriate degree of take-up. In 1986 an estimated 79 per cent of the population of age pension age were actually receiving age pension or service pension (age pension paid to ex-servicemen). By 1989, according to internal DSS estimates, this had fallen to an estimated 77 per cent. In the absence of policy change, one would expect the proportion to fall steadily in the future as, given superannuation initiatives in the 1980s, a growing proportion of the retired population will receive occupational pensions. Certainly, the receipt of occupational pensions among the pseudo-cohort is higher than in Australia in 1986. However, if the imputed 70 per cent take-up rate is considered too high or too low, the parameters can be easily amended.

With the above exception, no attempt was made to impute the assets test, and eligibility for the above payments was simply calculated by isolating all of those with the relevant family and other characteristics and then applying the appropriate income test to determine the amount of any payment received. Two further exceptions were made to this general procedure.

Sickness and Special Benefit Take-up

First, the incidence of sickness was not explicitly modelled. In determining *eligibility for sickness and special benefit* a two step procedure was followed. Those who had more than four weeks not in employment in any given year, who had been in the labour force earlier in the year or in the preceding year, and who were not in states which would obviously preclude them from receiving these two benefits (eg. they were not unemployed, full-time students, receiving a pension etc) were first isolated. This pool of potential recipients was obviously much larger than the number actually receiving sickness and special benefits, as at any point in time a significant proportion of those of labour force age are not employed but are also not sick or eligible for special benefit. A proportion of the potentially eligible were therefore then randomly selected to be in states which did not qualify them for sickness or special benefit.

This proportion was set so that the total expenditure on sickness and special benefits for the lifetime of the entire cohort was about 16 per cent of the total expenditure on unemployment benefits for the cohort. In 1986 aggregate expenditure on sickness and special benefit amounted to 16 per cent of aggregate expenditure on unemployment benefit (DSS,1986c:32-34). While the synthetic cross-section distribution which is created by using the pseudo-cohort's records does not exactly match the 1986 actual cross-section population in Australia (eg. there are more elderly people in the synthetic distribution), this seemed a reasonable method of approximating what take-up and expenditure on sickness and special benefits should be for the pseudo-cohort.

FIS Take-up

The second exception made in simulating the various social security income test was for *family income supplement*. FIS was only introduced in May 1983, and in 1986 provided a relatively low rate of payment in exchange for a rigorous income test. While most pensions and benefits and family allowance are believed to have extremely high take-up rates among eligible groups, FIS take-up was believed by the Department of Social Security to be quite low (Cass,1986:74). Although estimates of the eligible population are not precise, Pech estimated that take-up might be as low as one-third of eligible families (1986:3).

Following the replacement of FIS with FAS in 1987, and in an attempt to address the take-up problem, the test on income during the four weeks preceding the application for FIS was replaced with an income test on taxable income during the preceding tax year. Subsequent estimates suggested that FAS take-up was higher (perhaps some 58 per cent of total expenditure) (Whiteford and Doyle, 1989). As might be expected, take-up is believed to be higher among those entitled to full rather than part payment of FAS (Bradbury et al, 1990:65).

In addition, larger families are more likely to apply for FIS than smaller families, with the mean number of children in FIS families in April 1985 being 2.8 (Pech,1986:46), compared to an average family size in Australia of less than 2 children. Finally, although some 30 per cent of families receiving FIS derive all or part of their income from self-employment (Pech,1986:13), the larger number of self-employed families with very low incomes means that take-up rates among the self-employed are actually lower than among wage and salary earners.

Available evidence therefore suggests that in modelling FIS:

- take-up rates should be higher for the non-self-employed than for the self-employed;
- take-up rates should be higher for those with larger families; and
- take-up rates should be higher for those entitled to full FIS.

Selecting appropriate take-up rates is problematic, given the lack of reliable data about potential recipients with the above characteristics - a problem which is again shared by those constructing Australian static microsimulation models. In addition, it is not clear to what extent relevant characteristics of the pseudo-cohort vary from those of the 1986 Australian population (for example, the receipt of workers and accident compensation is not simulated in the model, thereby creating a larger low income pool potentially eligible for FIS than in the real world).

In June 1986, about 1.6 per cent of all married couple families received FIS (DSS,1986c:37-38). However, because many families received FIS for less than one year, the number who received FIS during the course of an entire year was higher than the number who received it at any single point in time. Examination of the 1986 IDS data on the number of weeks that FIS recipients received FIS in 1985-86 suggested that about two to three per cent of all married couple families could be expected to receive FIS during any given year. The FIS take-up parameters were therefore set to ensure that just under three per cent of all such families in the pseudo-cohort received FIS.

Whether the take-up rates approximate the true situation cannot be determined, but all parameters can be changed if desired. For 1986 the parameters in the simulation result in:

- about three per cent of all *married couple families* receiving FIS;

- an increase in take-up by *family size*, with about 1.7 per cent of all married couples with one child receiving FIS, rising to about 5 per cent for those with four or more children;

- variation in receipt by *self-employment status*, with some 3.85 per cent of all married couple families where at least one spouse was self-employed receiving FIS, compared to some 2.3 per cent of all wage earner couples with children. Because the number of self-employed families on low incomes is much higher than the number of wage and salary earners, these proportions imply a much lower take-up rate by the self-employed. The ratio between the number of self-employed and wage earner recipients produced by the model is almost the same as that found by Pech (1986).

- an *average number of children* per recipient family of 1.9, compared to 2.8 in the real world (presumably reflecting lower birth rates and smaller family size in the model);

- an *average period of FIS receipt* of 28 weeks, compared with 40 weeks in the 1986 IDS. (This shorter time period might reflect more accurate policing of income in the model than exists in the real world, in the sense that income increases were immediately reflected in either lower FIS payments or the termination of FIS, whereas in the real world recipients might not always report such increases promptly or at all.)

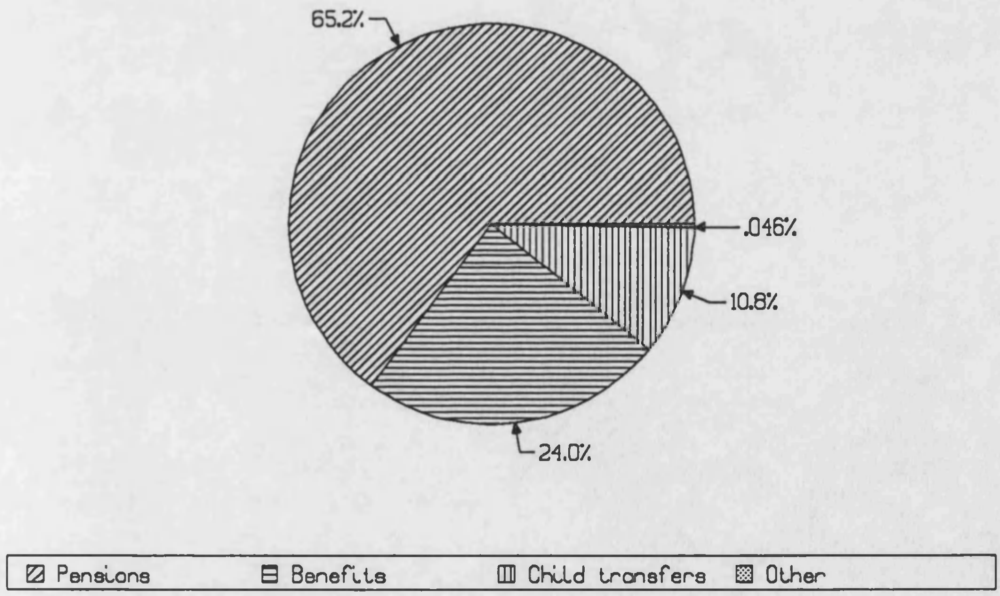
- an *average annual payout* per recipient family of about $800 in the model, compared to about $1690 per family in 1986 (reflecting smaller family size and a shorter average period of receipt, as well as unknown factors).

Excluded Cash Transfers

The payments included in the model and categorised above accounted for around 98 per cent of the total outlay of $15 billion on income maintenance cash benefits made by the Department of Social Security in 1986. A number of other social security payments or programs existing in 1986 were not modelled, either because of the low number of recipients, because the expenditure involved was not large, or because it was difficult to simulate the programs adequately. These payments comprised Class C widows pension, rent assistance, special temporary allowance, funeral benefit, orphans pension, handicapped child's allowance, remote area allowance and mobility allowance.

Figure 5.3 shows the division of social security cash transfers in 1985-86. Of these, about 97 per cent of the outlays on pensions are included in the simulation, 99 per cent of outlays on benefits, and 98 per cent of outlays on child transfers (family allowance, FIS, and multiple birth payments). Table 5.1 outlines the rates of payment made in June 1986 and included in the simulation.

Figure 5.3: Outlays on Income Maintenance Cash Benefits by the Department of Social Security, 1985-86.



Source: DSS (1986c:17)

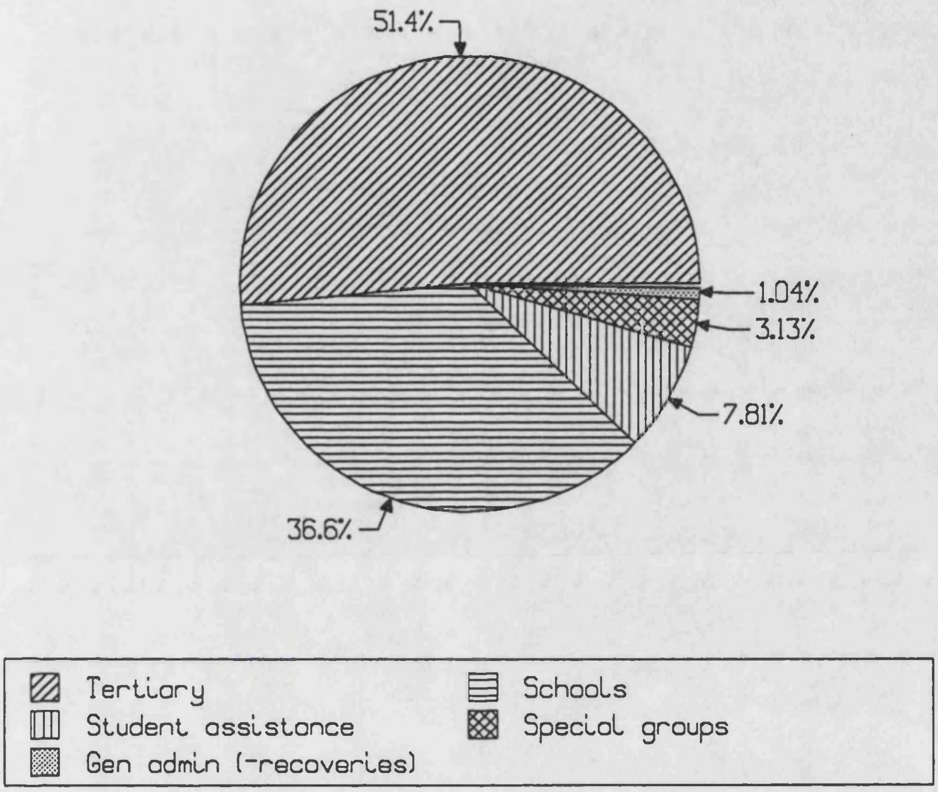
Table 5.1: Rates of Payment of Social Security Cash Transfers Included in Model

Payment		Weekly rate at June 1986 $
Pensions		
- single pensioner		102.10
- married pensioners (combined rate)		170.30
- mothers/guardians allowance for sole parents		12.00
- additional pension per child		16.00
Benefits		
- single beneficiary, aged under 18 without dependents		50.00
- single unemployed, 18-20 yrs, no dependents		88.20
- single unemployed, 21+ yrs, no dependents		95.40
- single sickness beneficiary, 18+ yrs, no dependents		102.10
- married beneficiary with dependent spouse		170.30
- additional benefit per child		16.00
Child Transfers		
- family allowance	- first child	5.26
	- second child	7.50
	- third or fourth child	9.00
	- fifth and subsequent	10.51
- supplement for triplets aged less than 6		34.62
- family income supplement - per child		16.00

5.3 EDUCATION OUTLAYS

Education outlays in Australia amounted to $4.9 billion, of which about half were devoted to the provision of tertiary education services, almost 40 per cent to school services, and eight per cent to the provision of cash transfers to students or their parents (Figure 5.4). All of the above are allocated in the model, so that some 96 per cent of all Federal education outlays are distributed.

Figure 5.4: Outlays on Education by the Commonwealth by Function, 1985-86



Source: Treasurer (1986:93)

Education Cash Transfers

In 1986 the Department of Education provided a number of cash transfers to students, of which the following are included in the model:

- *Secondary Allowances Scheme*, which assisted lower income families with children in the final two years of secondary education. With the exception of self-supporting students, the allowance was paid direct to parents. It was income-tested on joint parental taxable income in the tax year preceding the year of study, with special provisions for families whose taxable income in the year of study had fallen substantially.

- *Tertiary Education Assistance Scheme*, which assisted full-time students at universities, colleges of advanced education, colleges of technical and further education and other tertiary institutions. TEAS was income-tested upon both parental income in the preceding tax year (with special provisions for those whose parents had experienced a significant drop in income), and upon the income of the student. A lower rate was payable to students still living with their parents, while married students were income-tested upon the income of their spouse rather than their parents.

- *Postgraduate Awards Scheme*, which assisted full-time Master's and Phd students. The awards were not income-tested upon parental income (although there were limits to the amount of paid work awardees could undertake), but were competitive.

The above three schemes accounted for about 85 per cent of education cash transfers made in 1985-86 (DEET, 1987c:30). The other major schemes, which were not modelled, were those for special groups such as aboriginals and isolated children (neither of which could be imputed as racial origin and geographic location were not simulated in the model).

In January 1987, SAS and TEAS were replaced by AUSTUDY, which provided age-related assistance to secondary and tertiary students aged 16 and over. The new scheme was intended to improve incentives to undertake further education and to lessen the gap between unemployment benefit and education allowances for teenagers. While the government originally intended to pay any AUSTUDY entitlement to school students direct to the student (rather than to their parents, as under SAS), community concern resulted in the parents of secondary students under the age of 18 having the right to receive the allowance if they wished (although the allowance would still be treated as if it were the income of the student for taxation purposes).

The simulation of the education transfers was complex, not only because of the various income tests applicable to parental, spouse and student income and the additional income tests for allowances for dependent spouses and children, but also because receipt had to be simulated for two generations - ie. for both the pseudo-cohort and their children.

As with social security cash transfers, there is an issue about who the benefits of cash transfers should be assumed to be incident upon. For example, while SAS is paid to parents, the benefits are presumably, at least in part, passed onto the teenage students whom they are designed to help keep in school. There is also some question about the incidence of transfers between generations, with economists such as Barro arguing that attempts by the state to increase benefits to students (eg. via increases in TEAS) are subsequently negated by their parents then reducing their transfers to their children, either in the short term or in the longer term via reduced inheritances (1974).

Despite these issues, the benefits of education cash transfers were assumed in the model to be incident upon those actually receiving the cash transfers. Thus, in the model, SAS was assumed to be incident upon the pseudo-cohort when they were the parents of children in the final years of secondary school. In the case of married couples, SAS payments were divided equally between the two parents, with each parent thus being assumed to receive half. In contrast, TEAS was imputed to the pseudo-cohort when they were tertiary students themselves. However, the receipt of TEAS by their children a generation later was also simulated. In this case, while any TEAS income received by their children was not added to income unit income, the fact that the child was receiving TEAS was flagged, as it affected eligibility for family allowance.

Table 5.2 shows the value of the education allowances imputed to the cohort when they are students or the parents of students, while Table 5.3 shows the proportion of students in the simulation and in the real world receiving the various allowances.

Table 5.2: Weekly Education Allowance Rates Imputed in the Model*

Category	Weekly Rate 1986 SAS	TEAS	PGA
- at home	35.00	47.50	156.27
- away from home or independent	n.a.	73.28	156.27

* There are also supplements for dependent spouses and dependent children.

Source: Department of Education (1986:44); DEET (1987c:34)

Table 5.3: Proportion of Potentially Eligible Groups Receiving Various Education Transfers in the Model and in Australia in 1986

Estimated Percentage of Eligible Families or Students Receiving Transfers	Model	Australia 1986*
- SAS	25	25
- TEAS	36	38
- PGA	4	5

* Source: Department of Education (1986:40 ; 1987); Wran et al (1988:9).

Other Education Outlays

The only benefits from government outlays on goods and services currently imputed to the pseudo-cohort are education outlays. Both determining the beneficiaries and ascribing a monetary value to the *services* received by individuals is, however, much more contentious than in the case of *cash transfers*. The analysis of expenditure incidence can be divided into two discrete steps - first, the determination of who actually receives the benefits of government expenditures and, second, the calculation of the monetary value of those benefits. The allocation and valuation of the benefits of *pure public goods* (such as defence and environmental protection), which supposedly provide an indivisible collective benefit to all members of society, is a much disputed area, and many incidence studies have deliberately excluded such services from their balance sheet (eg. CSO, 1990; ABS, 1987b).

Identification of the beneficiaries of expenditures on *impure or divisible public goods and services*, such as education and health, is almost as contentious. Incidence studies have typically assumed that the benefits of such goods and services are only received by those *actually using the services* (Economic Planning Advisory Council (EPAC), 1987:23). They thereby make the questionable assumptions that there are no externalities from the services which bestow benefits upon non-users (such as the advantages to society or to employers from a highly educated or healthy workforce) and that all benefits should be allocated to the consumers of a service (eg. patients) rather than to the producers (such as doctors).

Further, after making such assumptions about who the beneficiaries of public services are, incidence studies typically value the benefits of those services at the *cost of provision*. For example, rather than attempting to determine the real value or utility of a service such as a year of tertiary education to the recipient, the average cost to government of providing a year of tertiary education is simply added to the income of a full-time tertiary student. Such an approach suffers from a number of deficiencies (Brown and Jackson,1990:184). Cost is unlikely to approximate the real worth of the services, is not based on market prices, and takes no account of the quality or efficiency of the goods and services delivered. For example, as McGranahan observes, "for the same level of service delivery, the income of the beneficiaries will be given a higher monetary imputation, the more inefficient or corrupt the service" (1979:40).

Further, such imputation procedures implicitly assume that the marginal utility of income is the same for all individuals (ie. that a dollar given to a rich person is worth the same as a dollar given to a poor person). Aaron and McGuire, in a controversial new approach, developed an explicit form of the utility function and concluded that under certain assumptions government expenditures caused no noticeable redistribution of income from high to low income groups (1970).

In conclusion, economists have not yet reached a firm consensus either about how to identify the beneficiaries of public services such as health and education or about how to value the worth of those services. For the current study, therefore, the benefits of education spending are assumed to be incident upon those actually using education services, and the imputed benefit is simply the average cost to government of providing the service, following the methodology used in Harding (1984), EPAC (1987), and in the ABS fiscal incidence study (1987b). (However, it will be possible in the future to experiment with other assumptions - eg. to assume that some proportion of education outlays are incident on non-users or to try different utility functions.)

The ABS kindly provided details of government expenditure upon each type of *tertiary education and upon pre-schools* in 1985-86 and this was divided equally among all users of the relevant service. All part-time students were assumed to equal half of a full-time student when calculating the total number of students among whom total expenditure was to be divided, and were also then subsequently imputed half of the benefit allocated to full-time students. Tertiary education outlays not elsewhere classified were divided equally among all tertiary students. As no distinction was drawn in the model between university and college of advanced education students, the total expenditure on these two sectors was pooled and then allocated. Technical and Further Education (TAFE) students were treated separately.

For *school students*, figures from the Department of Employment, Education and Training were used to calculate average government expenditure per student in 1986 for different types of students (1987a). Table 5.4 shows the annual amounts imputed.

Table 5.4: Annual Estimated Cost to Government of a Year of Education Provided to Various Types of Students

Sector	Annual Cost Per Student 1986 $
- pre-school	1043
- primary school	
- government	2313
- Catholic	1428
- other non-government	1288
- secondary school	
- government	3530
- Catholic	2211
- other non-government	1818
- university/CAE	
- full-time	7633
- part-time	3827
- TAFE	
- full-time	2711
- part-time	1366

5.4 Income Tax

As with the incidence of government expenditures, the incidence of taxes is an area of extensive debate among economists. To determine the incidence of taxes it is necessary to know who actually pays the taxes. Because individuals and firms have statutory obligations to pay taxes, it initially appears a simple matter to calculate the distribution of tax burdens. However, this *legal* incidence may differ greatly from *economic* incidence, as those legally liable to pay taxes may be able to shift the burden to others through changes in prices, wages or profits. The incidence of *indirect taxes and company taxes* is still a hotly debated matter (eg. see Musgrave and Musgrave, 1984; Browning and Johnson, 1979; Prest, 1955; Mathews, 1980) but, as no attempt is made to allocate these taxes in the current study, the area can be ignored for the present.

The economic incidence of *income tax* is generally less controversial and is assumed to be similar to its legal incidence although, for example, it is recognised that business executives, lawyers, doctors and others working in oligopolistic markets may be able to shift part or all of any income tax increases forward to their clients or to consumers (Break, 1974:179). However, in the simulation, income taxes are assumed to be fully incident upon those legally liable to pay them. Equally importantly, those with legal liabilities to pay tax are assumed to meet them and no account is taken of the underground economy or possible tax evasion. In addition, in this initial version of the model the burden of income tax is assumed to equal the amount of tax collected, even though income taxes may distort consumer choice and generate excess burdens (also known as deadweight loss)(Musgrave and Musgrave, 1984:307; Ballard et al, 1985; Bascand and Porter, 1986:364).

The income tax schedules applying in 1985-86 were used in simulating the income tax system, and are summarised in Table 5.5. First, total *assessable income* was calculated, by adding together all of the potentially taxable income received by an individual each year (see Table 5.6). Although in Australia expenditure necessarily incurred in earning assessable income and various other special deductions can be subtracted from assessable income, thereby leaving *taxable income*, no attempt was made in the model to simulate such deductions.

While these deductions can be significant for some groups, such as wage and salary earners with very high incomes and for the self-employed, such deductions are of minor importance to most taxpayers, amounting on average to some 2 to 3 per cent of assessable income. However, more importantly, on the 1986 IDS tape, which was used to simulate investment and business income, many of the income items reported were net of expenses incurred in earning that income, and therefore such expenses

Table 5.5: 1985-86 Income Tax Schedules

Taxable Income	Tax Due on Total Taxable Income
$ 0- 4595	Nil
$ 4596-12500	Nil + 25c for each $1 over $4595
$12501-19500	$ 1976.25 + 30c for each $1 over $12500
$19501-28000	$ 4076.25 + 46c for each $1 over $19500
$28001-35000	$ 7986.25 + 48c for each $1 over $28000
$35001 and over	$11346.25 + 60c for each $1 over $35000

Table 5.6: 1986 Tax Status of Income Components Included in the Model

Income Source	Tax Status
- wages and salaries	taxable
- investment income	taxable
- private occupational pension	taxable
- age pension, wife's pension and carer's pension (if wife or husband of age pension age), widow's pension, supporting parent's benefit, unemployment benefit, sickness benefit, special benefit	taxable
- TEAS (later AUSTUDY for tertiary students)	taxable
- Postgraduate Study Award	taxable*
- SAS (later AUSTUDY for school students)	not taxable**
- invalid pension	not taxable
- family allowance, multiple birth payment	not taxable
- additional pension/benefit, FIS (later FAS), mother's/guardian's allowance	not taxable
- dependent child supplements for TEAS and PGA recipients	not taxable
- maintenance	not taxable

* Not taxable in 1990
** Not taxable in hands of parents in 1986. Taxable income to school students in 1990.

should presumably not be subtracted again. Thus, for example, any tax avoidance by higher income groups achieved by investing in negatively geared housing or other assets should *already* have been captured earlier in the model, via lower net investment incomes being imputed to this group, rather than being captured at this stage in the form of substantial income tax deducations. Pending development of a sophisticated method of imputing deductible expenditures which avoids any double counting, taxable income has been assumed to equal assessable income.

The next step in imputing income tax was to apply the income tax schedule to taxable income, thereby calculating *gross tax* payable. Fourth, any rebates to which the taxpayer was entitled based upon their family and other characteristics were subtracted from gross tax. The rebates included in the model comprised:

- the *dependent spouse rebate* for those with and without a dependent child or student, designed to recognise the additional costs incurred by those supporting a dependent spouse;

- the *sole parent rebate*, designed to recognise the additional costs faced by sole parent taxpayers;

- the *pensioner rebate*, for taxpayers receiving a social security pension, and designed to protect full-year pensioners with little private income from income tax liabilities; and

- the *beneficiary rebate*, for taxpayers receiving unemployment, sickness and special benefit, and designed to protect full-year beneficiaries with little private income from income tax liabilities.

The daughter-housekeeper, housekeeper, invalid relative, parent, zone and overseas forces, home loan interest, averaging, termination payment, life assurance and medical expenditure rebates were not simulated. The rebates which were included in the model accounted for around 65 per cent of total rebates in 1985-86 (Australian Taxation Office, 1988:49).

The Medicare levy, which amounted to one per cent of taxable income, with special exemptions for low income individuals and families and certain social security recipients, was also modelled. *Net tax* payable was then calculated, equalling gross tax, minus any rebates, plus any Medicare levy.

5.5 INCOME AND TAX MEASURES USED IN THE MODEL

A number of different measures of income and welfare are used in the following chapters, and these are summarised in Table 5.7.

Annual Income Measures

Original income is income received from private sources, comprising wages, salaries and income from own business, income from superannuation and annuities, investment income and other non-government income such as maintenance. Much of the analysis in the following chapters compares the distribution of income *before* specified government actions with the distribution *after* such actions, and this immediately raises the issue of what the most appropriate 'before' benchmark (or counterfactual) is. For the moment, it has been assumed that the original distribution of pre-tax and pre-transfer income is an appropriate distribution against which to measure the redistributive effect of government taxes and expenditures. However, it should be appreciated that the implicit assumption that the original distribution of income would remain the same if no public sector existed is clearly invalid (although, particularly in the context of lifetime incidence models, it is not at all clear how the original income distribution should be adjusted to provide a better counterfactual).

Gross income comprises original income plus government social security and education cash transfers. *Taxable income* equals gross income minus non-taxable private income and non-taxable government cash transfers. *Disposable income* measures the amount of income individuals have left to spend each year, after taking account of income received from all sources, minus net income tax paid.

Table 5.7: Income and Tax Measures Used in the Model

Measure	Description
1. ANNUAL INCOME MEASURES	
Original Income	Earnings + investment income + superannuation income + maintenance income
Gross Income	Original income + taxable social security transfers + non-taxable social security transfers + taxable education transfers + non-taxable education transfers
Taxable Income	Earnings + investment income + superannuation income + taxable social security transfers + taxable education transfers
Gross Tax	Tax payable when tax schedules applied to taxable income
Net Tax	Gross tax - any tax rebates + Medicare levy
Disposable Income	Taxable income - net tax + non-taxable social security transfers + non-taxable education transfers + maintenance
Family Disposable Income	Disposable income of family unit (disposable income of wife + disposable income of husband in married couples); else just disposable income of single individuals
Shared Family Disposable Income	Disposable income of wife + disposable income of husband, divided by two with each half then allocated to each partner in married couples; else just disposable income of individuals
Equivalent Family Income	Family disposable income divided by selected equivalence scale.
Education Services Income	Imputed values of preschool income + primary school income + secondary school income + tertiary income (based on cost to govt of provision)
Final Income	Equivalent family income + education services income
DSS Transfers	Age pension + invalid pension + sole parent's pension + unemployment benefit + sickness and special benefit + FIS + family allowance + multiple births payments + additional pension/benefit + mothers/guardians allowance
Education Transfers	TEAS + SAS + PGA + any allowances for dependents
2. LIFETIME INCOME MEASURES	
Total	Available for each of above measures and equal to the lifetime sum received
Annualised ...	Again available for each of above measures, and equal to the lifetime sum received divided by years of life - 15.

All of the measures mentioned above use the *individual* as the income unit. Thus, for example, disposable income merely shows the personal amount of income remaining for an individual to spend after payment of any income taxes. While such individual income measures are of great interest and are used extensively in the following chapters, they take no account of the income sharing likely to take place between married couples. For example, an unmarried female with no original income is likely to have a very different standard of living to a married female who also has no original income but is married to a high income spouse. The following income measures attempt to take account of such sharing.

In the measures outlined below, no account is taken of any income received by the children of the pseudo-cohort in calculating family income. All such children who receive education transfers are assumed to be no longer dependent upon their parents and effectively form a separate income unit and exit the model. Similarly, children aged 16 and over who still live at home but are not dependent full-time students (and who are therefore mainly in employment, receiving unemployment benefit etc) are also assumed to be separate income units and thereby outside the scope of the model. Such children are thus ignored when calculating the family's income or standard of living.

Family disposable income shows the amount of disposable income received by each family, with a family defined as a single individual with or without dependent children or a married couple with or without dependent children. (There are no families of unrelated individuals in the model and currently no extended families.) Its main use is for the later derivation of equivalent family income; in a lifetime context it is less useful than the two measures described below, as family disposable income provides an inadequate guide to the living standards of the individuals within that family and cannot be usefully summed over time.

Shared family disposable income shows the amount of disposable income available to individuals to spend, assuming *completely equal sharing* within the family unit. In the case of married couples, the shared disposable income of each partner equals the sum of the disposable income of husband and wife, divided by two. In the case of single individuals, it is the same as disposable income.

Equivalent family income is the third measure which takes account of family circumstances, and it attempts to place families of different size and composition on an equal footing, so that their relative standards of living can be more easily compared. For example, in any given year, an individual with a disposable income of $20,000 enjoys a higher standard of living than a married couple family with six children whose total disposable income is also $20,000. But how much higher is the standard of living of the single person ? Equivalence scales attempt to summarise the differences in income required by various types of families to achieve comparable standards of living.

There are a number of methods of constructing equivalence scales including, for example, examining how much families of different size and composition spend upon food, clothing, housing etc, and then calculating the amount of income required by each family type to achieve the same standard of living as, say, a married couple without children. Comparison of these dollar amounts might then show, for example, that a single person required only 60 per cent of the combined income of a couple without children to achieve the same standard of living.

After using such techniques to construct an equivalence scale, if an equivalence scale, which employed a married couple without children as the base and gave them a value of 1, were applied to the single person and the family mentioned above, then the equivalent income of the single individual would be *higher* than their disposable income, while the equivalent income of the couple with six children would be *lower* than their disposable income. It would thus become clear that the couple with six children had a lower standard of living than the single individual (because they were supporting more people on the same disposable income), and the extent of their relative disadvantage would become clearer.

Most Australian work using equivalence scales has tended to use the equivalence scales implicit in the Henderson poverty lines developed in the 1970s and updated regularly since. However, the Federal Government has now explicitly endorsed new equivalence scales, which set the amount of extra income required by a family with a child aged under 13 at 15 per cent of the married rate of pension and with a child aged 13 to 15 at 20 per cent of the married rate of pension (Howe,1989:3). A single person is assumed to require 60 per cent of the income of a married couple to reach the same standard of living. These benchmarks were achieved by the January 1990 social security cash transfer rates, and these rates have therefore been adopted as the equivalence scale used in the model when estimating equivalent income (Table 5.9). The equivalence scale can, of course, be varied if desired.

It should be appreciated that, although the need to use equivalence scales to compare differing types of families is now widely accepted, there is still major debate about the validity of the various scales in use, about how to construct equivalence scales, about exactly which factors affecting need can be realistically included in the scales, and about whether a single set of scales is equally applicable to both high and low income families (Whiteford, 1985; Social Welfare Policy Secretariat, 1981). The Australian scale does not, however, seem out of step with international practice. For example, the British Central Statistical Office now rank all households by equivalent income in their yearly analyses of fiscal incidence, and use the McClements scale, which is quite similar to the Australian scale described in Table 5.8. [1]

(1) For example, this scale gives a single adult with no children a value of 0.61; children aged 13 to 15 a value of 0.27, those aged 10 to 12 a value of 0.25, 8 to 10 year olds a value of 0.23, 5 to 7 year olds 0.21, 2 to 4 year olds 0.18, and under two year olds a value of 0.09 (CSO, 1990:111).

Table 5.8: Equivalence Scale Implicit in the Australian Social Security System for Selected Family Types, January 1990*

Category	Equivalence Scale Value
Single Adult	
- with no dependent children	0.60
- with one dependent child, aged less than 13	0.80
- with one dependent child, aged 13 to 15	0.86
- with two dependent children, aged less than 13	0.96
- with two dependent children, aged 13 to 15	1.06
- with three dependent children, aged less than 13	1.11
- with three dependent children, aged 13 to 15	1.26
- with four dependent children, aged less than 13	1.27
- with four dependent children, aged 13 to 15	1.47
- additional children, aged less than 13	0.16
- additional children, aged 13 to 15	0.21
Married Couple	
- with no dependent children	1.00
- with one dependent child, aged less than 13	1.15
- with one dependent child, aged 13 to 15	1.20
- with two dependent children, aged less than 13	1.30
- with two dependent children, aged 13 to 15	1.40
- with three dependent children, aged less than 13	1.45
- with three dependent children, aged 13 to 15	1.60
- with four dependent children, aged less than 13	1.61
- with four dependent children, aged 13 to 15	1.81
- additional children, aged less than 13	0.16
- additional children, aged 13 to 15	0.21

* *Married couple with no dependent children used as the base.*

After application of an equivalence scale to the total disposable income of the family unit in the model, the resulting value for equivalent income is imputed to *both* husband and wife in the case of married couples. Although this intially appears confusing, as Danziger and Taussig point out, "the adjustment of the income concept for differences in unit size and composition is independent of the issue of how to weight the units" (1979:368). In a strict accounting sense this procedure appears strange, as it apparently 'multiplies' the amount of income in the economy, but it simply provides a way of attributing to each individual the standard of living of the family in which they reside.

An additional issue is that the standard assumption made by economists that income is equally shared within the family unit has been challenged by recent empirical work, which has shown that income is not always equally shared and that spouses do not always enjoy the same standard of living (Edwards, 1981; Pahl,1989,1990; Vogler,1989). Consequently, the model was written so that this benchmark 50/50 assumption can be changed to assume, for example, a 60/40 income split in the husband's favour within married couples. Although this is obviously a rather arbitrary method (eg. one would imagine that actual income sharing might vary with the relative share of family income contributed by the wife), nonetheless some results are presented in the following chapters which show the equivalent incomes of individuals assuming unequal sharing within the family unit.

Education services income is the amount of benefit imputed to the individual if they are using education or pre-school services in a given year. *Final income* is equivalent income plus education services income. Ultimately, it would be desirable to broaden the scope of the final income measure to include the imputed benefits of other services, such as health and housing, and to incorporate indirect taxes paid in the year. Finally, education and social security transfers are already fully incoporated in the various income measures, but the specific items they comprise are listed in Table 5.7 to avoid any confusion.

In Table 5.9 an example of a hypothetical family is used to illustrate all of the income concepts outlined above.

Table 5.9: Hypothetical Example of Income and Tax Measures Used in Model

Example for married couple with two children aged less than 13, husband employed full-time full-year earning $20,000, wife not employed and studying full-time at a university, zero investment or other private income.

	HUSBAND'S INCOME	WIFE'S INCOME
Original income	20,000	0
Gross income - original income plus family allowance	20,000	967.20
Taxable income	20,000	0
Gross tax	4,306	0
Net tax - gross tax + $200 Medicare levy, minus $1030 dependent spouse rebate	3,478	0
Disposable income	16,524	967.20
Family disposable income	17,491.20	17,491.20
Shared family disposable income	8,745.60	8,745.60
Equivalent family income - family disposable income divided by 1.3	13,454.77	13,454.77
Education services income	0	7,633
Final income	13,454.77	21,187.77

Lifetime Income Measures

While all of the income and tax measures outlined above are available for annual income, they can also be summed across the lifetime of individuals to produce lifetime measures of total original income, total disposable income, total equivalent income etc. In addition, each of the components of income included in the model can be summed to derive, for example, the total amount of family allowance or age pension received during an individual's lifetime. It should be emphasised that *no discount rate* is currently employed when calculating lifetime income measures, but that annual incomes are simply summed. This means that a dollar of income received late in life is given the same value as a dollar of income received early in life, contrary to the practice of many lifetime income studies which give a higher weighting to income received early in the lifecyle via use of a discount rate (Lillard, 1977; Fase, 1971; Hancock and Richardson, 1981). The discount rate is used to reflect not only individual preferences for receiving money now rather than in the future, but also to capture the economic advantage bestowed by money received early in the lifecycle due to the interest which can be earned on it if invested.

However, use of a discount rate in a study such as this which also abstracts from economic growth is problematic. Because cross-section data were used to set the various earnings and income parameters, the yearly increases in real incomes which could be expected to occur in the real world with economic growth were abstracted from. While it would have been easy to model increases in wage rates etc due to economic growth, it was not clear how the various other parameters in the model would then have to be changed.

For example, if real increases in wages and other income were modelled then the various social security income tests would presumably require amendment every year, otherwise an ever-declining proportion of the pseudo-cohort would be eligible for income-tested cash transfers. The tax scales would presumably also require amendment, otherwise the proportion of income paid in tax would increase markedly over the lifetime.

Similarly, if real wages were rising then presumably there would also be increasing wages for university staff and teachers, and the imputed cost of a year of each type of education would also have to be ratcheted up for every year of the model. The imputation of economic growth is thus very complex, and a steady state world seemed easier to simulate and more clearly understandable, at least for the first round of the model. This is also the practice of the Canadian and West German dynamic cohort models, both of which assume that the rates of economic growth and of discounting cancel each other out (Wolfson, 1988:233; Hain and Helberger, 1986:63).

If economic growth is abstracted from, is there still a case for discounting? As mentioned above, in the real world earnings after adjusting for inflation tend to increase at about the rate of economic growth - about three per cent a year during the 60s and 70s (Moss, 1978:124). It is therefore only an advantage in an economic sense to receive income early in the lifecycle if the real interest rate is higher than the real growth in income. In a model which abstracts from economic growth, the discount rate which should be applied is only any *difference* between the real discount rate and the rate of real income growth, and it is not certain that the former exceeds the latter. Thus, for the present, the real discount rate has been implicitly assumed to equal the rate of real income growth, so that the two cancel each other out. However, analysing the difference that other assumptions about discount rates would make to the results is an interesting area for future development of the model.

A separate issue is that while the *total lifetime income* of individuals is of great interest, it can distort perceptions of inequality and income distribution. Some of the cohort have low lifetime incomes simply because they died at an early age, rather than because they received low earnings. Further, despite their apparently low lifetime incomes, this group would also appear to have received minimal social security transfers, having died long before age pension age, thereby creating a misleading impression of the lifetime progressivity of cash transfers.

Some other lifetime microsimulation models have dodged this problem, by making all individuals in the model die at the same age. For example, in the Davies model each household consists of a husband and wife who start economic life together at age 20 and die together at age 75 (Davies et al, 1984:636). Similarly, all individuals in the Blinder model start economic life at age 18 and die 54.7 years later at about age 73 (1974). While the West German SFB3 dynamic cohort model contains the option of using age-sex-family status specific death rates or of terminating all cohort records at the same age, published work comparing the lifetime incomes of individuals has fixed a uniform age of death, thereby avoiding the issue (Hain and Helberger, 1986:63).

However, as the aim of this study was to directly compare lifetime incomes, a further set of *annualised* lifetime measures were developed. First, all of those who died before the age of 20 were excluded, as many of this group would not have entered the workforce, and would thus have zero annualised income. Second, for those remaining, total lifetime income was then divided by their number of years of life minus 15. (It is equally easy to divide lifetime income by total years of life, but because the cohort typically enter the labour force between the ages of 15 and 20, such a procedure results in annualised lifetime incomes which appear quite low at first glance.) Dividing by years of life minus 15 thus gave a more accurate 'eyeball' impression of living standards.

This second set of annualised measures is available for all of the summary income and tax measures listed in Table 5.9, and for any of the individual components of income included in the model.

5.6 CONCLUSION

All of the major social security and education cash transfers, income tax and the major income tax rebates, and outlays on education services are currently included in the model, capturing about one-third of total budget outlays and one-half of total receipts by the Australian government. The imputation of the benefits of these outlays, particularly in the case of education services, and of the burden of income taxes, is not an uncontested area within economics, and a number of important assumptions have been made. For example, cash transfers have been assumed to be incident upon those receiving them and their value has been assumed to equal their cash value. Similarly, the benefits of education services have been assumed to be wholly incident upon those using such services, and their value has been assumed to equal their cost of provision. The burden of income tax has been assumed to be incident upon those with the legal liability to pay such taxes, the value of that burden has been assumed to be equal to the amount of tax collected, and it has been assumed that there is no tax evasion.

In calculating lifetime income received or taxes paid, the rate of economic growth and the discount rate have been assumed to be equal so that, for example, total lifetime earnings simply equals the sum of earnings received during every year of life. While income and tax measures are available for every individual, the measures of *shared family disposable income* and of *equivalent family income* attempt to take account of the difference made by family circumstances to the welfare of an individual, in the former case by splitting the total income of married couples equally between the two partners and, in the latter case, by applying an equivalence scale to the income of the family unit. Finally, in an attempt to standardise for differential length of life, a set of *annualised* measures have been developed, consisting of the total lifetime measures divided by years of life minus 15.

CHAPTER 6: LIFETIME INCOME BY EDUCATION, FAMILY AND UNEMPLOYMENT STATUS

6.1 INTRODUCTION

This chapter begins the second part of the thesis, which describes some of the results of the simulation. The model has the potential to be used for a wide range of purposes. For example, the Australian government has introduced major social security, education and income tax reforms since 1986, and one possible use of the model is to assess the changes made to these systems since that date, to determine whether they have made the distribution of lifetime income more equal, and have directed resources to those stages of the lifecycle where individuals typically experience lower standards of living. Similarly, the model can be used to assess the lifetime impact of possible policy changes, such as increases in pension rates or changes to the Higher Education Contribution Scheme. In addition, it would also be interesting to change other parameters in the model, such as the differential mortality rates or the labour force participation rates, to assess the impact that such changes would make to the distribution and redistribution of lifetime income, and to assess the sensitivity of the results of the model to the hundreds of parameters embodied within it. Unfortunately, both time and length considerations prevented such analysis from being conducted and included within this study.

Chapters 7 to 9 present the results for the questions that the model was originally constructed to answer, about the distribution and redistribution of lifetime and annual income. This chapter provides an introduction to the output of the model, and analyses the results for *lifetime* income by various lifetime characteristics.

The impact upon lifetime income of *differing educational achievements* is analysed in Section 6.2. The first part of this section examines the sources and amount of income received by males by educational status, and then assesses the impact made by cash transfers and income tax upon the inequalities apparent in original income. The second part describes the personal incomes received by females by education level and then discusses the effect of the tax-transfer system. The third part of this section examines whether differential length of life makes any significant difference to the conclusions reached about the relative inequalities of income apparent by educational status, as the higher incomes of the better educated have to be spread over a longer lifespan.

The fourth part of Section 6.2 identifies the major differences in labour force participation patterns apparent by educational status, and points out that the better educated earn higher incomes in part because they work more hours than the less well educated. An attempt is made to take such differences in patterns of labour force participation and in unemployment into account, in the assessment of the relative lifetime advantage enjoyed by the better educated.

Finally, while the above analysis has dealt with the incomes received by *individuals*, any assessment of lifetime welfare requires that the impact of family circumstances upon standards of living also be taken into consideration. The final part of this section therefore examines the relative lifetime standards of living, measured through the use of equivalent income, enjoyed by those with different educational achievements.

The significant effect upon lifetime income and welfare of marriage and of having children is considered in Section 6.3. The impact upon the individual incomes of first women and then men of marriage and of children is analysed, while the third part of Section 6.3 broadens the analysis to take account of income sharing within the family. Finally, Section 6.4 briefly examines the effect upon lifetime income of repeated spells of unemployment during individuals' lifetimes.

6.2 LIFETIME INCOME BY EDUCATION STATUS

A question of enduring interest in economics and social policy has been the differing lifetime experiences of those with different educational achievements. How much higher is the lifetime income of those who undertake further education and to what extent do higher future earnings outweigh the earnings lost during years of full-time study ? In Australia, such questions assumed major policy significance during the heated debate surrounding the introduction of the Higher Education Contribution Charge in 1989 (Wran et al, 1988).

Total Lifetime Income of Males

After taking account of all private income and cash transfers from the state, men with degrees received total gross lifetime incomes of about $1.4 million per person, almost double the total income received by those with only secondary school qualifications and about 30 per cent more than the $1 million received on average by those with some tertiary qualifications (Table 6.1)[1]. There was, however, great variation in gross income, as shown in Figure 6.1, with the maximum gross lifetime income in the model of almost $5.4 million being achieved by a male graduate. Over half of all males with secondary qualifactions only received total lifetime incomes of between $0.4 and $0.8 million, and very few received lifetime incomes in excess of $2 million. In contrast, almost one-third of male graduates received total lifetime incomes ranging between $0.8 and $1.2 million, and about 10 per cent received gross incomes in excess of $2.8 million. (It should be noted that many of those with low incomes would have died prematurely.) What were the sources of these marked differences in income ?

The relative contribution to lifetime income made by *earnings* showed little differentiation by educational status, amounting to about 85 per cent for all three

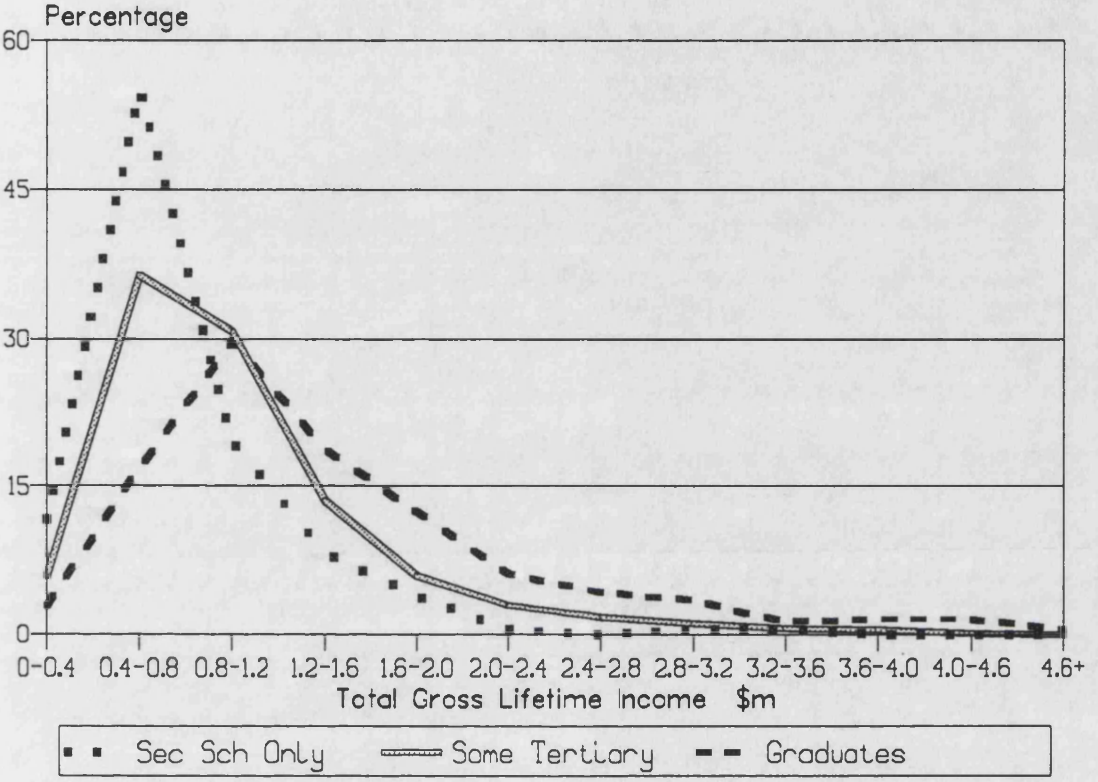
(1) All of the following results only include the records of men and women who lived until at least age 21.

Table 6.1: Average Lifetime Income and Tax Measures for Males by Education

Measure	EDUCATIONAL QUALIFICATIONS		
	Secondary School Only	Some Tertiary	Degree
1. TOTAL LIFETIME MEASURES			
Earnings	666,080	880,520	1,221,365
Investment Income	57,810	84,280	125,955
Superannuation	7,490	25,280	61,065
TOTAL ORIGINAL INCOME	731,380	990,080	1,408,385
Cash Transfers	55,030	41,840	37,575
GROSS INCOME	786,410	1,031,920	1,445,960
Income Tax Paid	184,640	285,085	493,470
DISPOSABLE INCOME	601,770	746,835	952,490
SHARED DISP INCOME (family unit)	547,195	657,800	787,400
EQUIVALENT DISP INCOME (family unit)	931,355	1,125,925	1,349,360
Education Services Income	33,990	37,025	61,575
Lifetime hrs in labour force	79,140	90,435	86,245
Lifetime hours employed	74,375	87,615	84,495
Lifetime hours unemployed	4,765	2,820	1,750
2. ANNUALISED LIFETIME MEASURES			
Earnings	11,765	15,465	20,665
Investment income	985	1,430	1,995
Superannuation	115	380	880
TOTAL ORIGINAL INCOME	12,865	17,275	23,535
Cash Transfers	860	650	575
GROSS INCOME	13,725	17,925	24,110
Income tax paid	3,245	4,975	8,225
DISPOSABLE INCOME	10,480	12,945	15,885
SHARED DISPOSABLE INCOME (family unit)	9,520	11,375	13,085
EQUIVALENT DISP INCOME (family unit)	16,165	19,410	22,375
3. AVERAGE MEASURES			
Av length of life	73.0	73.4	75.1
Av yrs in labour force (gt 1 ht per yr)	40.4	44.1	44.0
Av yrs any unemployment experienced	6.9	4.2	2.8
Av hours in L.F. during yrs in L.F.	1,945	2,045	1,965
Av hrs employed during yrs employed	1,830	1,980	1,925
Av lifetime hourly wage rate	8.95	10.10	14.35
Av yrs of education	12.6	13.5	16.6

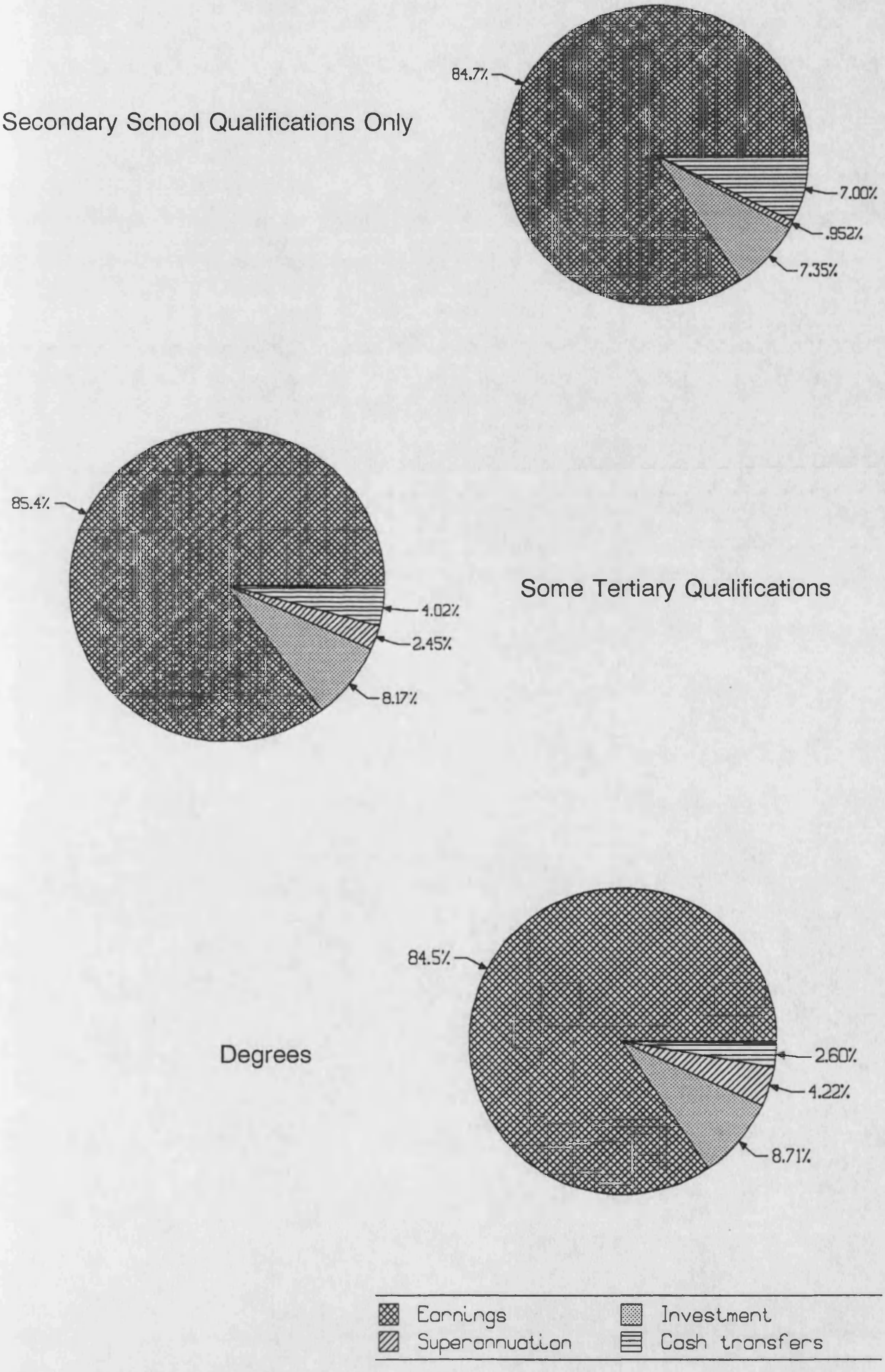
Note: All income figures rounded to nearest $5. Totals may not sum due to rounding.

Figure 6.1: Frequency Distribution of Total Gross Lifetime Income By Education for Males



groups (Figure 6.2). However, the absolute values received were very different, ranging from under \$700,000 for males with secondary qualifications only and rising to \$1.2 million for graduates. *Investment income* showed greater variation, amounting to under \$60,000 on average for males with secondary qualifications - or some 7.4 per cent of total gross lifetime income - and shooting up to \$126,000 for graduates, comprising almost 9 per cent of total income received by this group. Although this shows the *average* value of investment income received, there was great dispersion *within* the three educational groups, with investment income for graduates, for example, ranging from a low of zero to a maximum value of \$1.5 million during their lifetimes.

Figure 6.2: Sources of Total Gross Lifetime Income by Education for Males



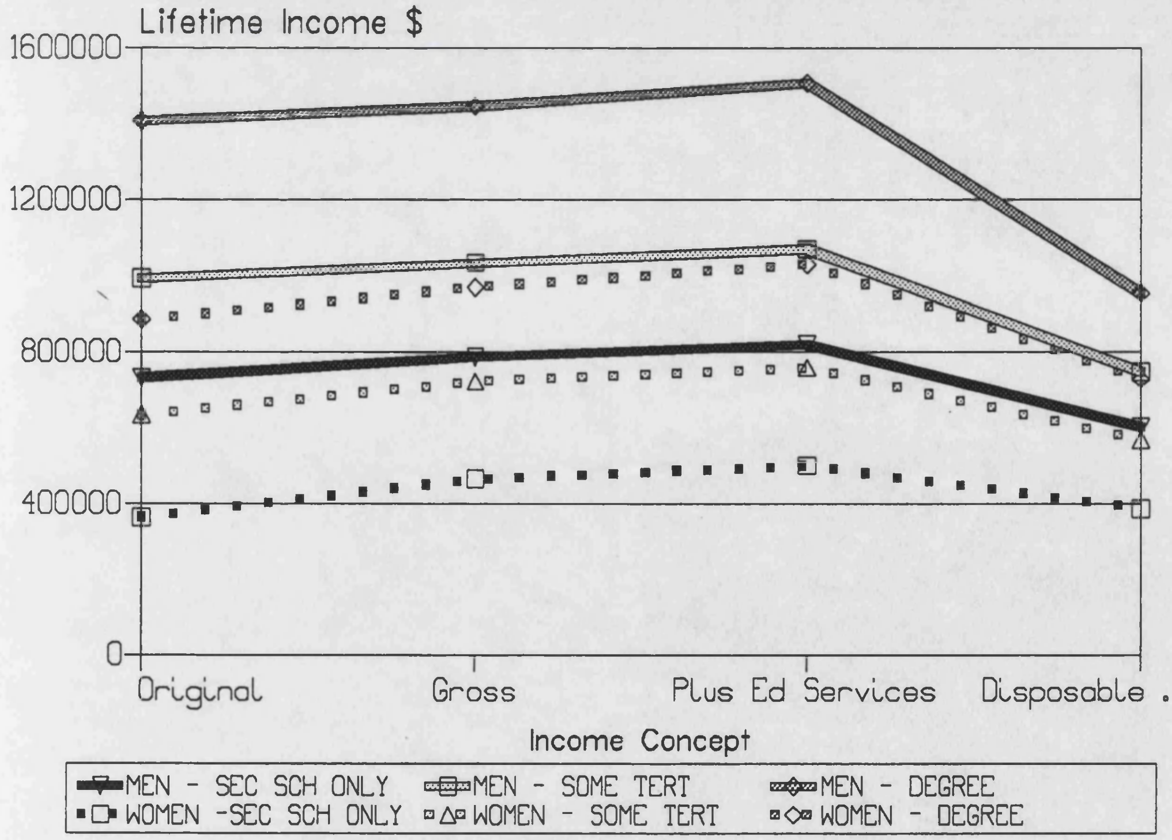
Superannuation income was the most unequally distributed source of original lifetime income, with those with degrees receiving on average about eight times as much superannuation income as those with secondary qualifications and about two and a half times as much as those with some tertiary qualifications. Superannuation income was a negligible source of lifetime income for those with secondary school qualifications, not even reaching one per cent of gross lifetime income, but contributing just over 4 per cent of the gross lifetime income of graduates.

What contribution did government programs make to equalising the distribution of original income ? Social security and education *cash transfers* were a relatively minor source of lifetime income for males, although the average $55,000 received by those with secondary schooling accounted for 7 per cent of their total gross lifetime income. Almost 70 per cent of this was accounted for by age pension receipts, with unemployment benefit being the other major source, amounting to 22 per cent of all cash transfers received. Education cash transfers for this group were insignificant, amounting to around 2 per cent of all cash transfers received. This average picture disguises major differences in lifetime patterns of receipt, with some 6.7 per cent of the secondary group receiving no cash transfers during their entire lifetimes, while the maximum value received was $207,000.

In contrast, those with degrees received only $38,000 in total cash transfers on average during their lifetimes, less than three per cent of their total gross income. Again, age pension received in retirement amounted to 74 per cent of all cash transfers received, but education transfers accounted for 10 per cent of all such transfers, reflecting the assistance provided to many graduates during their years at university. Once again, there was enormous variation in receipt patterns. While 7.3 per cent of graduates received no cash transfers during their entire lifetimes, the maximum value received of $182,000 was not much less than the highest amount received by those with secondary qualifications.

The impact made by *income tax* was more far-reaching. Figure 6.3 shows the average amounts of income received by males by education, using different definitions of income. The difference between original and gross income shows the contribution made by *cash transfers*. For males, who are represented by the unbroken lines in Figure 6.3, the addition of cash transfers makes little difference to the dispersion of incomes still apparent at the gross income stage. As an experiment, the figure next shows the total amount of income received if imputed education services income is added to gross income. Because those with degrees

Figure 6.3: Average Amounts of Total Lifetime Income Received by Sex and Education, Using Different Income Concepts



utilise education services to a greater extent, the degree of income inequality becomes greater at this stage, as shown by the slight widening of the gap between those with degrees and others, when the income measure is changed from gross income to gross income plus education services income.

However, *income taxes* markedly reduce the degree of income inequality, as shown by the narrowing of the gap in Figure 6.3 between graduates and non-graduates as the income base is changed from gross income (with or without education services imputed) to disposable income. Male graduates pay just under half a million dollars of income tax during their lifetimes, in comparison to the $185,000 contributed by those with secondary qualifications and the $285,000 paid by those with some tertiary qualifications (Table 6.1). As a result, while the total *original* lifetime income of graduates is 1.9 times higher than that of secondary schoolers, the total *disposable* income of graduates, after the intervention of the tax-transfer system, is only 1.6 times greater.

Total Lifetime Income of Females

How do these results compare with those for females? As Figure 6.3 demonstrates clearly, the average lifetime incomes of females are much lower than those of males, with even the incomes of the top-ranking education group of female graduates only exceeding the incomes of the bottom-ranking males with secondary qualifications. The total gross lifetime income of female graduates of almost $970,000 (Table 6.2) amounts to only two-thirds of the gross income of male graduates, and is about 94 per cent of the gross income of males with some tertiary qualifications. However, female graduates fare very much better than other females, receiving twice as much income during their lifetimes as women with only secondary school qualifications and about 27 per cent more income than women with some tertiary qualifications.

The gross incomes of women also show great dispersion, with the top ranking female with secondary qualifications reaching a lifetime gross income of about $2 million, compared to the highest value for a female graduate of $3.7 million. Again,

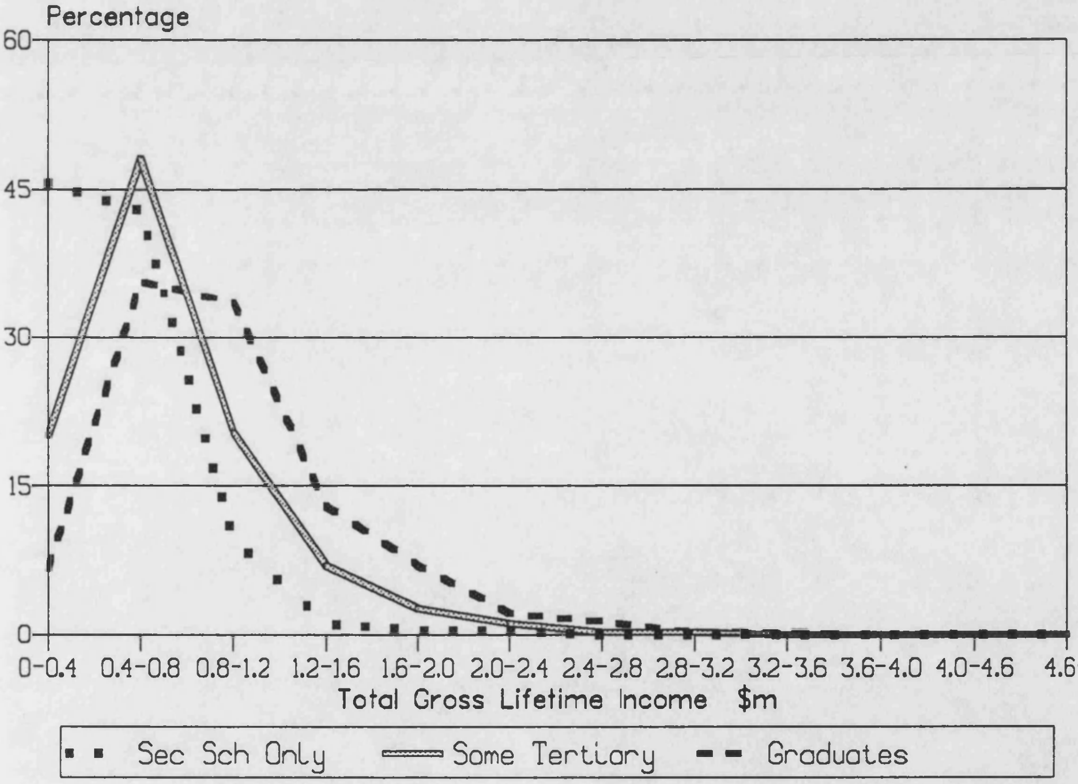
Table 6.2: Average Lifetime Income and Tax Measures by Education for Females

Measure	EDUCATIONAL QUALIFICATIONS		
	Secondary School Only	Some Tertiary	Degree
1. TOTAL LIFETIME MEASURES			
Earnings	296,660	489,930	693,640
Investment Income	54,335	125,285	139,060
Superannuation	10,100	15,445	48,780
TOTAL ORIGINAL INCOME*	363,235	633,380	884,480
Cash Transfers	101,865	87,680	83,570
GROSS INCOME	465,100	721,060	968,050
Income Tax Paid	78,430	153,930	239,530
DISPOSABLE INCOME	386,675	567,125	728,520
SHARED DISP INCOME (family unit)	550,290	670,830	770,615
EQUIVALENT DISP INCOME (family unit)	920,775	1,119,140	1,291,240
Education services income	34,525	36,630	59,985
Lifetime hrs in labour force	41,600	57,760	65,800
Lifetime hours employed	38,540	55,005	64,735
Lifetime hours unemployed	3,060	2,755	1,065
2. ANNUALISED LIFETIME MEASURES			
Earnings	4,960	7,980	10,825
Investment income	860	1,900	2,030
Superannuation	145	215	675
TOTAL ORIGINAL INCOME*	5,995	10,140	13,580
Cash Transfers	1,545	1,320	1,230
GROSS INCOME	7,540	11,460	14,815
Income tax paid	1,305	2,465	3,660
DISPOSABLE INCOME	6,235	8,995	11,150
SHARED DISPOSABLE INCOME (family unit)	8,845	10,700	11,780
EQUIVALENT DISP INCOME (family unit)	14,735	17,800	19,700
3. AVERAGE MEASURES			
Av length of life	77.8	78.5	80.6
Av yrs in labour force	26.3	34.3	39.1
Av yrs any unemployment experienced	4.8	4.5	2.0
Av hours in L.F. during yrs in L.F.	1,535	1,655	1,665
Av hrs employed during yrs employed	1,405	1,570	1,640
Av lifetime hourly wage rate	7.65	8.85	10.70
Av yrs of education	12.8	13.4	16.4

* Totals also include maintenance income.

there is substantial variation in the total lifetime incomes of women within each educational grouping. About 90 per cent of women with secondary qualifications receive total gross lifetime incomes of less than $0.8 million, compared to only 60 per cent of those with some tertiary qualifications and less than 50 per cent of female graduates (Figure 6.4). (Again, some of the low gross lifetime incomes would reflect those who died at an early age, as well as women who spent many years out of the labour force.)

Figure 6.4: Frequency Distribution of Total Lifetime Gross Income by Education for Females



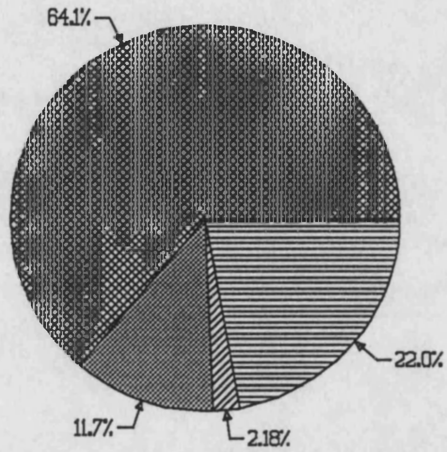
The sources of total lifetime gross income are also very different for women. While *earnings* contributed around 85 per cent of all lifetime income for men, the comparable figure for females with secondary qualifications is only 64 per cent, rising to 72 per cent for female graduates (Figure 6.5). The absolute amounts of lifetime earnings received are also much lower, with the $296,000 earned by females with secondary qualifications and the $694,000 earned by female graduates amounting to only 45 and 57 per cent respectively of the earnings of males with comparable education. The dispersion in average earnings among women is, however, greater, with female graduates earning 2.3 times more on average than women with secondary qualifications during their lifetimes.

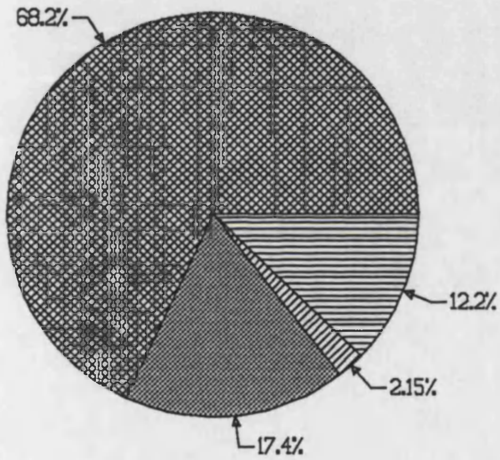
Somewhat suprisingly, women with some tertiary qualifications or degrees received higher lifetime *investment* incomes than men. This is in part accounted for by women living for about five years longer than men on average, with substantial amounts of investment income being received during these last years of life while in retirement. After accounting for differential length of life (discussed further below), women with some tertiary qualifications still received more investment income than comparable men (although the investment income received by male and female graduates becomes almost the same). However, this simply reflects the imputation of investment income in the simulation using the data available in the 1986 IDS, which does find that women with some tertiary qualifications receive more investment income after age 50 than comparable men (see Figures 4.4 and 4.5 in Chapter 4). Whether this is due to sampling error is unclear.

However, due both to the higher absolute amounts of investment income received during the lifecycle and to the lower absolute amounts of other income sources, investment income remains a more significant source of income for women than for men, amounting to about 12 per cent of total gross lifetime income for those with secondary qualifications and reaching a peak of 17 per cent for those with some tertiary qualifications (Figure 6.5). *Superannuation* income was again the most unequally distributed component of original income, with the average $49,000 received by female graduates being almost five times that received by women with secondary qualifications.

Figure 6.5: Sources of Total Gross Lifetime Income by Education for Females

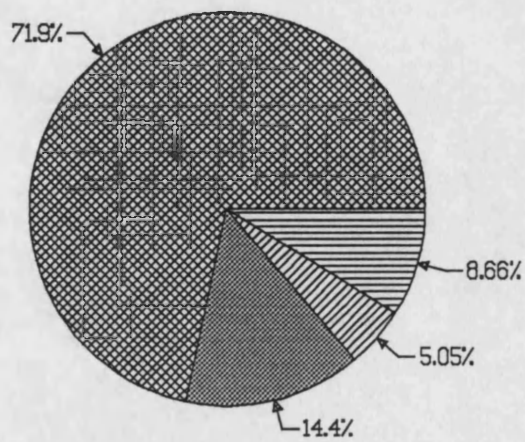
Secondary School Qualifications Only

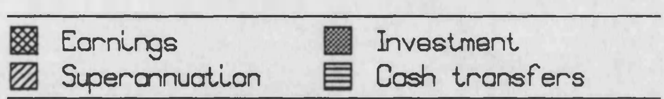




Some Tertiary Qualifications

Degrees





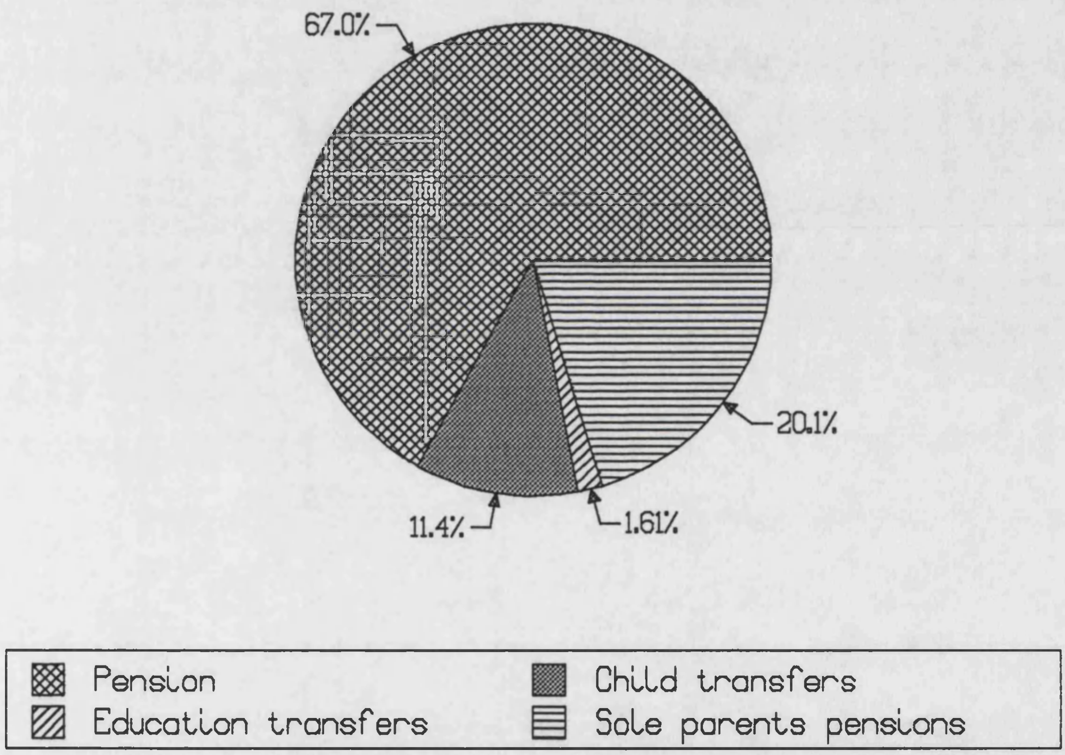
The tax-transfer system again ameliorates these inequalities in original income. *Cash transfers* are a vastly more important source of lifetime income for women than for men, reflecting both the provision of child transfers to women, their greater likelihood of experiencing sole parenthood and their longer lives and commensurately lengthier receipt of age pension. Women received about twice as much in cash transfers during their lifetimes as men and this, allied with their lower original incomes, made cash transfers a very significant component of lifetime income. For women with secondary qualifications, cash transfers amounted to just over one-fifth of all income received during their lives, although the importance of such transfers declined with increasing education, reaching less than 9 per cent of the total gross lifetime income of women with degrees (Figure 6.5).

The *composition* of lifetime cash transfers is also very different for women than for men. A breakdown of lifetime transfers for women with secondary qualifications only is shown in Figure 6.6. Pension payments account for 67 per cent of all cash transfers (of which age pension comprises some 98 per cent and invalid pension the remainder). The second largest contender is sole parents pension, amounting to one-fifth of all transfers received, followed by family allowances and FIS which comprise just over one-tenth of all transfers. Education transfers are negligible at around 2 per cent; of the average $1575 received in lifetime education transfers, just under half are transfers received by these women when they are students themselves and the remaining majority are transfers paid to them in middle age in respect of their student children.

The compositional pattern for other women is fairly similar although, for women with degrees, education cash transfers not suprisingly are more significant, amounting to some $4,200, or 5 per cent of total transfers received by this group. Of these education transfers, over 84 per cent are TEAS and PGA payments made to these graduates when they are students.

There is again great variation in the amount of cash transfers received by those with the same educational status, although the maximum values for each education grouping are again reasonably close, amounting to $285,000 for women with secondary qualifications and almost $280,000 for women with degrees.

Figure 6.6: Components of Total Lifetime Cash Transfers Received by Women with Secondary Qualifications Only



Income taxes markedly reduce the inequalities apparent in the distribution of original and disposable income, as shown by the closing of the gap between the dashed lines for women with different educational achievements in Figure 6.3, as the income measure is changed from gross to disposable income. Reflecting their lower incomes, the amount of income tax paid by women is much less than that by men, with female graduates contributing some $240,000 in income tax on average during their lifetimes. Women with secondary qualifications pay less than $80,000 in income tax during their lives.

Taking Account of Differential Length of Life

While the above figures suggest that those with higher education enjoy much higher lifetime incomes, it is conceivable that this advantage might be partially or even fully offset by the longer lifespans of those with higher education. As discussed in Chapter 2, differences in mortality after the age of 45 were simulated in the model, although there is no way of knowing, given the lack of Australian data, whether the simulated differences were sufficiently large. Because men die at an earlier age on average than women, the differences in mortality by education are not as apparent. Men with degrees live two years longer on average than those with secondary qualifications only, but women with degrees live almost three years longer on average than women without any tertiary qualifications (Tables 6.1 and 6.2). The higher incomes of the better educated thus have to be spread over a somewhat longer lifespan.

To take account of this phenomenon, *annualised lifetime measures* were developed (see Chapter 5), which simply attempted to put all those in the simulation on a more equal footing, by dividing the various lifetime totals by years of life minus 15 (the assumed age of potential labour force entry). While the various annualised income measures are listed in Table 6.1 for men, Figure 6.7 attempts to summarise the conclusions which can be drawn. The figure shows the total lifetime original, gross and disposable income received by males with degrees and by males with some tertiary qualifications as a percentage of the comparable incomes received by men with secondary qualifications only, and then shows the difference which is made by using annualised lifetime income rather than total lifetime income measures.

Figure 6.7: Total and Annualised Lifetime Original, Gross and Disposable Incomes of Males with Degrees or with Some Tertiary Qualifications as Proportion of Comparable Incomes of Males with Secondary Qualifications

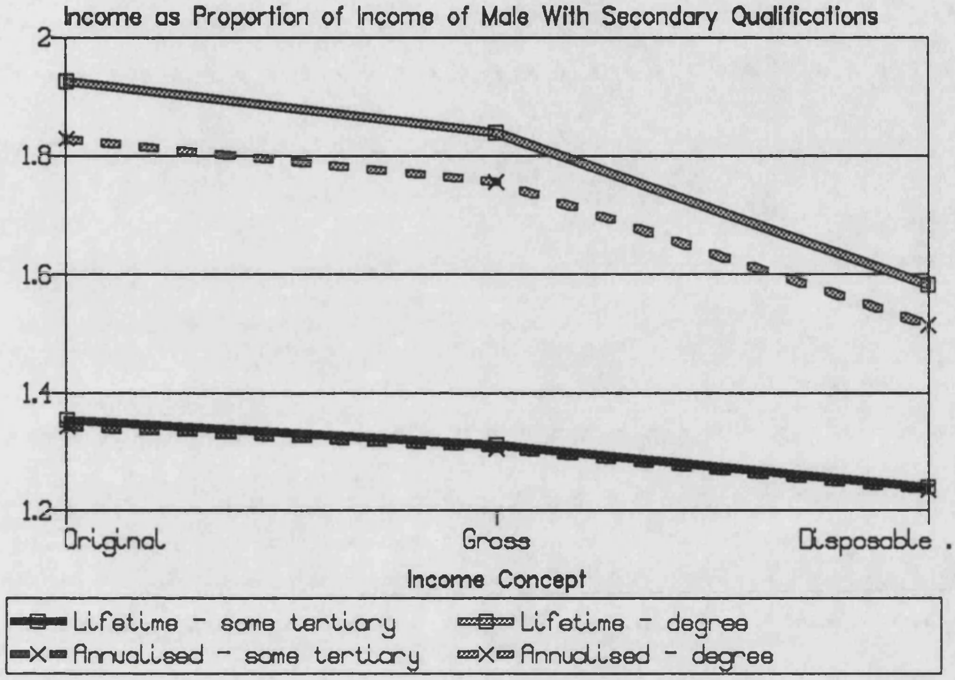
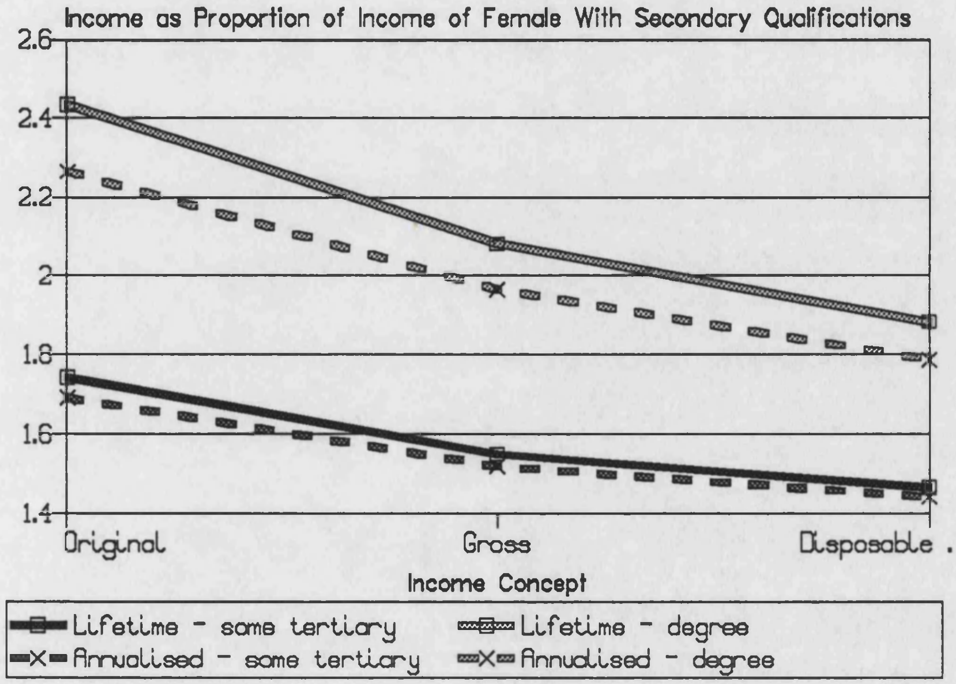


Figure 6.8: Total and Annualised Lifetime Original, Gross and Disposable Income of Females with Degrees or with Some Tertiary Qualifications as Proportion of Comparable Incomes of Females with Secondary Qualifications



For males with *some tertiary qualifications* there is almost no difference between the two concepts, as such males on average live for only five months longer than males without any tertiary qualifications. For males with *degrees*, however, the extra length of life does make some difference. For example, while the original (pre-tax, pre-transfer) total lifetime income of men with degrees is more than 1.9 times higher than the total original lifetime income of men without tertiary qualifications, their *annualised* original lifetime income is only slightly more than 1.8 times higher. The magnitude of the difference made by accounting for differential length of life appears to stay fairly constant, whether original, gross or disposable income is used as the basis of comparison. In conclusion, while the extra few years of life do reduce the relative advantage enjoyed by males with degrees, the difference appears fairly insubstantial, indicating that such males do still enjoy much higher lifetime incomes than their less well educated peers.

For women, however, the difference made by moving from total lifetime to annualised lifetime income measures is more pronounced. As Figure 6.8 demonstrates, while the total original lifetime income of *women with degrees* is about 2.43 times higher than that of women with no tertiary qualifications, their annualised original lifetime income is only about 2.27 times greater - a cut of about 7 per cent. Similarly, the relative lifetime incomes of women with *some tertiary qualifications* are also somewhat lower once account is taken of their longer lifespans. (Comparison of Figures 6.7 and 6.8 also shows that the gap between the average incomes of better and less well-educated men is less wide than it is for women.)

In conclusion, although the differences are not vast, the longer lives enjoyed by the better educated do reduce the relative income advantage apparent when only the total lifetime results are examined.

Taking Account of Varying Labour Force Participation Patterns

Even more importantly, the various annualised measures could be regarded as overstating the real advantage enjoyed by those with higher educational qualifications. Further examination of the data showed that the higher lifetime incomes of those with tertiary qualifications were due to a greater number of hours worked during the lifetime, as well as to a higher average hourly wage rate.

For example, men with secondary qualifications spent an average 40.4 years in the labour force compared with 44 years for more highly educated men and, once in the labour force, spent 20 hours less per year in the labour force. As a result of these factors, those with degrees averaged an additional 8000 hours in the labour force during their lifetimes compared to those without any tertiary qualifications - or the equivalent of 200 forty-hour weeks. Interestingly, those males with some tertiary qualifications (which included many self-employed tradespeople) worked longer hours than either of the other two groups.

The differences were even more marked for women. On average, women with secondary qualifications only participated in the labour force (for an hour or more per year) during 26 years of their life. This rose to 34 years for those with some tertiary qualifications and to 39 years for those with degrees. In addition, when actually in the labour force, the better educated worked more hours per year. Thus, female graduates and those with some tertiary qualifications averaged about 1660 hours in the labour force during the years they were in the labour force, while those with secondary qualifications averaged only 1535 hours. In summary, less well educated women were more likely to drop out of the labour force upon marriage and childbirth than their better educated counterparts and, when they did enter the labour force, were more likely to work part-time.

These trends resulted in enormous differences in total lifetime hours in the labour force, with those women with some tertiary qualifications spending an extra 16,000 hours in the labour force and those with degrees spending an additional 24,000 hours in the labour force during their lifetimes in comparison to women with secondary qualifications only - a difference of 404 and 605 working weeks respectively.

In addition to these participation differences, there was also a substantial difference in the average lifetime wage rate (calculated as total lifetime wages divided by lifetime hours of employment). For women with secondary school qualifications only, the average lifetime wage rate was $7.65 an hour, compared with $8.85 for those with some tertiary qualifications and $10.70 for those with degrees (Table 6.2). Men's hourly wage rates were higher than women's, at $12.60, $13.50 and $16.60 respectively (Table 6.1).

While there were thus significant differences in the lifetime hourly wage rate received by the better educated, the wide variation in labour force participation rates raised the question of whether an attempt could be made to control for this variation, so that the relative monetary advantage enjoyed by the better educated could be more accurately assessed. It is difficult to determine the extent to which differences in lifetime hours worked should be treated as an involuntary choice forced upon workers (eg. in the case of the greater likelihood of forced early retirement for those with less education) or as a voluntary choice between labour and leisure, which would imply that leisure could be valued at the wage rate (Scitovsky, 1973).

However, if differences in hours worked reflect relative preferences for leisure over labour, and if such differences are significant between those with different educational qualifications, then those numerous studies of the relative rates of return to education which simply calculate such rates by examining the *total yearly* incomes by age received by those with different educational qualifications seem fundamentally flawed, by not taking into account the different periods of time spent earning such incomes (Clark and Tarsh, 1987; Psacharopoulos, 1973; Chapman and Chia, 1989; Chapman, 1988).

Standardising Lifetime Hours Worked

Without seeking to enter the debate about whether hours worked reflect voluntary or involuntary choices, an attempt is made below to standardise lifetime hours in the labour force, so that at least the magnitude of the potential difference may be assessed. A further issue is that, even if the labour force participation patterns of individuals did not vary by education, because those with less education are more likely to spend some of their labour force hours unemployed this presumably should also be taken into account when assessing lifetime rates of return (Miller, 1981). Finally, the impact of progressive tax systems in reducing the return to education is widely recognised (Miller, 1981; Richardson and Hancock, 1981; Chapman, 1988), so that earnings net of income tax seem the approriate measure to use in assessing private returns to education.

The attempt to distinguish between the separate effects of education and hours worked on lifetime earnings outlined below can, however, only be regarded as very approximate. The average age of labour force entry, after taking account of years of full-time study, is only an approximation as, for example, some graduates might have studied part-time to attain their degrees. All individuals are assumed to leave the workforce at the legal age pension age and, following Eckaus, all are assumed to work a standard 2000 hour year (quoted in Miller, 1981).

The proportion of time spent unemployed during each year is simply calculated by taking lifetime hours unemployed as a percentage of lifetime hours in the labour force (Tables 6.1 and 6.2), and the assumption that the same proportion of time would be spent unemployed if labour force participation rates were increased might not be valid. Equally, the resultant hours in the labour force per year have simply been multiplied by the average hourly lifetime wage rate to derive annual earnings, and this abstracts from such issues as whether those within each educational group who have lower than average participation rates would also have lower than average wage rates.

It should also be noted that no attempt has been made to impute the unemployment benefits which might be payable to individuals while they were unemployed (thereby *overestimating* the gains made by the better educated). Similarly, the costs of full-time study, calculated by the Department of Employment, Education and Training as $595 in 1984 (1987d), and possible part-time earnings by graduates while they are studying (calculated by DEET as $1,483 per year for those not receiving student assistance and $865 for those receiving such assistance), have also been abstracted from, as has any student assistance paid to graduates, thereby *underestimating* the relative gains made by the better educated. Finally, possible differences in family circumstances have been ignored when calculating income tax payments, so that the tax rates applied are simply those applicable to single taxpayers without dependents in 1985-86.

Table 6.3 shows the figures which are the basis of the calculation, while the results are presented in Figure 6.9. While the total lifetime earnings of males with some tertiary qualifications in the simulation are 1.3 times greater than those of males with only secondary qualifications, their earnings after standardisation for different labour force participation patterns are only 1.15 times greater. Similarly, while the total lifetime earnings of male graduates in the simulation are more than 1.9 times higher than those of males with secondary qualifications, their imputed earnings after imposing comparable lifetime hours in the labour force are only 1.55 times greater.

The relative advantage enjoyed by the better educated is further lessened by income tax. While the imputed earnings *after-tax* cannot be precisely compared with any of

Table 6.3: Estimates of Lifetime Earnings After Standardising for Differential Labour Force Participation Patterns

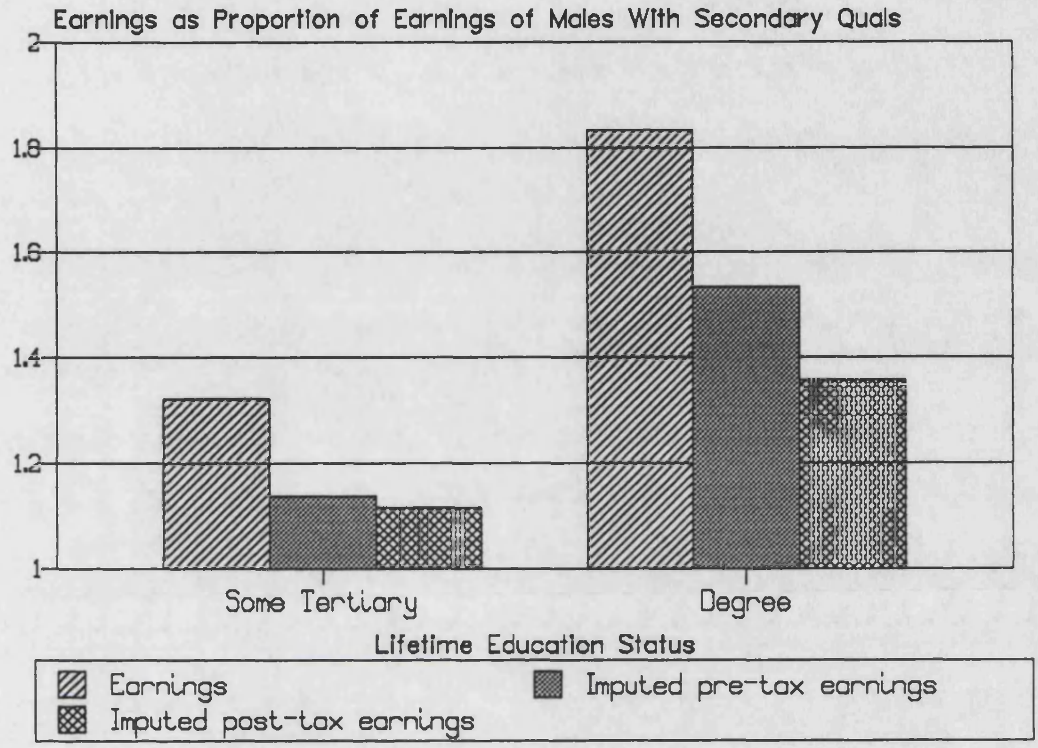
	Secondary School Only	Some Tertiary	Degree
MALES			
Av age of labour force entry	16.5	17.5	20.5
Assumed age of l.f. exit	65	65	65
Years in labour force - (A)	48.5	47.5	44.5
% of yearly hours in l.f spent unemployed	6.02	3.12	2.03
Av hours per yr spent in employment	1880	1938	1959
Av annual gross (pre-tax) earnings [(1)] - (B)	16,826	19,574	28,112
Av annual after-tax earnings[(2)] -(C)	13,552	15,464	20,072
Lifetime gross (pre-tax) earnings - (A x B)	816,061	929,765	1,250,984
Lifetime after-tax earnings (A x C)	657,272	734,540	893,204
FEMALES			
Av age of labour force entry	16.5	17.5	20.5
Assumed age of l.f. exit	60	60	60
Years in labour force - (A)	43.5	42.5	39.5
% of yearly hours in l.f spent unemployed	7.36	4.77	1.62
Av hours per yr in employment	1853	1905	1968
Av annual gross (pre-tax) earnings [(1)] - (B)	14,175	16,860	21,058
Av annual after-tax earnings[(2)] - (C)	11,696	13,575	16,265
Lifetime gross (pre-tax) earnings - (A x B)	616,613	716,550	831,791
Lifetime after-tax earnings (A x C)	508,776	576,969	642,470

(1) Average hours of employment per year multiplied by average lifetime hourly wage rate.
(2) Applying 1985-86 income tax schedules, and assuming no rebates, deductions etc.

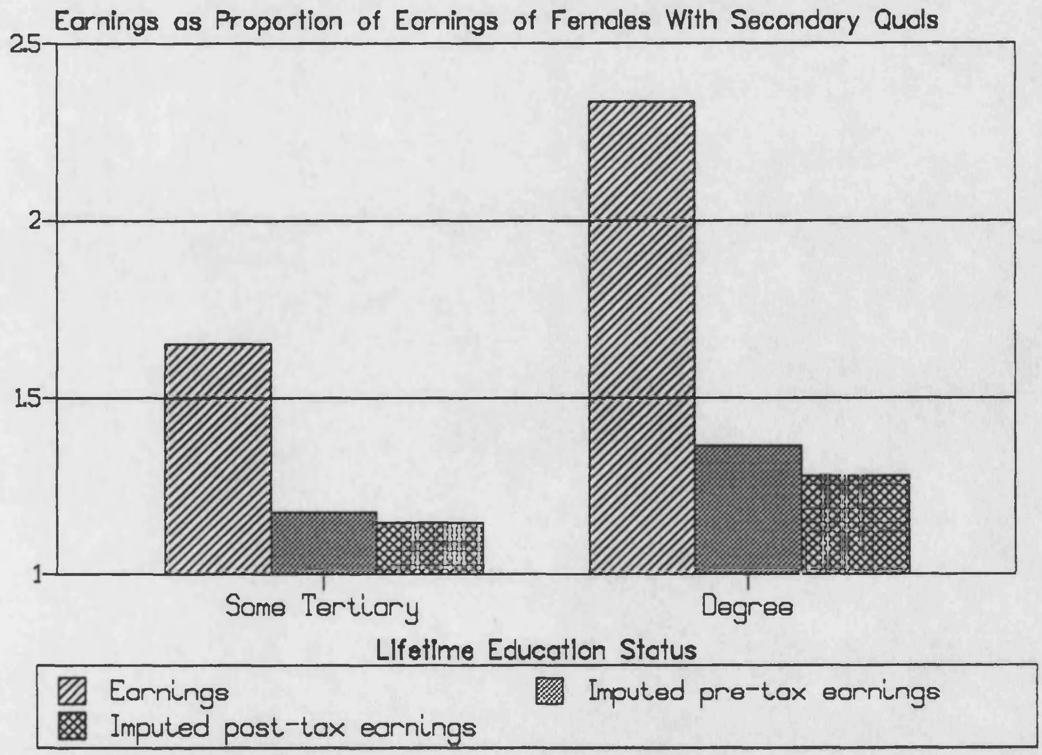
the results presented earlier, comparison of Figure 6.9 with Figure 6.7 shows that the disposable imputed earnings of graduates are about 1.35 times greater than those of males with secondary qualifications, while their total lifetime disposable incomes (which include other sources of income and are thus not directly comparable) are almost 1.6 times greater.

Figure 6.9: Actual and Imputed Lifetime Earnings of Males and Females with Tertiary Qualifications as a Proportion of the Lifetime Earnings of Those with Only Secondary Qualifications

MALES



FEMALES



Standardisation for hours worked has an even more dramatic effect for females, because of the much greater variation in their labour force participation patterns by education. While the earnings originally simulated for females with degrees in the model were about 2.3 times higher than those of women with secondary qualifications, their imputed earnings after assuming similar labour force profiles were only about 1.35 times greater. A marked decline in the relative earnings advantage enjoyed by women
with some tertiary qualifications is also apparent. There was less change in relative advantage for women than for men after taking into account income tax payments, because the lower earned incomes of women meant that the progressive nature of the tax system had less impact.

While the above calculations can only be regarded as a very rough attempt to isolate the contribution made by differential labour force participation patterns to the earning inequalities apparent amongst those with different educational qualifications, the results suggest that such differences in lifetime hours worked do make a significant contribution to such inequalities, particularly for women.

The extent to which such differences reflect voluntary or involuntary choice is important when attempting to make a value judgement about the implications of these results for the analysis of income inequality. However, as the labour force participation rates of women seem more likely to reflect the result of a deliberate choice between paid work in the labour force and unpaid work in the home, to a much greater extent than for men, the sharp drop in the relative advantage enjoyed by female graduates, once variations in participation rates are standardised for, suggests that any analysis for females which does not take differences in work effort into account may be highly misleading.

Taking Account of Family Circumstances

While the personal incomes received and taxes paid by individuals are of great interest, they take no account of income sharing within the family unit, which helps to attenuate the marked disparities between the incomes of men and women described above. For example, the very low earned incomes of many women without tertiary qualifications might not provide an accurate guide to the lifetime standard of living they achieve, because they might be married to high income spouses who share income with them. However, only the incomes of individuals can be tracked in any meaningful way over time, as families are constantly dissolving and reforming from year to year, with marriage, divorce, children leaving home, and so on (Elder,1985:28).

Consequently, as described in Chapter 5, two additional income measures were developed for use in the simulation which took varying degrees of account of family circumstances. The first, *shared disposable income*, assumes completely equal sharing of income between adults, so that in married couples all income received is divided equally between each partner, irrespective of the relative contribution of each partner to that combined income. While such equal sharing could be applied to any of the income and tax measures used, disposable income has been selected, as it captures the amount of money available to individuals and couples to spend after the intervention of the tax-transfer system. Implicitly, therefore, the measure splits the income taxes paid and cash transfers received by a couple equally between them, irrespective of who actually received the income or paid the taxes. During those years when individuals are single, their shared disposable income is simply the same as their personal disposable income.

The second family-based measure was *equivalent disposable income*, where an equivalence scale was applied to the total disposable income of a family , and the resulting values for equivalent income were attributed to both partners in the case of married couples.[1] This measure thus goes further than the shared income measure in also taking into account the financial demands imposed by any children, as well as the possible economies of scale enjoyed by a couple living together and sharing accommodation etc, relative to a single person.

As Table 6.4 demonstrates, the inequality apparent between men and women, when only their personal incomes are considered, largely disappears when account is taken of family circumstances. For example, women with only secondary qualifications have personal annualised lifetime disposable incomes of only $6235 a year on average. However, once they are assumed to benefit equally in the incomes of their husbands their annualised lifetime shared disposable incomes rise to $8,845 a year. Because of the higher incomes of female graduates, allied with the fact that about one-quarter are married to males who do not have degrees, the increase in their income when the base is changed from personal disposable income to shared disposable income is not as great, but still amounts to about $600 a year on average.

Not suprisingly, the incomes of men fall when they are assumed to split income equally with their wives, with the shared disposable income of men with secondary qualifications being almost $1,000 lower per year than their personal annualised lifetime disposable incomes. The drop is more pronounced for male graduates; once they are assumed to split income equally with their wives during the years they are married, their shared disposable income during each year of adult life is almost $3,000 lower than their personal annualised lifetime disposable income.

(1) A family is defined as a single person with or without children and married couples with and without children. As in comparable dynamic cohort microsimulation models, there are currently no extended families or 'families' of unrelated individuals in the simulation.

Table 6.4: Lifetime Disposable, Shared and Equivalent Incomes by Educational Status and Sex

MEASURE	EDUCATIONAL STATUS		
	Secondary School Only	Some Tertiary	Degree
MALES			
Annualised disposble income	10,480	12,945	15,885
Annualised shared income (family unit)	9,520	11,375	13,085
Annualised equivalent income (family unit)	16,165	19,410	22,375
Annualised equivalent income (60:40 split within couples)	18,010	21,615	25,105
Total lifetime disposable income	601,770	746,835	952,490
Total lifetime shared income (family unit)	547,195	657,800	787,400
Total lifetime equivalent income (family unit)	931,355	1,125,925	1,349,360
Total lifetime equivalent income (60:40 split)	1,040,915	1,255,670	1,513,015
FEMALES			
Annualised disposble income	6,235	8,995	11,150
Annualised shared income (family unit)	8,845	10,700	11,780
Annualised equivalent income (family unit)	14,735	17,800	19,700
Annualised equivalent income (60:40 split within couples)	12,765	15,690	17,410
Total lifetime disposable income	386,675	567,125	728,520
Total lifetime shared income (family unit)	550,290	670,830	770,615
Total lifetime equivalent income (family unit)	920,775	1,119,140	1,291,240
Total lifetime equivalent income (60:40 split)	797,850	988,050	1,139,985

The figures also provide an interesting illustration of the importance of adjusting for differential length of life. For example, the *total lifetime* shared disposable incomes of women with secondary qualifications are higher than those of men with comparable qualifications; however, as such women live on average for an additional five years, this total income is spread over a longer lifespan, and their *annualised shared disposable incomes* are actually lower than those of men with similar qualifications. Even with assumed full income sharing, men have higher annualised shared incomes than women, because they receive higher incomes than women during the years they are single.

Once the income measure is broadened to take account of the number of children also dependent upon it, the discrepancy between men and women widens slightly, possibly reflecting the greater number of years women spend as sole parents and as single retired individuals relative to men. For example, while the annualised shared disposable income of women with some tertiary qualifications amounts to 94 per cent of that of men with some tertiary qualifications, their annualised equivalent income is only 92 per cent of that of such males.

Even after standardising for differential length of life and differing family experiences (but not for labour force participation differences), the incomes of the better educated remain substantially higher than those of the less well educated, with the annualised equivalent incomes of female graduates being about one-third higher than those of women without any tertiary qualifications. The incomes of male graduates are some 38 per cent higher than the annualised equivalent incomes of around $16,000 per year received by males with only secondary qualifications.

This is particularly interesting, because it represents a reversal of the relative positions apparent when personal disposable income was used. That is, while the annualised disposable incomes of female graduates were about 1.8 times higher than those of women with secondary qualifications, their annualised equivalent disposable incomes were only 1.3 times higher (Table 6.4). In contrast, while the annualised disposable incomes of male graduates were 1.4 times higher than those of males with secondary qualifications, their annualised equivalent disposable incomes were also about 1.4 times higher. Thus, taking account of family circumstances markedly reduces the degree of relative inequality amongst women with different educational achievements but has little impact upon the relative disparity amongst men.

6.3 LIFETIME INCOME BY FAMILY STATUS

How does marriage affect the lifetime incomes of men and women ? How much does having children lower lifetime standards of living ? Such questions are of vital importance to policy-makers, as every budget they reconsider the level of cash transfers to families and of tax allowances provided to those with dependent spouses and children.

Lifetime Incomes of Women

To answer such questions women were divided into the following five groups:
- women who never married and never had children (6 per cent of the total);
- women who never married but had children (4 per cent);
- women who married at least once but never had children (5 per cent);
- women who married at least once and had one or two children (60 per cent);
- women who married at least once and had three or more children (25 per cent).

It should be recalled that 'marriage' was defined in the model to include those who lived in 'marriage-like' de-facto relationships so that, for example, the women who never married group comprises those who were never legally married and never lived in marriage-like common law relationships during their lifetimes.

Married and unmarried women who *never had children* have fairly similar lifetime labour force profiles; both groups average about 38 to 41 years of participation in the labour force, and work almost 1,800 hours a year on average during those years they do enter the labour force. Annualised lifetime earnings are consequently also similar, at over $10,000 per year (Table 6.5).

As one would expect, *women with children* spend less years in the labour force, fewer years working full-time full-year, and also work fewer hours when they do enter the labour force. The earned income of women with children, and particularly of women who were married and had three or more children, is correspondingly lower. A substantial part of the inequality of income apparent between women with different marital and child status is thus due to these different patterns of labour force participation, with the annualised earned incomes of married women with three or more children amounting to only 64 per cent of those of married women without children and 69 per cent of those of never married women without children.

The *investment income* of married women is significantly higher than that of never married women, reflecting the pooling of investments within marriage. *Superannuation* pension levels are, however, fairly similar, with the notable exception of never married women with children. Such women are less likely to benefit from occupational superannuation than never married women without children, while also being doubly disadvantaged because they do not pick up the pensions of deceased husbands, as do married women. Adding together these components of original income, married women who never had children emerge with the highest annualised original incomes of about $13,000 a year, trailed by never married women and then by ever married women with children. Married women who had three or more children have particularly low original incomes of just over $9000, some two-thirds of those received by married women without children (Figure 6.10).

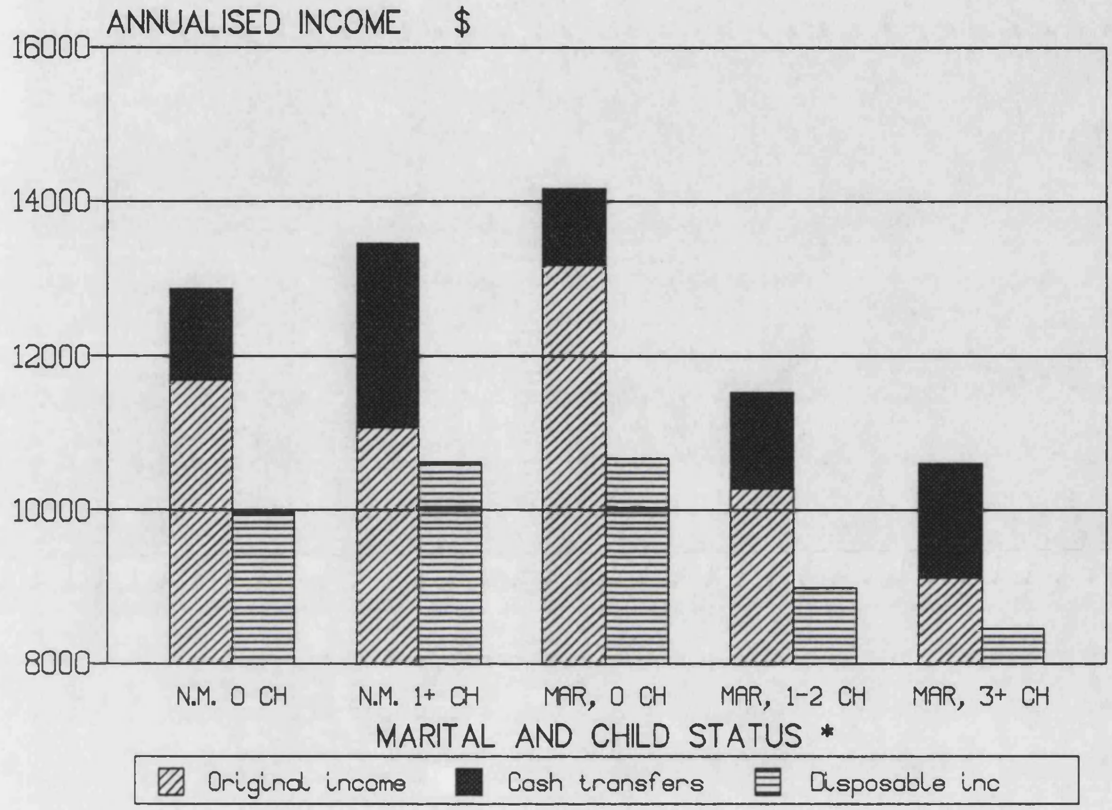
To what extent do the cash transfers for children and the various family-related income tax allowances offset these inequalities in original income ? *Never married women with children* receive about twice as much income from pensions and benefits as other women, principally because of the large amounts of sole parents pension received. All *never married* women receive higher annualised age pension than married women, presumably because the single pension rate is higher than half of the married pension rate. Women with children receive higher child transfers and, to a lesser extent, education transfers, via family allowance, FIS and SAS. However, such transfers do little to compensate for the lower earned incomes of women with children.

Table 6.5: Average Lifetime Income and Tax Measures for Women by Lifetime Family Status

Measure	Never Married		Ever Married		
	No child (n=117)	1+ child (n=70)	No child (n=107)	1-2 child (n=1189)	3+ child (n=505)
1. TOTAL LIFETIME MEASURES					
- earnings	607,665	564,730	680,300	503,885	431,905
- original income	715,215	661,735	842,935	649,415	577,500
- gross income	796,140	801,785	913,095	733.765	675,105
- income tax paid	179,120	169,605	224,110	161,980	137,135
- disposable income	617,020	632,185	678,985	571,780	537,965
- equivalent inc	1,028,520	1,241,280	1,241,280	1,161,695	1,069,165
2. ANNUALISED LIFETIME MEASURES (ie. divided by years of life - 15)					
- earnings	10,060	9,630	10,765	8,105	6,955
- investment	1,380	1,360	2,140	1,830	1,790
- superannuation	255	90	260	310	295
- maintenance	0	0	0	40	80
- TOTAL ORIGINAL	11,700	11,080	13,165	10,285	9,120
- sole parent pen	0	1,210	70*	245	245
- age/inv pension	1,015	905	815	810	810
- benefit	130	75	110	45	20
- TOTAL PENSION OR BENEFIT	1,145	2,195	995	1,100	1,080
- child transfers	0	110	1#	135	350
- education trans	15	40	15	30	45
- TOTAL GROSS	12,860	13,430	14,170	11,540	10,595
- income tax	2,890	2,810	3,500	2,565	2,160
- DISPOSABLE INC	9,965	10,615	10,680	8,980	8,440
- SHARED INC	9,965	10,615	10,965	10,750	10,575
- EQUIVALENT INC	16,610	15,315	19,250	18,320	16,755
- EQUIV INC(60:40 split)	16,610	15,315	18,045	15,905	14,440
3. AVERAGE MEASURES					
- years of life	76.6	74.6	80.3	79.0	78.9
- yrs labour force	37.9	35.8	40.7	34.2	31.6
- yrs any unemp exp'd	4.3	5.2	4.7	4.1	3.6
- yrs worked full-time, full-year	26.3	24.0	28.2	20.6	17.6
- hours in labour force during yrs in l.f.	1,769	1,722	1,790	1,644	1,561
- hours employed p.a.	1,697	1,633	1,706	1,564	1,484
- av. wage rate	$9.25	$9.40	$9.65	$9.00	$8.85

* Sole parent's pension comprises supporting parents benefit plus widow's pension, and a small number of married women without children receive Class B widow's pension, payable to widowed women aged at least 50 without children. All income figures rounded to nearest $5. Totals may not sum due to rounding.
# Although they have not had any children of their own, married women without children may marry male sole parents and thus receive child transfers in respect of their stepchildren.

Figure 6.10: Annualised Lifetime Original, Gross and Disposable Income of Women by Lifetime Family Status



* The categories are from left: never married women without children; never married women with children; ever married women without children; ever married women with one or two children; and ever married women with three or more children.
Gross income is shown in the first column, and equals original income plus cash transfers.

After payment of *income tax*, married women without children still have the highest annualised disposable incomes, but the combined impact of sole parent transfers and the sole parent rebate have resulted in a reversal of the relative positions of never married women, with never married women with children having higher annualised disposable incomes than their counterparts without children.

Lifetime Incomes of Men

Not suprisingly, marital status and the presence of children have a dramatically different effect on men's lifetime income profiles. In the model, all children were assumed to remain with the mother upon divorce, and this, allied with high divorce and remarriage rates, suggested that the number of children fathered was not the most appropriate indicator to capture the impact of children upon men's lifetime welfare. Instead, men were categorised by the number of years they spent in a family with one or more dependent children present. Men were thus divided into the following categories:

- never married men (15 per cent of the total);
- ever married men who spent 0 years in a family with dependent children (3 per cent);
- ever married men who spent 1 to 14 years with dependent children present (19 per cent);
- ever married men who spent 15 to 20 years with dependent children (28 per cent);
- ever married men who spent more than 20 years with dependent children (36 per cent).

Married men received annualised *earnings* which were about $2,000 higher each year than those of never married men, principally because of the higher hourly earnings of married men (Chapter 4), with all married men receiving annualised earnings of between $16,000 and $17,000. Married men who spent 15 years or more in households with dependent children spent marginally more years in the labour force, more years working full-time full year, and also averaged somewhat longer hours once in the labour force. *Superannuation and investment* income also showed little variation by marital and child status (Table 6.6).

Table 6.6: Average Lifetime Income and Tax Measures for Men by Lifetime Family Status

Measure	Never Married	Ever Married by No of Years Children Present			
		0	1 to 14	15 to 20	21 +
	(n=289)	(n=56)	(n=369)	(n=549)	(n=718)
1. TOTAL LIFETIME MEASURES					
- earnings	796,680	935,535	855,795	950,970	986,210
- original income	907,385	1,045,820	961,265	1,072,264	1,116,515
- gross income	953,385	1,084,630	1,000,790	1,112,920	1,160,045
- income tax paid	265,945	319,100	289,160	323,435	339,550
- disposable income	687,440	765,530	711,630	789,490	820,495
- equivalent inc	1,145,905	1,286,370	1,128,575	1,181,330	1,125,610
2. ANNUALISED LIFETIME MEASURES (ie. divided by years of life - 15)					
- earnings	14,360	16,340	16,125	16,230	16,680
- investment	1,380	1,260	1,425	1,480	1,605
- superannuation	415	530	370	480	470
- TOTAL ORIGINAL	16,150	18,130	17,920	18,190	18,755
- pension	565	450	470	470	490
- benefit	140	135	130	130	140
- TOTAL PENSION OR BENEFIT	710	585	605	600	630
- child transfers	0	0	0	5	10
- education transfers	25	20	20	25	25
- TOTAL GROSS	16,885	18,730	18,545	18,815	19,420
- income tax	4,660	5,615	5,425	5,470	5,690
- DISPOSABLE INC	12,225	13,120	13,120	13,340	13,725
- SHARED INC	12,225	12,440	11,835	11,340	11,165
- EQUIVALENT INC	20,380	21,910	20,470	19,840	18,710
- EQUIV INC (60:40)	20,380	20,320	22,320	22.685	21,685
3. AVERAGE MEASURES					
- years of life	70.6	74.4	70.5	74.8	75.5
- yrs labour force	41.9	44.2	41.5	44.4	45.0
- yrs any unemployment experienced	4.0	3.8	3.7	4.5	4.4
- yrs worked full-time, full-year	33.6	34.6	33.6	36.2	36.2
- hours in labour force during yrs in l.f.	1,997	1,990	2,013	2,036	2,029
- hours employed p.a.	1,927	1,931	1,953	1,969	1,963
- av. wage rate	$9.65	$11.15	$10.65	$10.90	$11.20

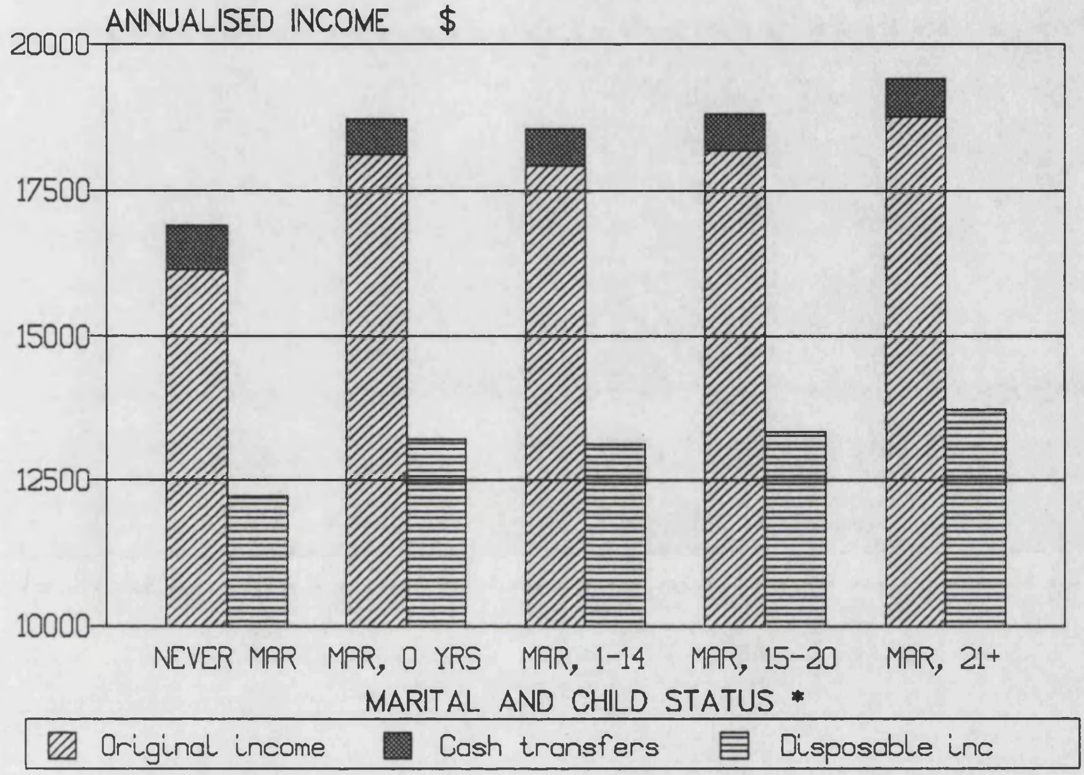
All income figures rounded to nearest $5. Totals may not sum due to rounding.

In comparison to the situation for women, marital and child status thus had little impact upon the annualised *original* incomes of men. After ranking the various groups by their personal annualised original incomes, the original income of the top ranking female group of married women who never had children was 44 per cent higher than that of the bottom ranking group of married women with three or more children. The annualised original income of the top ranking group of men who spent more than 20 years in families with dependent children was only 16 per cent higher than that of the bottom group of men who never married. In stark contrast to the pattern for women, the personal incomes of men tended to increase with greater exposure to children, while those of women decreased.

Cash transfers were of much less importance to the incomes of men (Figure 6.11). There was little difference for men in social security cash transfers receipt by marital or child status, although unmarried men received marginally more age pension because of the higher payment to single pensioners. Men received lower average age pensions than women, because of their shorter lifespans. The major importance of the social security system to women was again emphasised as, despite unemployment and sickness benefit being payable to the male in married couples, cash transfers received by men were about half those paid to women.

While the annualised gross incomes of unmarried men were some $2000 lower than those of married men, after allowing for the payment of income tax this difference had been halved. Ever married men who spent more than 20 years in families with dependent children had the highest annualised disposable incomes, some 12 per cent higher than those of never married men, who received the lowest place. Again, the degree of dispersion of annualised disposable incomes by marital and child status was lower than that for women, as married women with no children received annualised disposable incomes some 27 per cent higher than those of married women with three or more children.

Figure 6.11: Annualised Lifetime Original, Gross and Disposable Incomes of Men by Lifetime Family Status

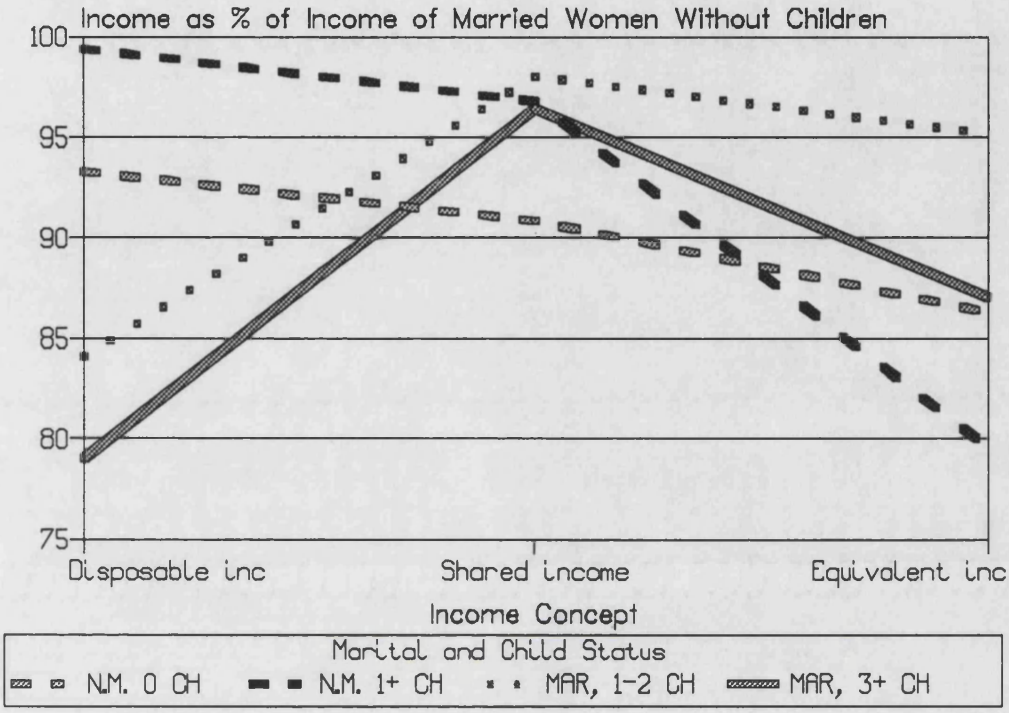


* The categories are from left: never married; ever married with no dependent children; ever married with 1 to 14 years spent in a family with dependent children present; ever married with 15 to 20 years spent with dependent children and ever married with 21 or more years with dependent children present.

Taking Account of Family Circumstances

The picture changes dramatically, however, once account is taken of family circumstances. *Ever married women without children* enjoyed the highest incomes, both when personal annualised disposable income was used as the yardstick and when the income measure was broadened to take account of income sharing between couples or extended again to take account of dependent children and economies of scale. The relative rankings of other women changed greatly, however, once family circumstances were taken into account, as summarised in Figure 6.12.

Figure 6.12: Annualised Lifetime Disposable, Shared and Equivalent Incomes of Women as a Percentage of the Incomes of Ever Married Women Without Children



Note: The legend categories are from left: never married wtihout children; never married with children; ever married with one or two children and ever married with three or more children.

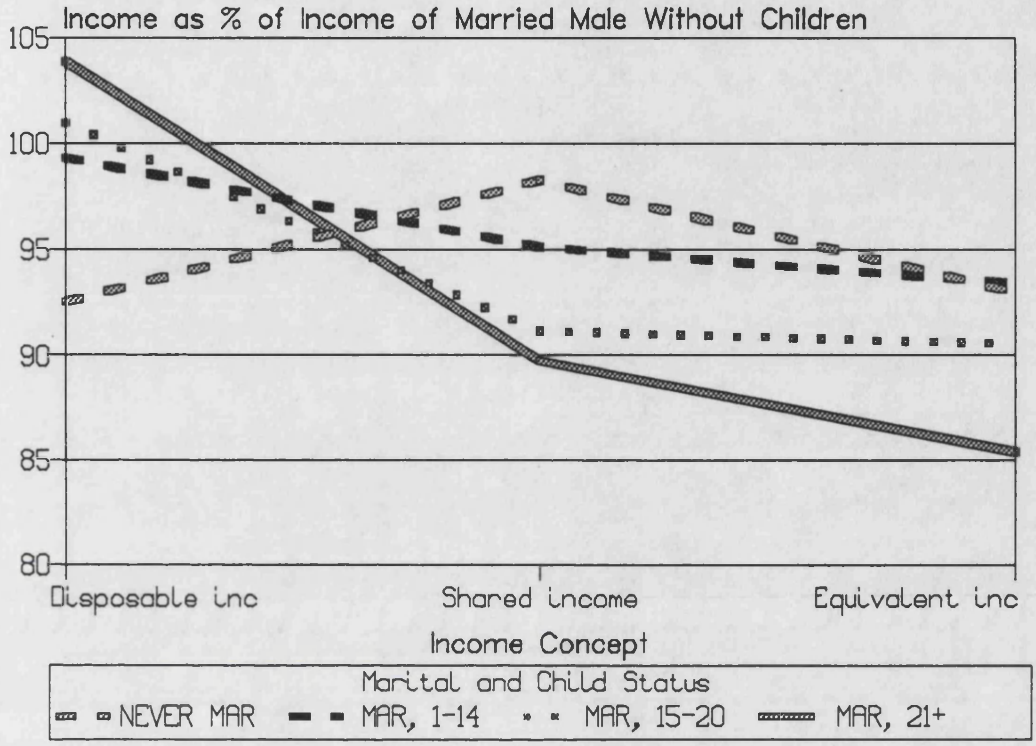
While *never married women with children* occupied second place in the income distribution ladder when annualised disposable income was considered, their relative position slipped when shared disposable income was used (as they had no other adult whose income they could share in) and dropped sharply when equivalent income was used. Thus, once their sole support of their children was taken into account, never married women with children suffered the lowest lifetime standard of living of any of the groups considered, with an annualised equivalent income which was only 80 per cent of that enjoyed by married women without children. Never married women *without children* also fared poorly, once their lack of access to the higher income of a husband was recognised, with their equivalent annualised income amounting to just over 85 per cent of that of married women without children.

Conversely, the low personal incomes of *married women with children* were partly offset by their presumed sharing in the incomes of their husbands, so that their shared disposable incomes were substantially higher than their personal disposable incomes. However, once the additional children whom this income had to support were considered, their position deteriorated, although for those with only one or two children the decline was not as marked. In contrast, the annualised equivalent incomes of ever married women with three or more children were only slightly higher than those of never married women without children and were only some 87 per cent of the equivalent incomes achieved by married women without children.

The relative positions of men also changed greatly once the impact of family circumstances was incorporated. While married men who spend more than 20 years in a family with dependent children had the highest annualised disposable incomes, their standard of living dropped precipitously once their dependents were considered, so that both their shared and equivalent incomes were lower than any of the other categories of men (Figure 6.13). Ultimately, their annualised equivalent incomes reached only 85 per cent of those enjoyed by ever married men without children. The relative position of ever married men who spend 15 to 20 years in a family with dependent children also declined, although not as sharply, with their annualised equivalent incomes amounting to just over 90 per cent of those won by ever married males without children.

The equivalent incomes of never married men and married men who spent one to 14 years in a family with dependent children were similar, averaging some 93 per cent of the incomes of their married counterparts without children. This suggests that the adverse effect of having to share income with a spouse was therefore more than offset for married men without children by the income of that spouse. In addition, it

Figure 6.13: Annualised Lifetime Disposable, Shared and Equivalent Incomes of Men as a Percentage of the Incomes of Ever Married Men Without Children



Note: The legend categories are from left: never married; married with 1 to 14 yrs with dependent children; ever married with 15 to 20 yrs with children and ever married with more than 20 yrs with children.

should be emphasised that the groups do not have the same characteristics, so that the males within each family group differ by more than just their family status.

6.4 LIFETIME INCOME BY UNEMPLOYMENT STATUS

In the model, the number of years in which more than one hour of unemployment was experienced was recorded, and all cohort members can thus be categorised by the number of years during their lifetimes when they experienced any unemployment.

Males

As Table 6.8 demonstrates, there were not marked differences in the number of *lifetime hours spent in the labour force* for men with different unemployment experiences. There were, however, major differences in the percentage of those hours spent unemployed rather than employed. For example, for men who experienced unemployment in more than 10 years of their lives, almost 10,000 hours were spent unemployed, compared to some 2000 hours for those who experienced unemployment in only one to five years of their lives. As a result, annualised earnings declined with increasing years of unemployment, from around $18,600 during each year of adult life for those males who never experienced any unemployment, to only $13,000 for those males who experienced any unemployment in more than 10 years.

Figure 6.14 shows the annualised original, gross and disposable incomes of males ranked by years of unemployment experienced. The amount of unemployment and sickness benefit received increased for males with greater years of unemployment, from $95 on average during each year of adult life for those with between one and five years of unemployment to $390 per year for those with more than 10 years of unemployment. Unemployment benefit in Australia does not approach earnings replacement rates, so that such benefits did relatively little to counteract the lower original incomes of the chronically unemployed. Consequently, while the annualised original incomes of men who never experienced any unemployment were 1.53 times greater than those of men who experienced unemployment in more than 10 years of their lives, their annualised gross incomes were still 1.47 times greater. The cash transfer system thus did relatively little to offset the disadvantage experienced by the chronically unemployed.

The income tax system had a greater impact in equalising the incomes of those with different unemployment characteristics, as Figure 6.15 also illustrates. While the gross incomes of those who experienced unemployment in more than 10 years of their

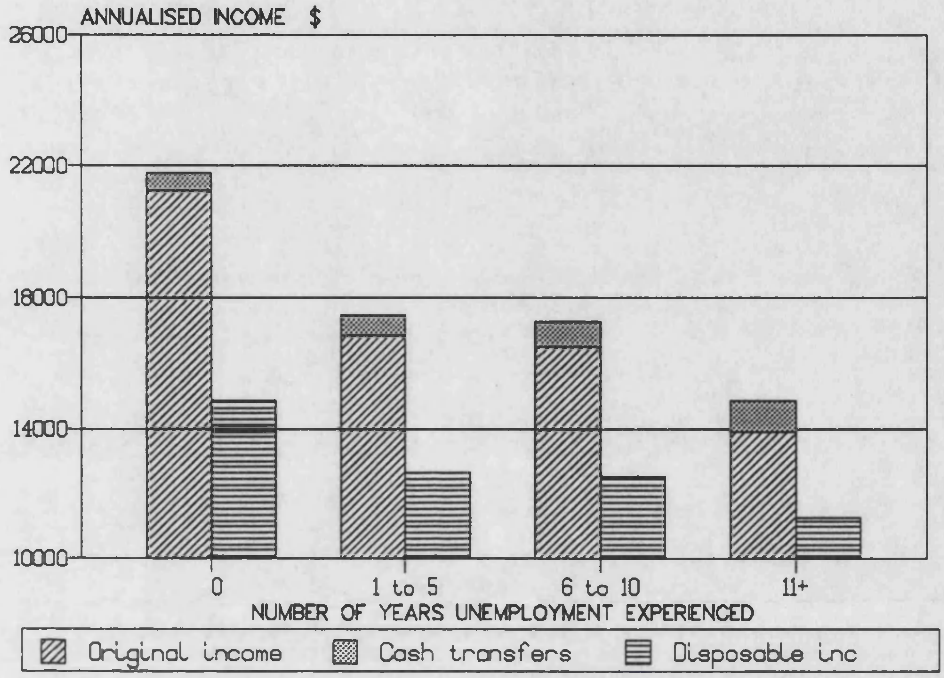
Table 6.7: Average Lifetime Income and Tax Measures by Lifetime Unemployment Status for Males

Measure	No. of Years in Which Any Hours of Unemployment Experienced			
	0 (n=723)	1 to 5 (n=636)	6 to 10 (n=391)	11+ (n=231)
1. TOTAL LIFETIME MEASURES				
- total earnings	1,064,855	857,710	881,445	746,605
- ORIGINAL INCOME	1,233,065	956,445	981,460	808,790
- GROSS INCOME	1,268,370	996,115	1,030,330	868,580
- DISPOSABLE INCOME	865,285	722,485	747,600	659,990
- EQUIVALENT INCOME	1,258,695	1,088,380	1,126,585	1,020,815
- Hours in labour force	87,765	87,570	91,300	89,685
- Hours unemployed	0	1,995	5,100	9,870
2. ANNUALISED LIFETIME MEASURES (i.e. divided by years of life - 15)				
- Earnings	18,560	15,220	14,915	12,885
- ORIGINAL INCOME	21,260	16,850	16,525	13,900
- Benefit	0	95	215	390
- Total Cash Transfers	525	620	765	955
- GROSS INCOME	21,785	17,470	17,290	14,855
- Income Tax Paid	6,930	4,810	4,750	3,585
- DISPOSABLE INCOME	14,855	12,660	12,540	11,270
- Shared family income	12,625	11,085	11,000	10,200
- EQUIVALENT INCOME	21,520	18,930	18,815	17,390
- Equiv. income (60:40 split)	23,935	21,135	21,005	19,530
3. AVERAGE MEASURES				
- Years of life	73.7	72.5	75.1	74.3
- Av. years in labour force	43.5	43.1	44.8	44.9
- Av. years any unemp. experienced (>1 hr per yr)	0	3.1	7.7	14.7
- Av. hrs. in labour force during yrs. in lab. force	2015	2030	2035	2000
- Av. hrs. employed per year employed	2015	1978	1920	1775
- Average lifetime hourly wage rate	$12.15	$10.05	$10.25	$9.40

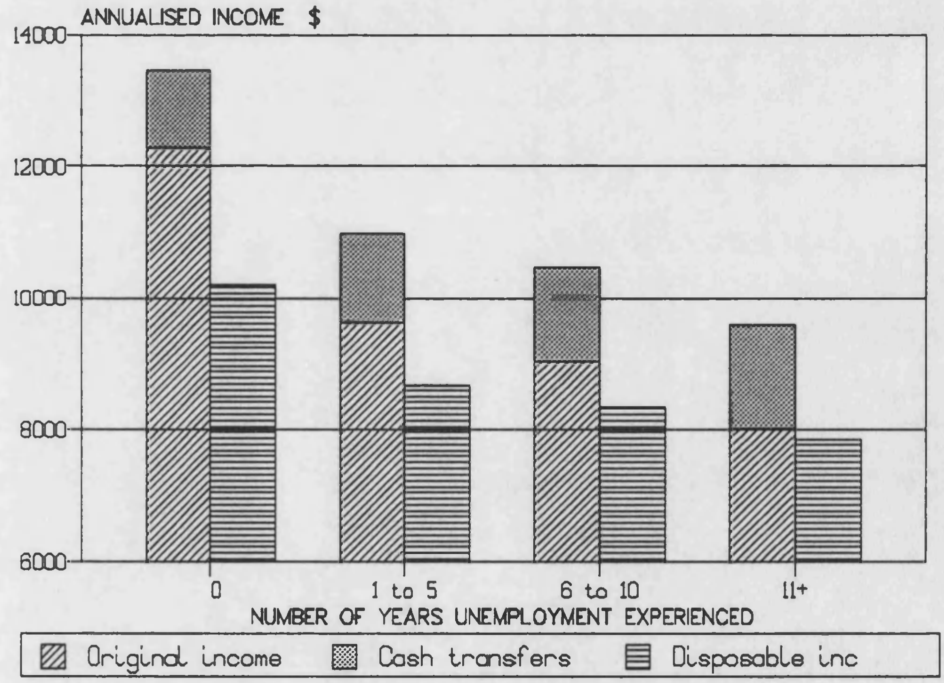
All income figures rounded to nearest $5. Totals may not sum due to rounding.

Figure 6.14: Comparison of Annualised Lifetime Original, Gross and Disposable Incomes by Sex and Lifetime Unemployment Status

MALES



FEMALES



lives were less than 70 per cent of those who were never unemployed, their disposable incomes were about 76 per cent of those of the never unemployed. Once account was taken of income sharing within families, the living standards of males showed less variation by unemployment status, with the annualised equivalent incomes of the chronically unemployed amounting to slightly more than 80 per cent of those of never unemployed males.

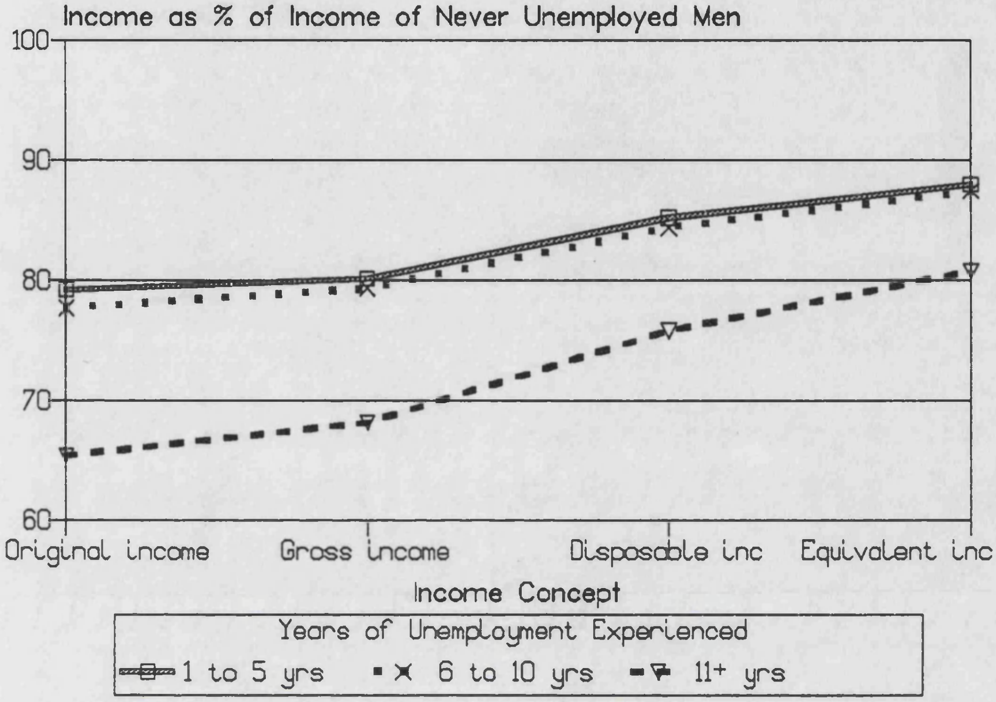
The relatively minor differences between the incomes of those males who experienced between one and five years of unemployment and those who experienced unemployment in six to 10 years of their lives are surprising, and appear to be due to stochastic factors. Those in the six to 10 years of unemployment category had slightly higher hourly wage rates than those in the one to five years category, and also spent slightly more hours in the labour force; these differences were sufficient to almost offset the negative financial impact of the additional hours they spent with low incomes while unemployed. This emphasises again that those in each unemployment category are not matched samples who only differ in the number of years they experience unemployment; those in each group also differ in many other respects, such as the number of years they survive and in their educational status.

Females

For women, additional years of unemployment were also associated with lower earnings and lower original incomes (Table 6.9). Although women received higher cash transfers than men, this was due to their higher receipt of pensions and child transfers rather than benefits. The average amount of unemployment and sickness benefit received by women was lower than that for men, with those who experienced unemployment in more than 10 years during their working lives receiving only $140 on average during each year of adult life in benefit, compared to the $390 received by men in the same unemployment status category. This was partly due to unemployment benefit being paid to the male in married couples and partly due to

Figure 6.15: Annualised Lifetime Original, Gross, Disposable and Equivalent Incomes by Unemployment Status as a Percentage of the Incomes of the Never Unemployed by Sex

MALES



FEMALES

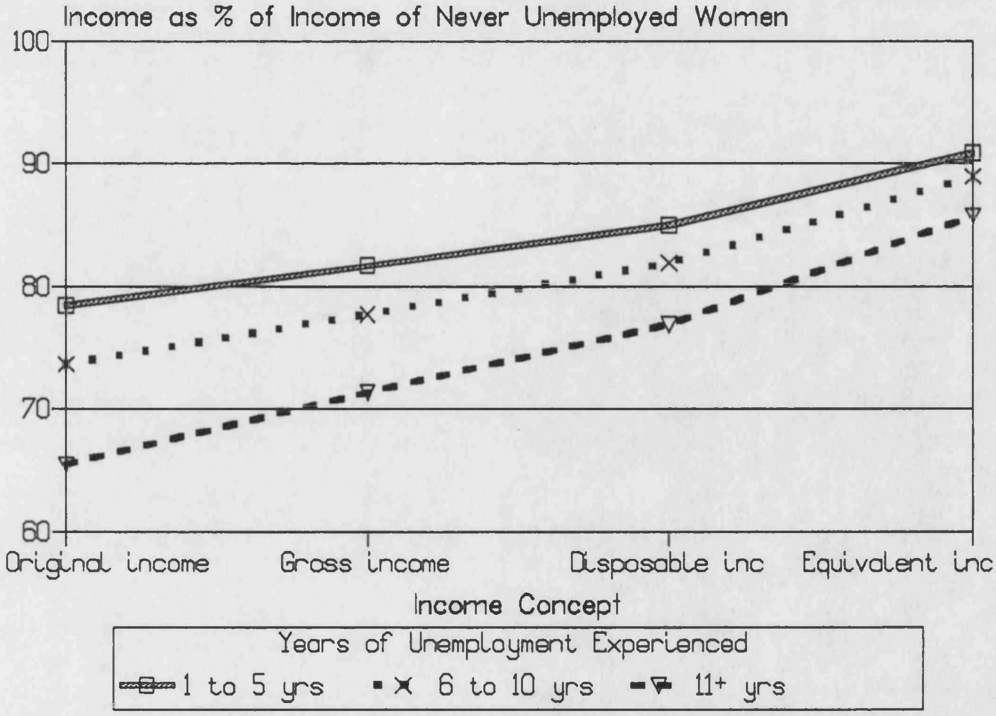


Table 6.8: Average Lifetime Income and Tax Measures by Lifetime Unemployment Status for Females

Measure	No. of Years in Which Any Hours of Unemployment Experienced			
	0 (n=678)	1 to 5 (n=687)	6 to 10 (n=446)	11+ (n=177)
1. TOTAL LIFETIME MEASURES				
- total earnings	594,705	470,780	452,465	407,990
- ORIGINAL INCOME	769,700	603,765	576,800	509,010
- GROSS INCOME	848,345	693,830	672,045	614,540
- DISPOSABLE INCOME	643,600	547,740	537,860	503,620
- EQUIVALENT INCOME	1,197,990	1,096,995	1,089,635	1,054,735
- Hours in labour force	57,825	55,300	57,913	60,450
- Hours unemployed	0	1,955	4,680	8,475
2. ANNUALISED LIFETIME MEASURES (i.e. divided by years of life - 15)				
- Earnings	9,665	7,625	7,210	6,495
- ORIGINAL INCOME	12,270	9,625	9,040	8,035
- Benefits	0	30	80	140
- Total Cash Transfers	1,185	1,365	1,420	1,565
- GROSS INCOME	13,455	10,990	10,460	9,605
- Income tax paid	3,250	2,320	2,105	1,760
- DISPOSABLE INCOME	10,200	8,670	8,355	7,845
- Shared Family Income	11,425	10,460	10,170	9,800
- EQUIVALENT INCOME	19,085	17,340	16,970	16,365
- Equiv. income (60:40 split)	16,810	15,225	16,975	14,410
3. AVERAGE MEASURES				
- Years of life	78.0	78.5	79.7	80.1
- Average years in labour force	34.6	33.2	34.6	35.8
- Av years any unemp. experienced (> 1 hr per yr)	0	3.2	7.6	14.1
- Average hrs in labour force during years in labour force	1640	1630	1650	1670
- Av hrs employed per year employed	1640	1565	1500	1425
- Average lifetime hourly wage rate	$10.15	$ 8.70	$ 8.35	$7.85

All income figures rounded to nearest $5. Totals may not sum due to rounding.

more women being barred from receipt of unemployment benefit by the income of their spouse.

As Figure 6.14 makes clear, although women who experienced more years of unemployment did receive slightly higher cash transfers, this was not sufficient to offset their lower original incomes, so that annualised gross income declined sharply by unemployment status. (Although, again, it must be emphasised that the never unemployed group were better educated than those who experienced unemployment, and their resultant higher hourly wage rates also contributed to their higher gross incomes.)

As Figure 6.15 illustrates, both cash transfers and income taxes reduced the disparities apparent amongst women with different unemployment histories, with the *annualised disposable* incomes of women who experienced any unemployment in more than 10 of their working years amounting to about 77 per cent of those received by never unemployed women during each year of adult life. The inequalities apparent between women by unemployment status were again reduced once account was taken of income sharing within the family, with the annualised equivalent incomes of women in the 10 or more years category comprising more than 85 per cent of those of women who never experienced any unemployment.

6.5 CONCLUSION

There are major differences in lifetime income by educational qualification, with males with degrees earning about 1.83 times as much during their entire lifetimes as males without any tertiary qualifications and female graduates earning 2.34 times as much as females without any tertiary qualifications. These differences are reduced somewhat when the longer lifespans of the better educated are considered, with the annualised earnings of male and female graduates amounting to 1.76 and 2.18 times the incomes of males and females without tertiary qualifications respectively.

Because the less well educated tend to spend less years in the labour force and work fewer hours when in the labour force than the better educated, these remaining disparities are due in part to differential labour force participation patterns. While it is not clear that the greater hours of leisure experienced by the less well educated should be regarded as a voluntary choice, an attempt was made to standardise labour force participation rates, so that at least the relative magnitude of this effect could be better assessed. While the adjustment can only be regarded as very approximate, the imputed pre-tax total lifetime earnings of male graduates after standardising for different labour force participation patterns were about 1.53 times higher than those of males with no tertiary qualifications, while the relevant figure for females was about 1.36. The enormous difference to the apparent relative advantage of female graduates caused by standardising labour force participation patterns suggested that studies which did not account for this in calculating rates of return were likely to be highly misleading.

Lifetime income and welfare also varied greatly by family status. While women with children generally had lower earned, original, gross and disposable incomes than those without children, relative rankings changed once account was taken of family circumstances. Sole parents who never married had the lowest lifetime standard of living, followed by never married women without children. While all married women enjoyed higher equivalent incomes on average than never married women, standards of living declined with increasing numbers of children. Ever married women without children had the highest equivalent income, while ever married women with three or more children had the lowest equivalent incomes among married women, and were only slightly better off than never married women without children.

The personal original incomes of men showed relatively little variation by marital and child status but, after incorporating the effect of family circumstances, the equivalent incomes of married men declined with increasing years spent in a family with dependent children. Men who never married were not, however, as relatively disadvantaged as women who never married, as their annualised equivalent incomes exceeded those of ever married males who spent more than 14 years in a family with dependent children. For both men and women, the highest lifetime standards of living were achieved by marrying but not having children.

Finally, lifetime welfare was also adversely affected by repeated experiences of unemployment with, for example, the annualised disposable incomes of males who experienced any unemployment in 11 or more years during their lifetimes amounting to only 76 per cent of those of males who experienced no unemployment.

This chapter has ranked individuals by various lifetime *characteristics* and examined the differences in their income and lifetime standard of living. In the following chapter another tack is taken, with individuals being ranked by their lifetime *income*, and the characteristics and differing fortunes of those with high and low lifetime incomes then being analysed.

CHAPTER 7: THE DISTRIBUTION OF LIFETIME INCOME

7.1 INTRODUCTION

While in Chapter 6 those with varying lifetime experiences were identified and their lifetime incomes were analysed, this chapter reports the results when individuals are ranked by the amount of equivalent income they receive during their lifetimes, and the differing characteristics of those with high and low lifetime standards of living are examined. While any of the various lifetime income and tax measures available in the model could be used to rank individuals, equivalent income has been selected as the measure which best encapsulates lifetime welfare.

If equivalent lifetime income was not used to rank individuals then, for example, a never married male with a lifetime income of half a million dollars would be regarded as having achieved the same lifetime standard of living as another male with the same total lifetime income who for 20 years supported a non-working spouse and four children. Thus, the use of equivalent income to try to improve comparisons of welfare is now widely accepted and, for example, is endorsed by the British Central Statistical Office, who now rank all households by equivalent income in their yearly analyses of fiscal incidence in the UK (CSO,1990).

It should be appreciated, however, that no equivalence scale can capture fully the differences in the needs of various types of income units due to their differing circumstances. Most equivalence scales do not, for example, allow for the possible differences in income required by families with severely disabled members. There is also extensive debate about whether equivalence scales applicable to low income families are equally applicable to high income families and about how to measure accurately the differences in income required by those in different circumstances (Whiteford,1985). Despite these problems, equivalent income is now widely used in cross-sectional income distribution studies to rank different types of income units (eg. Kakwani, 1986; O'Higgins et al, 1981, 1988). The alternative of assuming that those with the same monetary income but very different needs have the same standard of living is seen as even more unacceptable.

As discussed in Chapter 5, it is also not immediately obvious how to make sense of lifetime income measures. If the income received by an individual in every year of life is summed, and the population is then divided into deciles of total lifetime income, many of those in the lowest income decile will simply be those who died at a younger age. Their lower lifetime incomes will thus reflect the reduced number of years in which they earned income, rather than necessarily pointing to a low lifetime standard of living. Measures of tax and transfer incidence will be similarly distorted as, for example, those who died early will have received no age pension, and the transfer system might therefore falsely appear to be regressive.

To circumvent these problems, the incomes received by the cohort in every year of life were summed and then *annualised* lifetime income measures were derived, as discussed earlier, by dividing the various lifetime totals by years of life minus 15. However, when the cohort were ranked by their annualised lifetime equivalent incomes, those with higher annualised incomes tended to be those who died at an earlier age (although the trend was not very marked for men). Because those who died soon after retirement did not experience a substantial number of years of low post-retirement income, those with higher annualised lifetime incomes tended to be those who died while still comparatively young and, conversely, those with lower annualised lifetime incomes tended to be those whose lifetime original incomes were spread over more years because they died at a later age. This trend is illustrated in Tables 7.1 to 7.4 where, particularly for women, higher annualised incomes are associated with shorter lifespans.

This effect could be a result of using the government-endorsed equivalence scale implicit in the Australian social security system in 1990. As the social security system does not assume that needs decrease with age (and thus, for example, a single invalid pensioner aged 40 is paid the same rate as a single age pensioner aged 70), the equivalence scale derived from it does not differentiate by age. Similarly, the costs of work (eg. travel, clothing) are not explicitly incorporated into rates of payment made under the social security system so that, even though the income test might differ by source of income, an equivalence scale derived from the social security rate structure does not differentiate by labour force status.

There is no universally accepted up-to-date equivalence scale for Australia which takes account of the number and age of children, the number and age of adults, and the labour force status of all adults in the income unit. However, the standard costs scales developed by Henderson in the 1970s, based upon 1954 New York expenditure data, have been widely used in the past in Australia (1975). Although it is not clear how relevant these scales are to Australia in the 1990s, the scales can nonetheless be used to construct an equivalence scale which incorporates differences in costs by age and labour force status (although many would question the desirability of an equivalence scale which assumed that elderly people had fewer needs than younger people simply because of their age).

Consequently, tests were carried out to examine the effects of using a significantly different equivalence scale upon the results, and to see whether the use of the Henderson scales would eliminate the phenomenon of lower lifespans being correlated with higher annualised equivalent income. In the event, the scales introduced the reverse phenomenon of *increases* in lifespan for women being associated with higher equivalent income. Consequently, in all of the following analysis the equivalence scale used is that implicit in the 1990 social security system. This equivalence scale is very similar to the DHSS equivalence scale used by the British Central Statistical Office to rank families (CSO,1990), and further sensitivity analysis using this DHSS scale therefore produced results very similar to those using the Australian social security scale. While sensitivity analysis conducted in fiscal incidence studies by Kakwani (1986) and the British CSO

(1987) suggested that it was the *use* of an equivalence scale which profoundly affected the results rather than the *precise scale* used, this result has been disputed by Buhman et al (1988), and it should therefore be recognised that use of a markedly different equivalence scale might appreciably change the results.

Sections 7.2 and 7.3 describe the patterns of income distribution and redistribution found when first males and then females are divided into deciles of *annualised lifetime equivalent income.* Section 7.4 broadens the analysis to take account of presumed income sharing within the family unit, and discusses how the marked differences between the personal incomes of men and women are attenuated once family circumstances are considered. Section 7.5 briefly discusses the lifetime income distribution for the cohort as a whole.

7.2 THE LIFETIME INCOME DISTRIBUTION OF MALES

As one might expect, higher lifetime *original* (ie. pre-tax, pre-transfer) incomes are the product of higher earnings, greater investment income and increased access to occupational superannuation, with investment income being much more unequally distributed across income deciles than earnings, and the distribution of superannuation income being highly skewed towards those in the top three deciles of lifetime income (Table 7.1).

These trends are reflected in Figure 7.1, which shows the composition of *annualised lifetime gross* income by quintile groups, ranked by annualised lifetime equivalent income. For the bottom 20 per cent of males, cash transfers contribute an average 10 per cent of gross income during each year of adult life, and earnings almost all of the remainder. For the top quintile, earnings are relatively less important, cash transfers almost non-existent, and investment income and superannuation together make up almost 20 per cent of annualised gross income.

Table 7.1: Annualised Lifetime Income Characteristics of Decile Groups of Men, Ranked by Deciles of Annualised Lifetime Equivalent Disposable Income

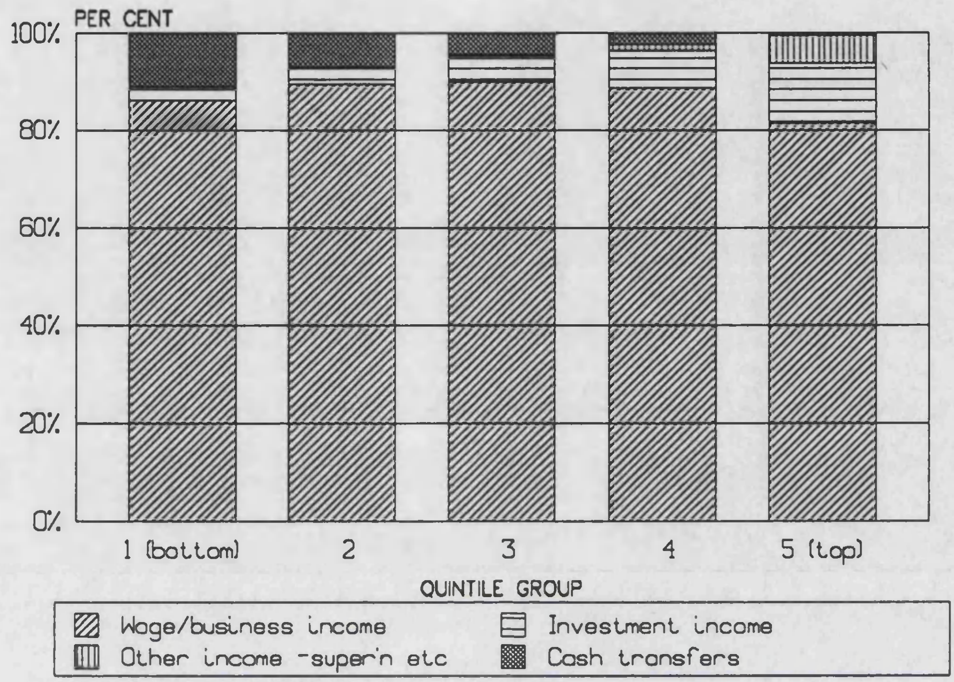
MEASURE	DECILE OF ANNUALISED LIFETIME EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	6,840	8,890	10,940	12,385	13,715	15,445	16,945	19,580	23,430	32,785	16,105
Investment income	200	300	445	470	650	1,050	1,180	2,020	2,885	5,740	1,495
Superannuation	0	5	0	5	30	80	125	375	1,115	2,745	450
ORIGINAL INCOME	7,040	9,200	11,385	12,860	14,400	16,575	18,250	21,975	27,435	41,270	18,050
Invalid pension	45	40	25	15	5	10	5	15	5	5	15
Age pension	665	785	750	680	570	470	420	250	115	25	475
Unemployment and other benefits	230	185	140	145	140	140	120	110	95	50	135
Education transfers	45	35	30	25	25	25	30	30	20	15	20
TOTAL CASH TRANSFERS*	985	1,040	945	860	740	650	575	405	235	100	655
GROSS INCOME	8,025	10,240	12,335	13,720	15,140	17,220	18,825	22,380	27,675	41,370	18,705
Income tax paid	1,110	1,745	2,400	3,005	3,595	4,375	5,130	6,690	9,300	16,890	5,430
DISPOSABLE INCOME	6,915	8,495	9,935	10,720	11,545	12,845	13,695	15,690	18,375	24,480	13,275
Shared disposable income (family unit)	5,985	7,550	8,595	9,500	10,320	11,220	12,225	13,565	15,525	20,740	11,525
Equivalent disposable income (family unit)	10,050	12,795	14,530	16,140	17,600	19,115	20,905	23,265	26,750	35,505	19,675
Equiv income - 60:40 split within couples	11,205	14,290	16,340	18,075	19,970	21,425	23,420	25,940	29,945	38,745	21,945
Lifetime education services income #	38,610	36,960	39,320	40,660	42,745	41,585	40,290	42,740	43,105	44,895	41,360

* Includes small amount of child transfers (family allowance and sole parents pension for male sole parents). # This is the total amount of education services income received during the entire lifetime (ie. it has not been annualised). All income figures rounded to nearest $5. Totals may not sum due to rounding.

Table 7.2: Other Characteristics of Decile Groups of Men, Ranked by Deciles of Annualised Lifetime Equivalent Disposable Income

MEASURE	DECILE OF ANNUALISED LIFETIME EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
1. LABOUR FORCE CHARACTERTISTICS											
Av years in labour force (gt one hr per yr)	39.7	43.4	42.9	43.8	44.4	44.7	44.6	44.0	45.0	45.2	43.8
Av years any unemployment experienced (> 1 hr per yr)	5.5	5.1	4.0	4.4	4.9	4.5	4.0	3.8	3.7	2.1	4.2
Av years worked full-time full year	31.3	34.2	34.6	35.5	35.8	36.2	36.4	36.3	36.6	36.5	35.3
Av years of self-employment	13.6	11.8	9.3	8.6	8.8	8.6	8.2	7.2	8.4	10.2	9.5
Total hours in l.f. during lifetime	80743	86931	86679	88674	90084	90680	90589	89391	91255	91198	88624
Av hours in labour force during yrs in labour force	1996	1999	2018	2030	2030	2034	2030	2031	2032	2025	2022
Average hours in employment per yr in l.f.	1897	1918	1953	1961	1955	1968	1969	1972	1977	1995	1957
Average hours of unemployment per yr in l.f.	99	81	65	69	75	66	61	69	55	30	65
Average hourly wage rate	$5.28	$6.66	$7.61	$8.79	$9.43	$10.24	$11.24	$12.68	$15.10	$20.77	$10.78
2. MARITAL AND CHILD STATUS											
Per cent ever married	81	88	86	85	90	86	87	84	89	78	85
Per cent ever divorced	22	33	27	29	29	26	33	31	33	32	29
Av no years with dependent children present	15.7	16.8	16.9	16.8	17.8	16.2	15.9	15.0	15.8	12.8	16.0
Average years married for ever married	40	40	40	41	42	39	39	38	38	34	39
3. EDUCATION											
Av years of education	13.5	13.7	13.6	13.9	14.2	14.1	13.9	14.2	14.2	14.7	14.0
Av no of years attended govt schools	9.4	9.5	9.1	9.1	9.1	8.2	8.4	8.8	9.8	8.1	8.9
Av no of years attended private schools	2.7	2.6	2.8	2.9	2.9	3.8	3.5	3.4	2.3	4.2	3.1
Av years tertiary education	2.5	2.7	2.8	2.9	3.1	3.1	2.9	3.1	3.1	3.4	3.0
Per cent with degree	9.10	9.6	12.1	17.2	19.7	19.2	18.2	23.7	25.3	33.7	18.8
Average years of life	71.6	76.9	74.2	75.7	74.8	73.8	73.5	71.5	72.5	72.5	73.7

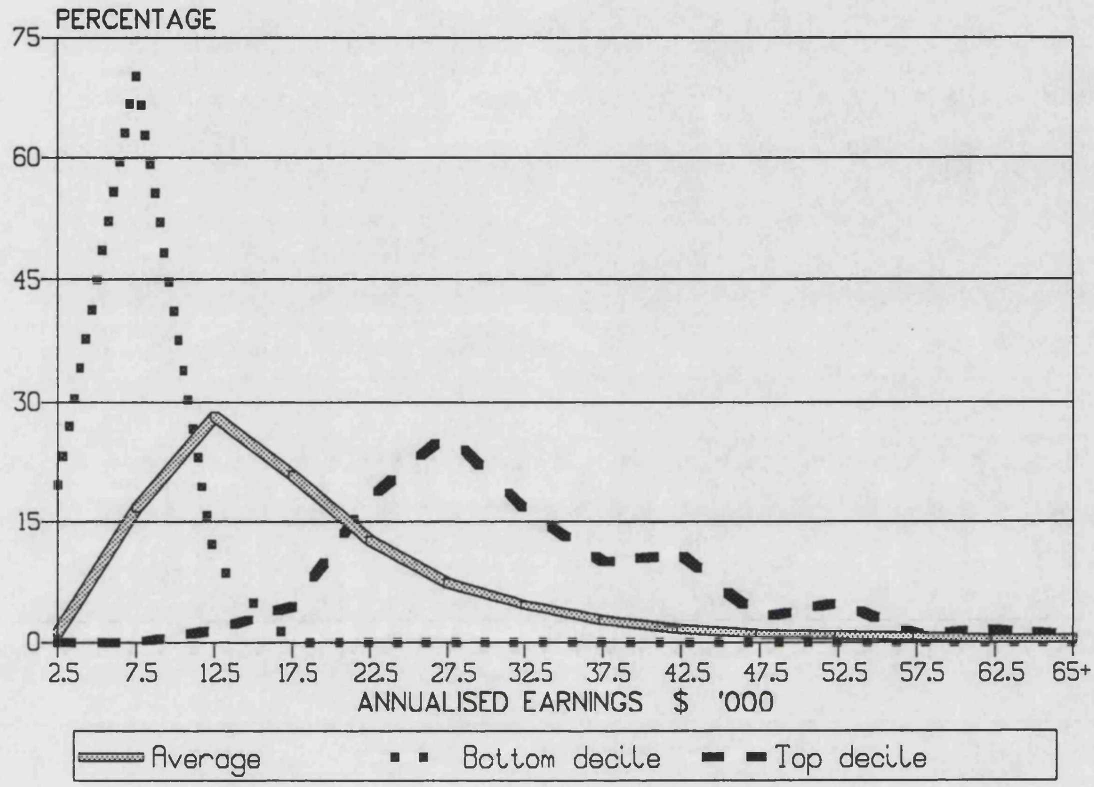
Figure 7.1: Sources of Annualised Lifetime Gross Income for Men, Ranked by Quintile Groups of Annualised Lifetime Equivalent Disposable Income



Those males who received sufficient income to place them in the top 10 per cent of the distribution received on average about $32,800 in earnings every year, around $5,700 in investment income and about $2750 in superannuation payments, resulting in an annualised *original* income of almost $41,300 (Table 7.1). In contrast, those males who were placed in the bottom 10 per cent of the income distribution averaged only $6850 of earnings, about $200 of investment income and no occupational superannuation, leading to a total original income of some $7,000.

The dispersion of earnings for males is shown in Figure 7.2, with just under 30 per cent of all males receiving annualised earnings between $10,000 and $15,000 (the midpoints of the various earnings ranges are shown on the vertical axis). Some 70 per cent of all males in the *bottom decile* received annualised earnings of between $5,000 and $10,000 during each year of adult life, and only 10 per cent received more than $10,000. In contrast, about one-quarter of males in the *top*

Figure 7.2: Frequency Distribution of Annualised Earnings for Males



decile of annualised equivalent income received annualised earnings of between $25,000 and $30,000, and almost 10 per cent received more than $50,000 a year.

As Table 7.2 shows, the higher earned incomes of those in the top half of the income distribution were due in part to their higher hourly wage rate, with the average hourly lifetime wage rate of $20.75 received by the top decile being almost four times higher than the $5.30 averaged by males in the bottom decile. However, those in higher income deciles also spent substantially more years in the labour force and, when in the labour force, spent significantly more hours in employment and fewer hours unemployed. For example, those in the top decile averaged 45.2 years in the labour force and 1995 hours of employment during each of those years, while those in the bottom decile averaged only 39.7 years in the labour force and 1895 hours of employment per year during those years.

The higher average wage rates received by those at the top of the income distribution were associated with more years of education and, in particular, with the attainment of a degree. Of all those who gained a degree during their lifetimes, only 26 per cent received incomes which placed them in the bottom four income deciles, while 44 per cent were in the top three deciles and almost 20 per cent in the top decile. For those who achieved only secondary school qualifications, only 3 per cent reached the top income decile and 17 per cent the top three income deciles, while 41 per cent were clustered in the lowest quintile. Those with some tertiary qualifications were fairly evenly spread throughout the income distribution.

How did government programs affect this original income distribution ? *Cash transfers* from the government were progressive, and made the gross income distribution more equal than the original income distribution. Education and social security transfers amounted to 12.2 per cent of the annualised gross income received by the lowest income decile, declining to 0.002 per cent for those in the highest income decile.

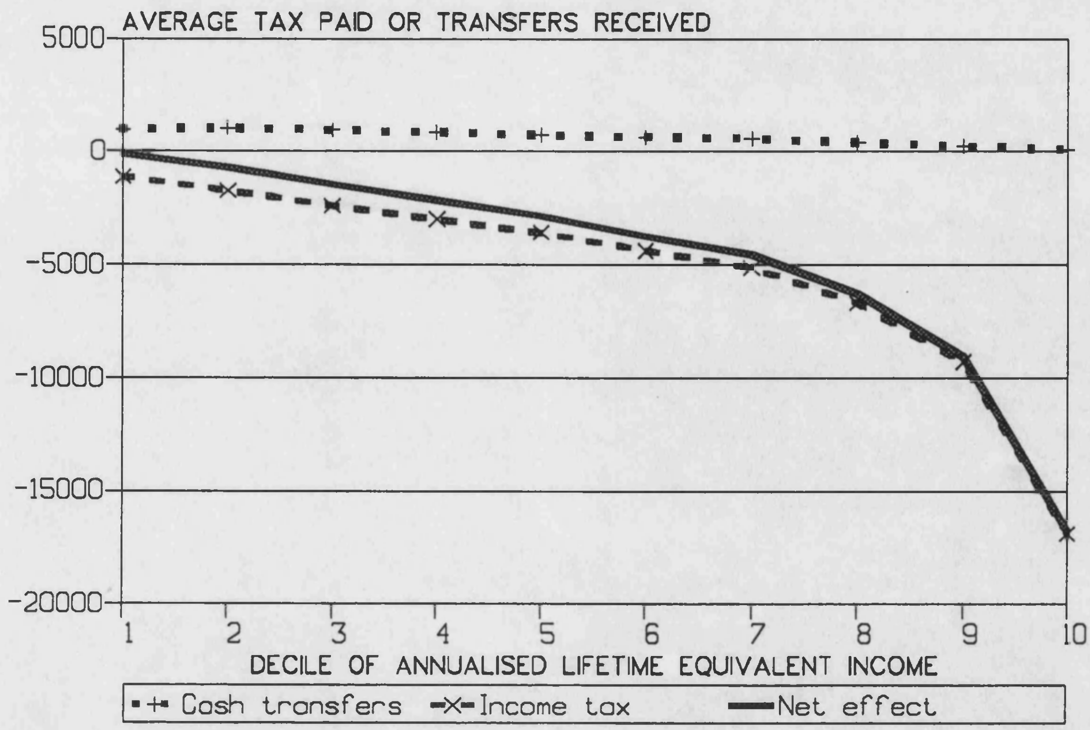
Those with lower lifetime incomes received more in unemployment and other benefits, reflecting the greater period of time they spent unemployed. Disability also affected lifetime income, with the incidence of severe disability during working years and the associated receipt of invalid pension being concentrated upon those in the bottom three income deciles.

Average age pension received declined as original income and superannuation receipt increased, although those in the lowest income decile averaged somewhat lower age pension receipt than those in the next three deciles, apparently as a result of their significantly shorter lifespans (71.6 years for those in the lowest decile compared to 76.9 years for those in the second decile). The absolute value of education transfers showed no definite pattern by income decile, with those in the bottom deciles being more likely to receive SAS in respect of their student children and those in the top deciles being more likely to recieve TEAS or PGA when they were themselves students.

Income tax payments were also progressive, amounting to 13.8 per cent of the annualised gross income of those in the bottom decile and rising to 40.8 per cent of the gross income of the top decile. Figure 7.3 shows the absolute amounts of annualised taxes paid or transfers received by decile of lifetime annualised equivalent income. For example, those in the highest income decile received less than $100 a year in transfers but paid out almost $16,900 a year in income tax, leaving a net deficit each year of around $16,800.

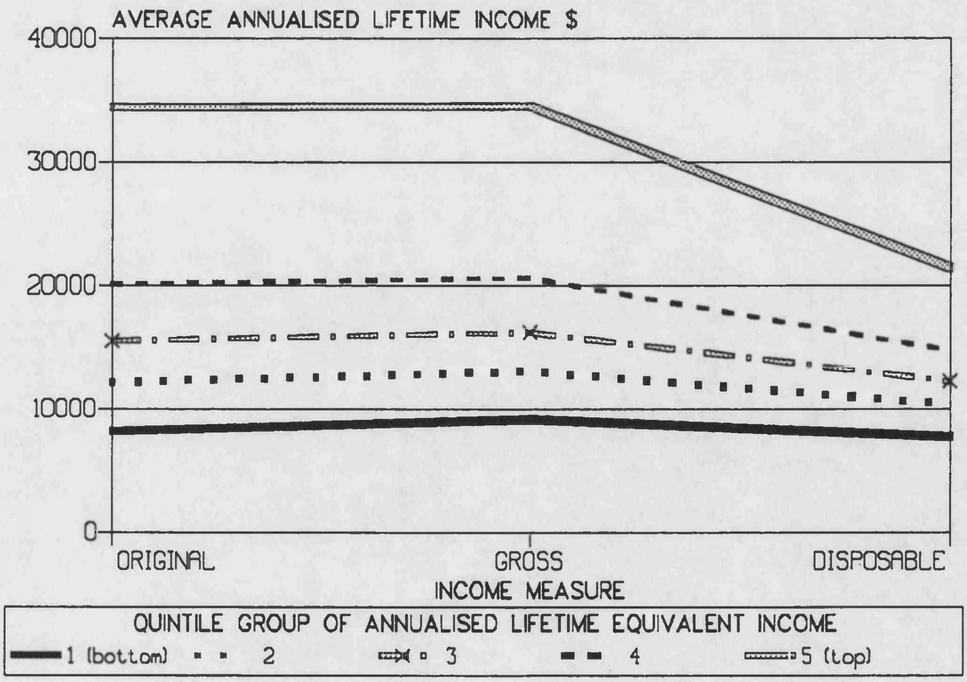
The variation in the amount of cash transfers by decile is insignificant in comparison to that of income tax, with the latter thus having the major impact upon reducing the variance of incomes. As Figure 7.3 demonstrates, even for the lowest income decile, average taxes paid exceeded average transfers received, in marked contrast to the results derived from 'snapshot' cross-section studies of tax-transfer incidence.

Figure 7.3: Amount of Annualised Lifetime Cash Transfers Received and Income Tax Paid by Men, Ranked by Deciles of Annualised Lifetime Equivalent Income



These effects are also captured in Figure 7.4, which shows how the dispersion of incomes is reduced at each stage of the tax-transfer system. For example, at the *original* income stage shown at the left hand side of the graph, the annualised original income of the top quintile of $34,000 is some 4.2 times greater than the $8,000 received each year on average by the bottom quintile. After adding any cash transfers received to their original income, this dispersion is narrowed somewhat, with the annualised *gross* income of the top quintile being about 3.8 times the gross income received by the bottom quintile. Income taxes have a much greater impact, with the *disposable* incomes of the top quintile falling to just over $21,000, about 2.8 times more than the annualised disposable income received each year by those in the bottom quintile.

Figure 7.4: The Effect of Cash Transfers and Income Tax Upon the Lifetime Income Distribution of Men, Ranked by Quintile Groups of Annualised Lifetime Equivalent Income.

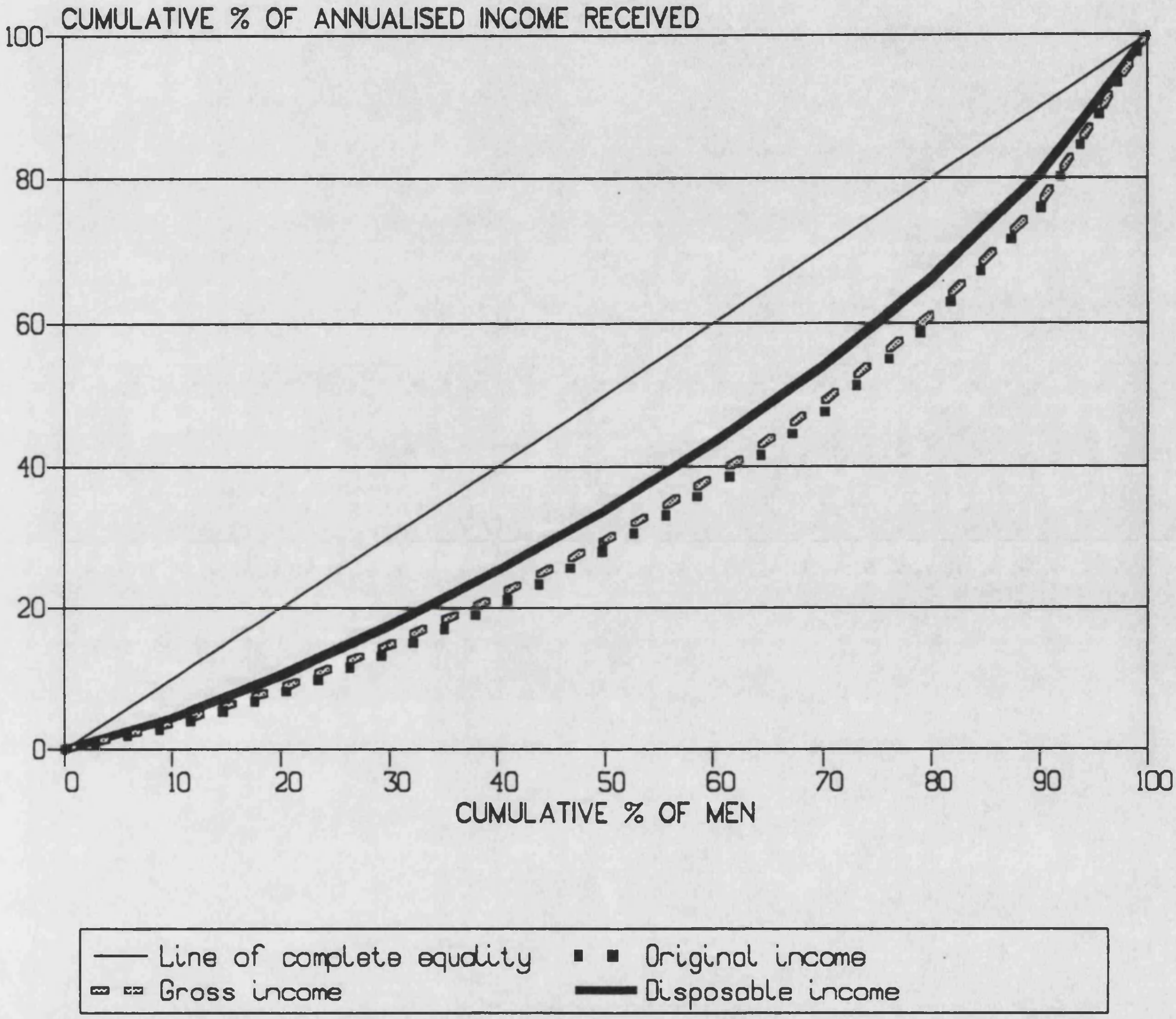


The impact of the tax-transfer system upon the income distribution can also be graphically illustrated using Lorenz curves, which plot the cumulative share of income against the cumulative share of households. The curve representing complete equality of income is thus a diagonal line from the bottom left hand corner of the graph to the top right hand corner: the more unequal the distribution of income, the more the Lorenz curve sags down away from the line of complete equality.

As Figure 7.5 shows, both lifetime transfers and taxes were progressive, as the distribution of disposable income was much more equal than the distribution of gross income, which was in turn more equal than the distribution of original income. For example, the share of original income received by men in the bottom 10 per cent of all men, ranked by amount of original income received, was only 3.2 per cent; after the receipt of transfers this share had increased to 3.7 per cent of gross income and, after the payment of income taxes, to 4.5 per cent of disposable income. Similarly, the share of income accruing to the highest income recipients was sharply reduced by the tax-transfer system. While the top 10 per cent of males received 24.5 per cent of original income, they gained only 23.7 per cent of gross income and 19.5 per cent of disposable (ie. post tax-transfer) income.

The imputed value of total (not annualised) income received from use of pre-school, primary and secondary school and tertiary education rose as lifetime income increased (Table 7.1). As shown in Table 7.2, those in higher deciles were more likely to attend private schools which, as discussed in Chapter 5, received a lower government subsidy than public primary and secondary schools. However, the lower education outlays received by those in higher income deciles while they were in primary and secondary school were more than offset by the imputed value of the tertiary education they received later in life. While the *distribution* of dollar education outlays was thus slightly pro-rich, the *incidence* of such transfers was still progressive, as they amounted to a smaller *proportion* of gross income for those in higher income deciles (see Harding, 1984:19-22 for a fuller discussion of the difference between distribution and incidence).

Figure 7.5: Lorenz Curves of Annualised Lifetime Original, Gross and Disposable Income for Men.



Note: Unlike the tables above, where individuals were ranked only once by their annualised equivalent incomes, individuals are re-ranked to produce each of the above Lorenz curves. To derive the Lorenz curve for original income all individuals are ranked by their original income, while to construct the Lorenz curve for disposable income all individuals are first ranked by their disposable income.

Although marital and child status seemed to have less impact upon men's lifetime income than education and labour force participation, it was notable that among those in the top decile only 78 per cent had ever married; for those who did marry the average number of years married was 34; and that the average number of years spent in a family with dependent children present was only 12.8. All of these were the lowest figures recorded for any decile.

7.3 THE LIFETIME INCOME DISTRIBUTION OF FEMALES

Women's annualised lifetime earnings were about half of those of men, and the relative gap between the average earnings of the top and bottom deciles was slightly lower, with the top decile earning 4.6 times as much a year on average as the bottom decile (Table 7.3). Women's earnings were also less dispersed, as a comparsion of Figures 7.6 and 7.2 demonstrates, with about 40 per cent of all women receiving annualised lifetime earnings of between $5000 and $10,000 a year (the midpoints of the various earnings ranges are shown in Figure 7.6). Almost one-third of women in the *top decile* of annualised lifetime equivalent income received earnings of between $10,000 and $15,000 a year, with just under 10 per cent receiving more than $25,000 a year. In marked contrast, about 90 per cent of women in the *bottom decile* received average earnings of less than $5000 during each year of adult life.

Investment income and superannuation were again more unequally distributed than earnings. The absolute amount of maintenance income recevied showed no clear pattern by decile, with those in the middle of the income spectrum tending to receive higher average amounts of maintenance.

As Figure 7.7 illustrates, cash transfers were a much more important source of lifetime income for women than for men, amounting to almost 30 per cent of gross income for women whose annualised lifetime equivalent income placed them in the bottom quintile. In contrast, they comprised a negligible proportion of the gross income received during each year of adult life for women in the top quintile. Despite the lower absolute amounts of investment income received by women, such income was a more significant component of their gross income than for men, because of the substantially lower earned incomes of women. The relative contribution made by superannuation was also more equal by quintile for women, reflecting their receipt of such pensions upon the death of their husbands.

Table 7.3: Annualised Lifetime Income Characteristics of Decile Groups of Women, Ranked by Deciles of Annualised Lifetime Equivalent Disposable Income

MEASURE	DECILE OF ANNUALISED LIFETIME EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	3,260	4,555	5,390	6,260	6,545	8,365	9,790	10,230	11,750	15,110	8,125
Investment income	330	510	530	745	925	1,535	1,870	2,740	3,550	5,180	1,790
Superannuation	45	30	80	230	215	220	275	345	590	885	290
Maintenance	20	40	25	50	60	55	65	30	40	45	45
ORIGINAL INCOME	3,655	5,130	6,025	7,285	7,745	10,180	11,995	13,345	15,940	21,220	10,255
Invalid pension	30	5	45	20	1	5	10	5	5	0	15
Age pension	870	1,240	1,150	1,090	1,020	920	770	510	400	175	815
Sole parents pension	460	420	355	295	290	205	160	165	105	105	255
Unemployment and other benefits	65	55	55	45	55	45	45	40	40	30	50
Child transfers (FA, FIS)	165	195	170	170	185	170	175	160	160	150	175
Education transfers	40	45	35	40	35	30	25	30	20	20	25
TOTAL CASH TRANSFERS	1,630	1,955	1,815	1,660	1,590	1,370	1,180	910	735	480	1330
GROSS INCOME	5,285	7,085	7,840	8,945	9,330	11,550	13,180	14,250	16,670	21,700	11,585
Income tax paid	520	865	1,080	1,430	1,570	2,250	2,970	3,380	4,475	6,850	2,540
DISPOSABLE INCOME	4,765	6,220	6,765	7,515	7,765	9,300	10,210	10,875	12,195	14,850	9,050
Shared disposable income (family unit)	5,925	7,475	8,230	8,980	9,790	10,635	11,570	12,460	14,105	17,460	10,665
Equivalent disposable income (family unit)	9,575	12,065	13,410	14,750	16,120	17,585	19,205	21,070	23,925	29,910	17,765
Equivalent income - 60:40 split within couples	8,540	10,755	12,005	13,105	14,145	15,515	16,865	18,375	20,995	26,060	15,640
Lifetime education services income	36,920	39,085	38,075	39,790	40,180	42,630	42,220	42,570	41,730	43,915	40,710

All income figures rounded to nearest $5. Totals may not sum due to rounding.

Table 7.4: Other Characteristics of Decile Groups of Women, Ranked by Deciles of Annualised Lifetime Equivalent Disposable Income

MEASURE	DECILE OF ANNUALISED LIFETIME EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
1. LABOUR FORCE CHARACTERISTICS											
Av years in labour force	28.5	30.1	31.2	33.2	33.2	37.3	37.1	36.5	36.3	38.5	34.2
Av years unemployment experienced	5.5	4.3	4.4	4.4	4.5	3.8	4.1	3.7	3.5	2.8	4.1
Av years worked full-time full year	15.6	16.4	18.4	19.6	20.0	23.3	23.0	22.7	23.2	24.9	20.7
Av years of self-employment	5.7	4.2	4.2	4.7	5.0	5.5	5.5	5.5	5.5	6.9	5.3
Total hours in l.f. during lifetime	46027	48271	51400	54942	55417	63109	62386	61990	61925	66582	57,205
Average hours in labour force during yrs in labour force	1571	1564	1605	1627	1646	1673	1659	1678	1681	1709	1640
Average hours in employment per yr in l.f.	1438	1467	1520	1541	1558	1610	1588	1616	1619	1659	1560
Average hours of unemployment per yr in l.f.	133	97	85	86	88	63	71	62	62	50	80
Average hourly wage rate	$5.35	$6.66	$7.06	$7.74	$7.88	$8.89	$10.32	$10.45	$12.11	$13.88	$9.05
2. MARITAL AND CHILD STATUS											
Per cent ever married	85	89	86	89	94	91	92	94	93	95	91
Per cent ever divorced	29	31	31	35	34	31	33	26	24	30	32
Per cent ever sole parents	23	28	25	33	28	24	27	21	16	23	25
Av no of years with dependent children present	19.6	20.5	19.3	19.4	20.4	19.1	19.7	18.2	18.3	18.4	19.4
Av no of children born	1.87	2.1	1.9	1.9	2.0	1.9	1.8	1.7	1.7	1.6	1.8
Av years married for those ever married	37	35	33	36	36	36	38	38	38	37	37
Av yrs of sole parenthood for sole parents	9.3	9.3	9.2	7.7	8.9	8.1	8.2	8.7	7.5	7.4	8.4
3. EDUCATION											
Average years of education	13.2	13.6	13.5	13.8	13.7	14.2	14.1	14.2	14.0	14.4	13.9
Av no of years attended govt schools	9.9	9.2	9.0	8.7	8.6	9.2	9.1	8.6	8.8	8.2	8.9
Av no of years attended private schools	2.2	2.9	3.0	3.4	3.4	2.9	3.0	3.3	3.2	4.0	3.1
Av years tertiary education	2.1	2.5	2.5	2.6	2.7	3.0	2.9	3.1	2.9	3.1	2.7
Per cent with degree	7.1	11.1	12.1	12.1	21.1	24.0	23.1	24.1	23.6	29.1	18.6
Average years of life	81.6	80.4	78.2	79.7	79.1	79.3	78.3	76.8	77.8	76.5	78.8

Figure 7.6: Frequency Distribution of Annualised Lifetime Earnings for Females

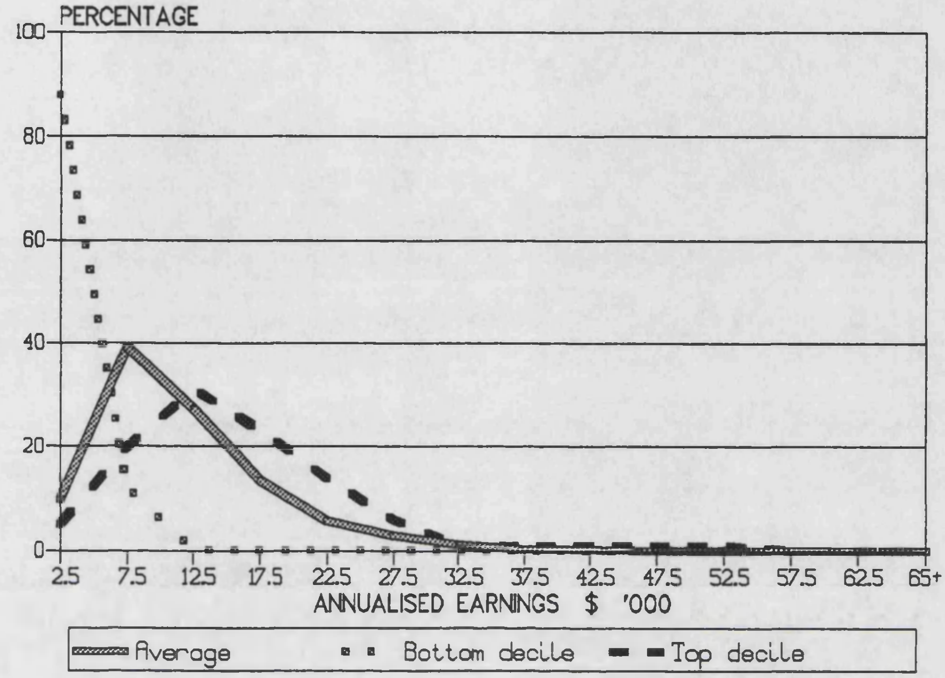
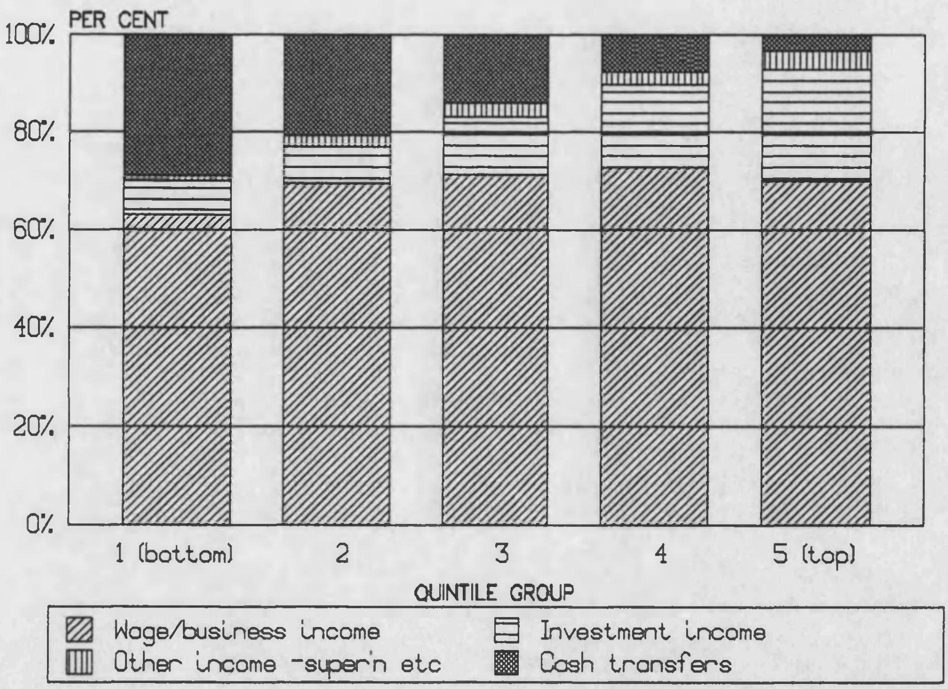


Figure 7.7: Sources of Annualised Lifetime Gross Income for Women, Ranked by Quintile Groups of Annualised Lifetime Equivalent Disposable Income



To an even greater extent than was apparent for men, the variation in the lifetime earnings of women resulted from different labour force participation patterns (Table 7.4). Women in the bottom decile averaged only 28.5 years of labour force participation, compared with 38.5 years for women in the top decile. Hours of employment once in the labour force also showed greater variation, with the 1,660 hours per year averaged by women in the top decile being 15 per cent higher than the 1,440 hours averaged by women in the bottom decile. Although still an important contributor to lifetime earnings inequality, the hourly wage rate of women showed less dispersion than that of men, with hourly earnings ranging from $5.35 for those in the bottom decile to around $13.90 for those in the top decile.

Education was also a significant factor affecting lifetime earnings, with increased lifetime income being associated with greater attendance at private schools, more years of tertiary education and, in particular, the gaining of a degree. Sixteen per cent of those who gained a degree achieved the top equivalent income decile while only 16 per cent were placed in the bottom five deciles. Amongst those who had only gained secondary school qualifications, only 4 per cent made the top income decile and 39 per cent were in the bottom quintile. Those with some tertiary education were again spread quite evenly across the income spectrum.

Average *cash transfers* received by women were about double those received by men and were again highly progressive, amounting to 30.8 per cent of gross income for those in the lowest income decile and declining to 2.2 per cent of gross income for those in the top decile. For women, characteristics such as being severely disabled and potentially eligible for an invalid pension or being unemployed were less likely to result in receipt of pension or benefit than for men, because the income of husbands more frequently made them ineligible under an income test which took the income of both partners into account. Despite this, low lifetime income was clearly associated with increased unemployment and higher unemployment benefit payments (Table 7.4).

The amount of sole parent pension received was much higher for women in lower deciles. Interestingly, this was not due to those in low income deciles having a much greater likelihood of ever experiencing sole parenthood, as the percentage ever experiencing sole parenthood did not show a clear trend by income decile but fluctuated greatly (Table 7.4). However, amongst those who experienced sole parenthood during their lifetimes, an increased number of years spent as a sole parent was correlated with reduced lifetime equivalent income. The amount of age pension received again declined as occupational superannuation increased, so that those in lower income deciles received more age pension.

Income tax was again progressive, amounting to 9.8 per cent of gross income for those in the lowest income decile and rising to 31.6 per cent of gross income for those in the top decile. Figure 7.8 charts the absolute amount of transfers received and income taxes paid by deciles of annualised lifetime equivalent income. While even for men in the lowest lifetime equivalent income decile the amount of transfers received did not exceed taxes paid, women in the bottom four deciles received on average more in transfers during each year of adult life than they paid in income tax. Only women whose income was sufficiently high to place them in the top half of the lifetime income distribution paid more in taxes than they gained from transfers.

Figure 7.9 shows the impact of cash transfers and income tax on the average annualised lifetime incomes of women, ranked by quintiles of annualised equivalent income. The gap between the average incomes of the top and bottom quintiles was reduced by cash transfers, as shown by the narrowing of the gap between the top and bottom lines in Figure 7.9 when moving from original to gross income. While the annualised lifetime *original* income of the top quintile was 4.2 times that of the bottom quintile, their *gross* incomes of about $19,000 were only 3.2 times greater than those of the lowest quintile. Income taxes further reduced these income differentials, so that the average lifetime *disposable* incomes of the top quintile were only 2.5 times those of the bottom quintile.

Figure 7.8: Amount of Annualised Lifetime Cash Transfers Received and Income Tax Paid by Women, Ranked by Deciles of Annualised Lifetime Equivalent Income

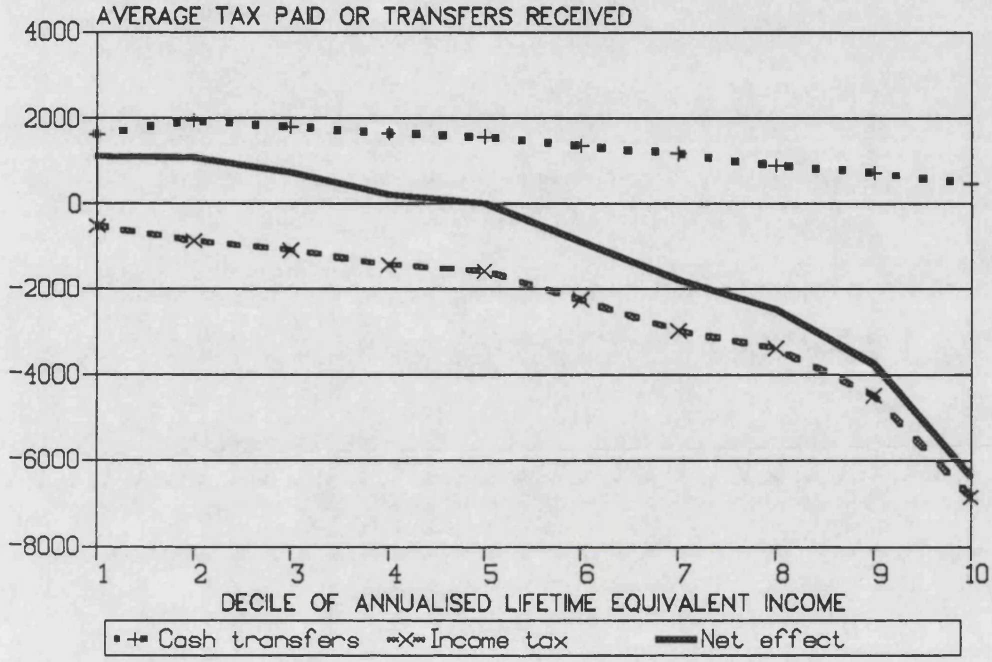
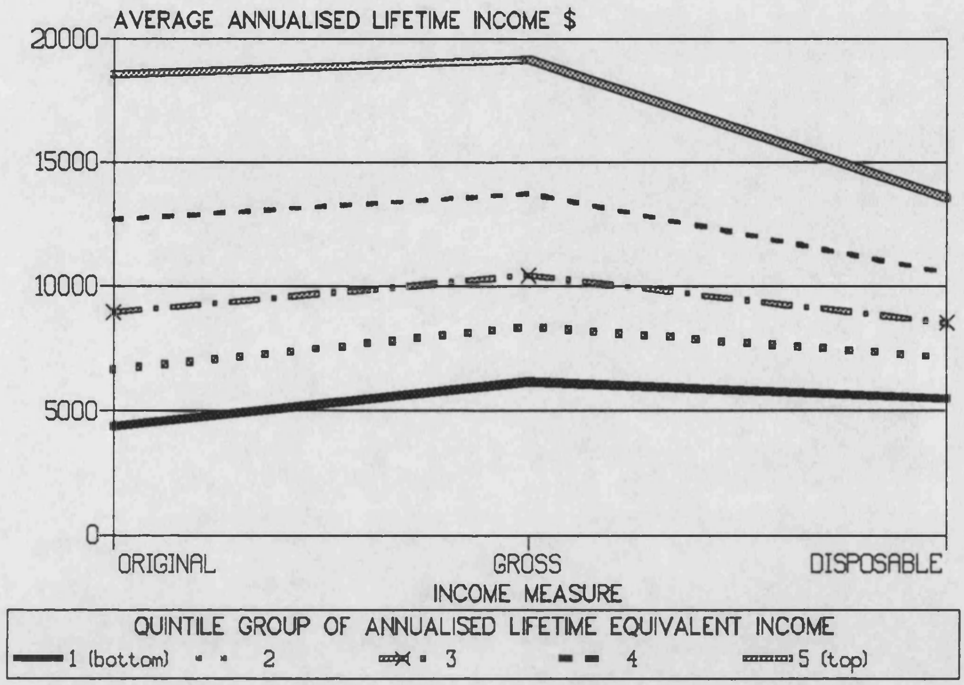
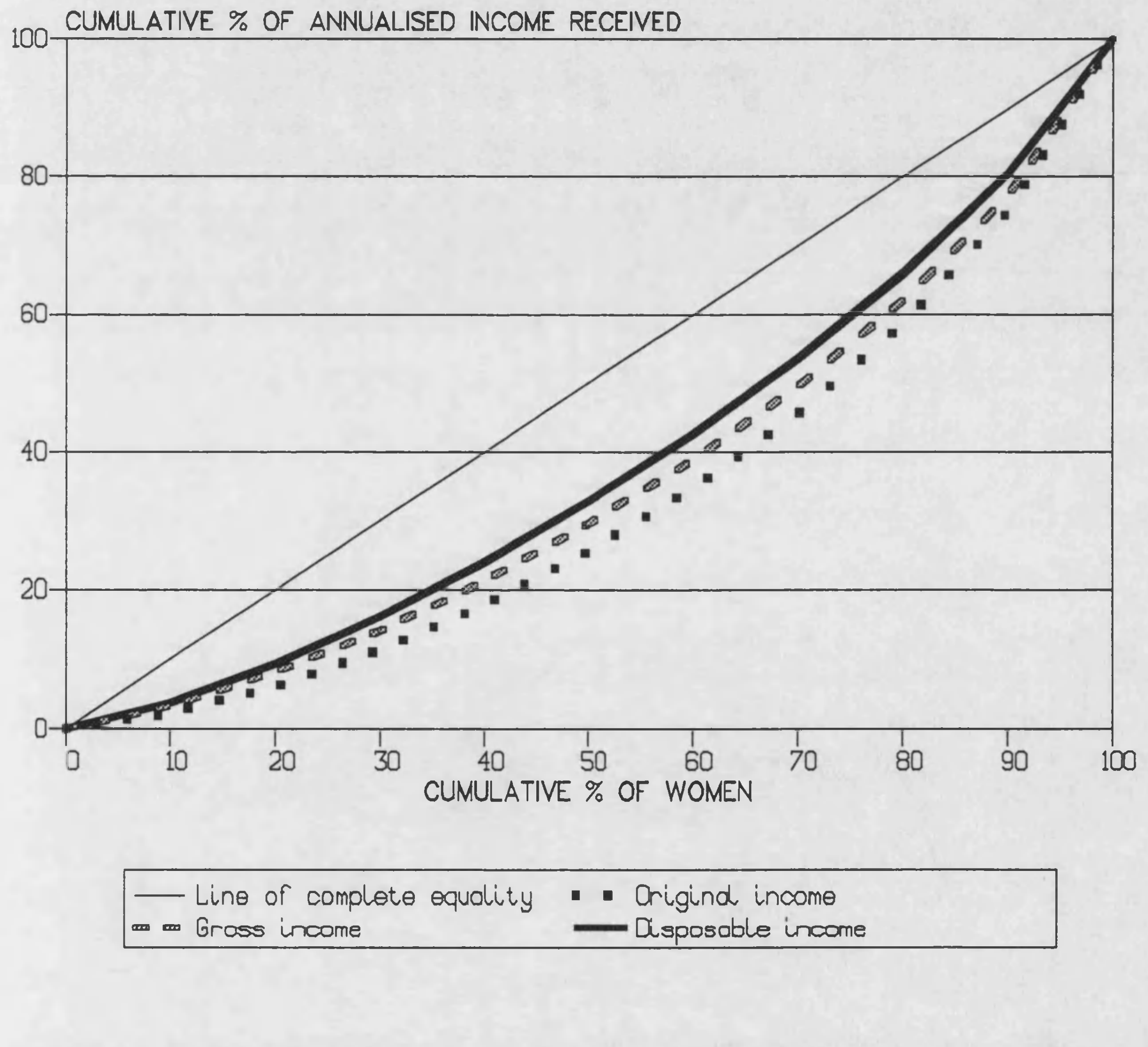


Figure 7.9: The Effect of Cash Transfers and Income Tax Upon the Lifetime Income Distribution of Women, by Quintile Groups of Annualised Lifetime Equivalent Income.



As the Lorenz curves in Figure 7.10 also indicate, the effect of taxes and transfers was to make the income distribution progressively more equal. For example, the *bottom 10 per cent* of women received only 2.3 per cent of annualised original income but 3.8 per cent of disposable income, while the *top 10 per cent* of women received 24.9 per cent of original income but only 19.4 per cent of disposable income.

Figure 7.10: Lorenz Curves of Annualised Lifetime Original, Gross and Disposable Income for Women.



While the marital and child status of men had relatively little effect on their lifetime standard of living, for women marital and child status played an important role in determining where they would be placed in the lifetime income distribution. As discussed in Chapter 6, women's lifetime equivalent incomes increased with marriage and decreased with greater family size. This was again reflected in Table 7.4, where a lower percentage of women in the bottom income decile had ever married compared to women in higher deciles, while women in the top decile were the most likely to have ever married but had also borne fewer children.

7.4 TAKING ACCOUNT OF INCOME SHARING WITHIN THE FAMILY

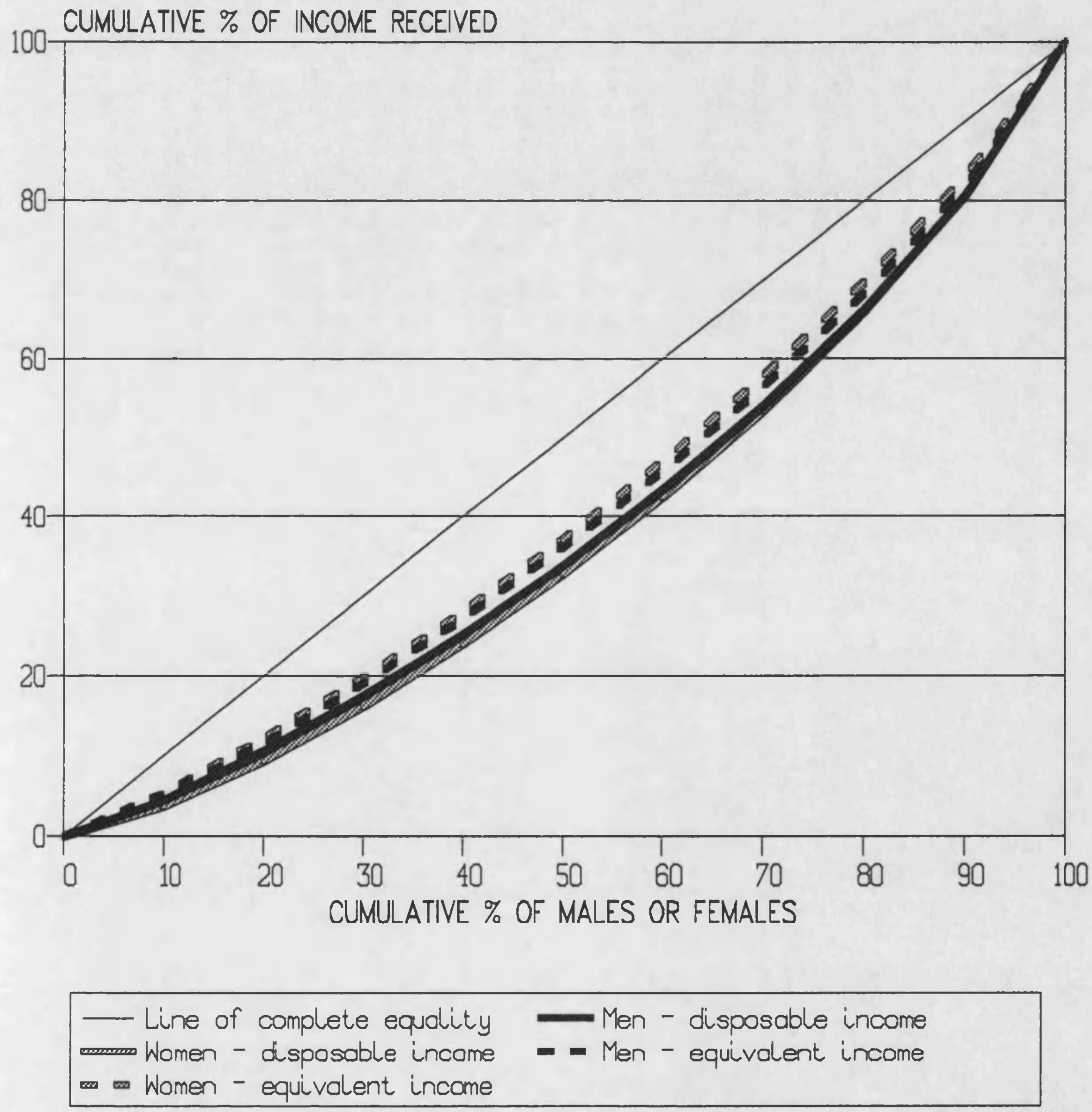
While the above analysis has dealt with the personal incomes received by men and women, the personal income distribution does not show the standard of living achieved by each sex, because it takes no account of income sharing within the family unit. As discussed in Chapter 5, *shared disposable* income shows the income distribution which results if income is split equally between adults in married couples. As one would expect, taking account of such sharing reduces the disposable income of men (Table 7.1) and increases the disposable income of women (Table 7.3).

However, a better measure of living standards is provided by *equivalent* income, as it incorporates the effect of both income sharing, the presence of dependent children and economies of scale. Once account was taken of presumed income sharing between couples, the standard of living of women rose sharply. Although the *absolute values* of equivalent income simply reflect the equivalence scale used, the *distribution* of equivalent income can be validly compared to that of disposable income.

As Figure 7.11 demonstrates, the distribution of income, once account is taken of needs, is more equal for both men and women than the distribution of personal disposable income, with the shift in the Lorenz curves showing the combined effect of taking account of income sharing within, and the composition of, the family unit.

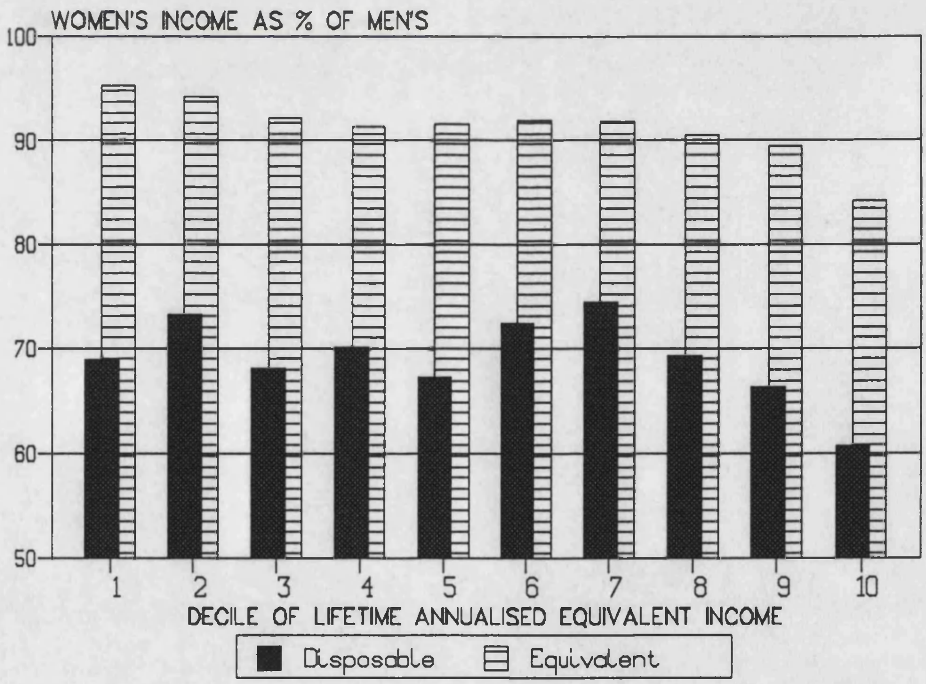
Interestingly, while the distribution of *disposable* income is more unequal amongst women than amongst men, the distribution of *equivalent* income is less unequal amongst women than amongst men.

Figure 7.11: Lorenz Curves of the Annualised Lifetime Disposable and Equivalent Incomes of Men and Women



In addition, although the lifetime standard of living of men is higher, the disparity is much less than a comparison of the personal disposable incomes of men and women might suggest. Figure 7.12 contrasts the absolute levels of average personal (not shared family) disposable and equivalent income received by women in each decile of female annualised lifetime equivalent income with those received by men in comparable male deciles. While the average *disposable* income of women in each decile is about 65 to 70 per cent of that of men in the comparable male decile of lifetime equivalent income, the *equivalent* income of women is some 90 per cent of that of men in comparable deciles.

Figure 7.12: Annualised Lifetime Disposable and Equivalent Incomes of Women, Ranked by Deciles of Annualised Equivalent Income, As Percentage of Comparable Incomes of Men



These results assume, of course, that income is shared equally within the family unit. Research by Pahl (1990), Edwards (1981) and Vogler (1989) has suggested that this is not always the case, and that women tend to fare less well than men, particularly if they are not contributing to earned income. Consequently, the bottom lines in Tables 7.1 and 7.3 show the effects of changing the assumption that income is equally shared between married couples, instead assuming that income is split 60:40 in the husband's favour (the same Australian government equivalence scale is used in both cases).

As expected, assuming less equal sharing of income within the family unit results in an increase in the equivalent disposable incomes of men and a decrease in women's incomes. For example, the equivalent income of men ranked in the bottom decile of all men rises by about 11 per cent to $11,200 when a 60:40 income split is assumed, while that of women in the bottom decile of women falls by almost 15 per cent to $8540. Thus, if this degree of unequal sharing is assumed, the equivalent incomes of women in the bottom decile amount to only three-quarters of the income of men in the lowest decile of men - a rather more unequal result than the 95 per cent of the incomes of such men shown in Figure 7.12. This suggests that income distribution might be more sensitive to the assumed distribution of income within the family than many economists have traditionally appreciated.

7.5 THE DISTRIBUTION OF LIFETIME INCOME FOR THE ENTIRE COHORT

While the preceding analysis has examined the lifetime incomes of men and women separately, most analyses of income distribution consider the entire population. Consequently, this section briefly examines the characteristics of lifetime income for the whole of the simulated cohort. Even though the entire cohort is ranked by annualised *equivalent* income, so that the enormous differences between the personal incomes of men and women are not as apparent as if the cohort was ranked by a measure which did not take account of family circumstances, women still tend to be clustered at the bottom of the income distribution and men at the top.

Almost one-quarter of all men were ranked in the top two deciles of annualised equivalent income, and 13 per cent of all men were in the top decile. In contrast, only 7 per cent of all women scraped into the top decile, while 23 per cent were clustered in the bottom quintile. Despite this, men still comprised 43 per cent of the bottom decile of annualised equivalent income, and such men amounted to just under 9 per cent of all men.

As one would expect, the 'averaging' of the incomes of men and women means that the original, gross and disposable incomes by decile are higher than those recorded for women only in Table 7.3 and lower than those achieved by men only in Table 7.1. Similarly, average cash transfers are lower and income taxes paid by each decile are higher. However, combining the records of men and women created greater *dispersion* of income across deciles, so that the annualised lifetime disposable income of the top decile was 3.6 times greater than that of the bottom decile.

For the population as a whole, the distribution of annualised lifetime disposable income was therefore still very unequal, with the bottom 10 per cent of all individuals receiving 3.7 per cent of all such disposable income. The bottom half of the income distribution received just under one-third of all annualised lifetime disposable income, while the top decile received one-fifth of all such income.

Those in the top decile again tended to spend more years on average participating in the labour force, with the bottom decile participating in the labour force for an hour or more for only 33.1 years, while for the top decile the comparable figure was 42.9 years. Hours worked per year once in the labour force also showed great variation, ranging from 1750 hours per year on average for those in the bottom decile to 1920 hours for those in the top decile - a difference of about 10 per cent. Average hourly wage rates also varied greatly, from $5.40 for those in the bottom decile to almost $18 an hour for those in the top decile.

Table 7.5: Annualised Lifetime Income Characteristics of the Cohort, Ranked by Deciles of Annualised Lifetime Equivalent Disposable Income

MEASURE	DECILE OF ANNUALISED LIFETIME EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	4,785	6,375	7,740	8,860	10,235	11,650	13,240	14,555	17,985	25,640	12,110
Investment income	270	390	560	670	825	1,195	1,670	2,155	3,270	5,430	1,645
Superannuation	25	20	60	150	100	125	195	425	605	2,000	370
ORIGINAL INCOME *	5,085	6,810	8,375	9,720	11,185	13,000	15,135	17,155	21,880	33,090	14,145
Invalid pension	35	25	35	15	10	5	5	15	5	0	15
Age pension	810	1,050	945	910	795	690	555	365	240	70	645
Sole parents pension	255	230	195	160	120	85	75	70	60	30	125
Unemployment and other benefits	140	110	105	90	95	100	80	80	75	50	90
Child transfers (FA, FIS)	95	110	100	100	90	80	85	75	75	50	85
Education transfers	45	40	30	35	25	30	30	25	25	15	30
TOTAL CASH TRANSFERS	1,380	1,565	1,410	1,305	1,135	995	835	625	480	215	995
GROSS INCOME	6,465	8,375	9,785	11,025	12,320	13,995	15,970	17,775	22,360	33,305	15,140
Income tax paid	770	1,210	1,655	2,085	2,550	3,195	4,000	4,785	6,895	12,675	3,980
DISPOSABLE INCOME	5,695	7,165	8,130	8,945	9,770	10,800	11,970	12,990	15,465	20,635	11,160
Shared disposable income (family unit)	5,960	7,500	8,400	9,240	10,060	10,880	11,900	12,925	14,860	19,225	11,095
Equivalent disposable income (family unit)	9,790	12,385	13,895	15,410	16,840	18,360	20,025	22,155	25,310	32,990	18,720
Equivalent inc- 60:40 split within couples	9,690	12,175	13,845	15,300	16,915	18,405	20,030	22,275	25,465	33,735	18,785
Lifetime education services income	37,930	38,725	39,310	40,065	41,500	42,125	42,120	41,115	43,360	44,090	41,035
Average years in labour force	33.1	36.2	36.5	37.8	39.9	41.2	40.6	40.5	40.9	42.9	39.0
Average hours in labour force	1750	1765	1785	1820	1855	1845	1850	1870	1870	1920	1830
Average hours employed	1630	1675	1705	1730	1785	1770	1790	1810	1810	1880	1760
Average hourly wage rate	5.40	6.55	7.35	8.15	8.50	9.65	10.60	11.45	13.50	17.95	9.90
Average years of education	13.4	13.5	13.6	13.8	14.0	14.1	14.1	14.0	14.3	14.5	13.9
Percent female	56.8	58.4	55.9	53.7	50.6	48.4	50.6	45.8	46.3	34.3	50.1
Av no of yrs dependent children present	17.7	19.3	17.9	18.7	18.4	17.9	17.8	16.7	17.6	14.7	17.7

* Includes maintenance. All income figures rounded to nearest $5. Totals may not sum due to rounding.

Years of education were again strongly correlated with higher lifetime incomes, with the top decile undertaking an average 14.5 years of education, compared to the average for all males of 13.9 years and for the bottom decile of 13.4 years. The adverse impact of children upon lifetime monetary welfare was also apparent, with those in the top decile spending only 14.7 years in families with dependent children present - well below the population average of 17.7 years.

7.6 CONCLUSION

Even on a lifetime basis, major inequalities in income were apparent. Males in the top decile of annualised lifetime equivalent income received almost six times as much pre-tax, pre-transfer income during each year of adult life as males in the bottom decile, while similar inequalities were observed for females. Higher lifetime original incomes were associated with higher earnings and investment income, and access to occupational superannuation. These factors were in turn correlated with education, family status and patterns of labour force participation.

The top 10 per cent of males, ranked by the amount of annualised original income received, gained almost one-quarter of all lifetime original income, while the bottom 10 per cent of all males received only three per cent of such income. Similarly, the top 10 per cent of females also gained one-quarter of lifetime original income, while those in the bottom 10 per cent reaped only two per cent of the total.

Both cash transfers and income taxes were progressive, and helped to offset these inequalities in factor income. For example, cash transfers accounted for 12 per cent of the average gross income received during each year of adult life by males in the top decile of annualised lifetime equivalent income, but declined sharply as income increased, to well under one per cent of the gross income of males in the top decile of equivalent income.

Average cash transfers received by women were about double those received by men, due to the combined effects of payment of child transfers to the mother, pensions for sole parents and widows, and greater age pension payments to women (due to their longer lifespans). Such transfers were again highly progressive, amounting to about 45 per cent of the total income received during each year of adult life for women in the bottom decile of annualised lifetime equivalent income, but only two per cent of the gross income of those in the top decile. Cash transfers thus made the lifetime distribution of income significantly more equal.

Income taxes were also progressive, amounting to 14 per cent of the gross income of males in the bottom decile of annualised lifetime equivalent income, and increasing steadily to reach 41 per cent of gross income for those males in the top decile. The average rates paid by women were lower, due to their lower lifetime incomes, but still increased from 10 per cent of the gross income of females in the bottom decile to 32 per cent of gross income for females in the top decile of annualised lifetime equivalent income.

The joint impact of the higher income taxes paid and lower cash transfers received by men, resulted in males making a net loss from the operation of the tax-transfer system. Even those males in the lowest decile of lifetime equivalent income paid slightly more in income taxes every year on average than they received in cash transfers. In marked contrast, women in the bottom four deciles of female annualised lifetime equivalent income received more in cash transfers during each year of adult life than they paid in income tax. Only the top 50 per cent of women made a net loss.

The personal incomes received by males during their lifetimes were much higher than for females, with the annualised lifetime disposable income for males of $13,275 being about one-third higher than the average $9,050 received by females. However, once income sharing within families was taken into account, the differences between the lifetime standards of living of men and women were much less pronounced, with the average annualised equivalent incomes of women amounting to 90 per cent of those of men.

This, however, assumed completely equal sharing of income within the family unit, and varying the presumed share of family income accruing to women in married couples suggested that such conclusions about the relative lifetime welfare of men and women were very sensitive to the sharing assumptions adopted. For example, if husbands were assumed to receive 60 per cent of the combined income of the couple, then the average equivalent income of women fell to only 71 per cent of that of men.

The above discussion therefore summarises the results produced by the simulation about the distribution and redistribution of lifetime income in Australia. How do these results compare to those for annual income ? This is the area to which we now turn, in Chapter 8.

CHAPTER 8: LIFETIME VS ANNUAL INCOME DISTRIBUTION AND REDISTRIBUTION

8.1 INTRODUCTION

In addition to providing a longitudinal profile, the model can be used to provide a *simulated cross-section sample*, by simply using every observation for every year of life for cohort members aged 15 and over. The thousands of records in the model can therefore be treated as separate observations, rather than as simply another year in the lifepath of a given individual. The synthetic cross-section population thus created has records for individuals of every age, just as a snapshot cross-section survey of the income distribution of a country does. Others involved in lifetime microsimulation modelling have also used this technique to create a synthetic annual distribution (Wolfson, 1989b:51; Blinder, 1974; Davies et al, 1984:51).

However, such a sample (and the inequality measures derived from using it), will not be directly comparable to the results of other cross-section surveys of income in Australia, because the characteristics of the simulated population will be different to those of the current Australian population, in ways which have a major impact upon the income distribution. (For example, as shown graphically in Chapter 2, because of lower death rates now than in the past, the simulated population contains many more over-60 year olds than the 1986 Australian population.)

In addition, most studies use the *family or household* as the income unit, while in the following analysis the *individual* is used. Many of those who have no income of their own, such as dependent teenage students or married women not in the labour force, live in families where other members earn income and are assumed to share this income. The distribution of family or household income is therefore significantly more equal than that of persons.

It *is* possible to group the individuals in the synthetic cross-section sample into nuclear families and then to use the family as the income unit. However, such results *cannot* then be compared to the lifetime results discussed in Chapter 7. As individuals move in and out of families and households during their lifetimes, a lifetime income distribution using the family as the income unit cannot be constructed. The most that can be done to capture the effect of family circumstances, as discussed earlier, is either to attribute to married individuals half of the joint income of the couple, or to assign to individuals an equivalent income which takes full account of the size, composition and income of the family in which they live.

In addition, while it would be possible to amend the records included in the synthetic cross-section sample (eg. to exclude full time students below a specified age who have no other income), for the initial analysis all records of those aged 15 and over have been included, as these are then *exactly the same records* as those used in the lifetime income profiles and they can thus be directly compared. This does mean, however, that many of those in the lowest simulated *annual* income decile are full-time students without income.

In Section 8.2, all the records for every year of life have therefore been treated as separate observations, and the resulting population has been ranked into deciles of *annual equivalent disposable income*. The annual income distribution of males and then females is first considered, and then the income distribution of all individuals is examined. These results thus provide a guide to the inequality of annual income, rather than lifetime income.

In Section 8.3 the distributions of lifetime and annual income are compared. The Gini indexes for lifetime and annual income, using a number of different concepts of income, are examined first. The second part ranks the cohort into deciles of annualised lifetime equivalent and annual equivalent income, and examines the extent of mobility by constructing transition matrices between the two. The extent to which the high or low incomes of those captured in cross-section surveys provide a guide to their lifetime welfare is thus examined.

Section 8.4 contrasts the lifetime and annual incidence of taxes and transfers, and compares the concentration coefficients of taxes and transfers on a lifetime and annual basis. Section 8.5 attempts to derive a clearer picture of the relative importance of intra-personal and inter-personal redistribition achieved by taxes and transfers, by comparing the distribution of cash transfers by decile with the distribution of the income taxes *used to finance those cash transfers.* Finally, Section 8.6 examines the annual and lifetime incidence of education outlays.

8.2 ANNUAL INCOME DISTRIBUTION BY DECILE

All of the following results use the *individual* as the income unit, and these results can therefore be directly compared to those in the preceding chapter. While the income distribution is thus extremely unequal, it is nonetheless conceptually comparable to the income distribution which would be obtained, for example, by using the person (rather than income unit) records on the 1986 Australian Income Distribution Survey (although the actual results would be different because the characteristics of the pseudo-cohort are different to those of the 1986 Australian population).

The Distribution of Men's Annual Income

As Figure 8.1 shows, the components of *annual* income are dramatically different to those for lifetime income. When the population are ranked by the amount of annual equivalent income received, about half of the income of the bottom quintile is derived from social security and education cash transfers, reflecting the large numbers of students and age pensioners. Investment income is more evenly spread across quintiles, due to the investment income received by the elderly. Similarly, rather than being concentrated upon those at the top of the income distribution, as was the case with lifetime income, superannuation income is also somewhat more equally distributed, as retirees are scattered across the annual income deciles.

The *composition* within each decile is also very different to that apparent for lifetime income. Many of those in the bottom annual equivalent income decile are full-time students with little or no income, while the aged are concentrated in deciles two and three (Table 8.1). The proportion within each decile who are in the labour force rises sharply as income increases, from only 37 per cent for the bottom decile to 95 per cent for the top. Lifecycle influences upon income are also evident, with the aged being concentrated in the bottom third of the income distribution, those in their thirties and forties with children in the middle, and those in the 'empty nest' stage of the lifecycle and with fewer children being placed in the top deciles (O'Higgins et al, 1988).

The *distribution of annual income* is far more unequal than that of lifetime income. The original income of the top decile is 75 times greater than that of the bottom decile and 19 times greater than that of the second bottom decile. *Cash transfers* are extremely progressive and, for example, double the income of the second lowest decile, while amounting to a negligible proportion of gross income for the top decile. *Income taxes* are also progressive and, as Figure 8.2 shows, the net effect of the tax-transfer system is to raise the income of males in the lowest three deciles while substantially reducing the income of the top half of the income distribution. For example, the top decile of males receive almost no cash transfers but pay almost $19,700 in tax, leaving the net deficit of just under $20,000 shown in Figure 8.2.

Figure 8.3 illustrates the impact of taxes and transfers by quintiles of annual equivalent income, and shows how the distribution of income is narrowed at each stage. *Income tax* has a much more significant equalising effect than transfers,

Table 8.1: Characteristics of Decile Groups of Men, Ranked by Deciles of Annual Equivalent Income

MEASURE	DECILE OF ANNUAL EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	395	2,040	3,670	9,250	14,005	16,785	20,285	23,075	26,935	41,140	15,760
Investment income	235	370	670	910	920	1,105	1,470	1,885	2,340	5,375	1,530
Superannuation	5	45	95	385	375	725	710	705	1,030	1,105	520
ORIGINAL INCOME	635	2,460	4,435	10,540	15,300	18,615	22,465	25,670	30,305	47,620	17,805
Invalid pension	0	95	40	40	15	0	0	0	0	0	20
Age pension	0	2,040	2,440	730	140	95	5	0	5	0	545
Unemployment and other benefits	35	320	335	220	150	95	60	35	20	5	130
Education transfers	70	130	25	15	15	5	5	5	5	0	25
TOTAL CASH TRANSFERS*	105	2,585	2,840	1,005	320	195	70	40	30	10	720
GROSS INCOME	740	5,045	7,270	11,545	15,615	18,810	22,535	25,710	30,330	47,630	18,525
Income tax paid	0	60	525	1,865	3,340	4,610	6,145	7,560	9,860	19,710	5,370
DISPOSABLE INCOME	740	4,985	6,745	9,680	12,275	14,200	16,390	18,150	20,470	27,920	13,155
Shared disposable income (family unit)	770	4,630	5,935	7,805	9,765	11,630	13,685	15,930	18,630	25,705	11,450
Equivalent disposable income (family unit)	1,325	7,865	10,195	12,970	16,165	19,435	22,975	27,095	32,430	45,485	19,595
Equiv inc - 60:40 split	1,445	8,485	11,410	14,775	18,450	21,990	25,865	30,180	36,045	50,165	21,880
Av no dependent children	0.15	0.31	0.42	0.72	0.77	0.66	0.61	0.47	0.32	0.19	0.46
Per cent married	29.9	40.9	59.3	69.5	70.7	65.8	62.9	57.1	55.7	52.7	56.5
Per cent above retirement age	10.7	45.1	53.7	26.4	13.4	13.0	7.4	6.4	6.6	6.5	18.9
Per cent in labour force	36.6	46.0	44.2	72.2	84.4	86.5	92.4	93.8	94.1	95.4	74.6
Average age	36.9	54.1	56.5	46.0	42.0	42.9	41.7	42.3	44.3	47.1	45

* Includes child transfers (FA, FIS). All income figures rounded to nearest $5. Totals may not sum due to rounding.

Figure 8.1: Sources of Annual Gross Income for Men, Ranked by Quintile Groups of Annual Equivalent Income

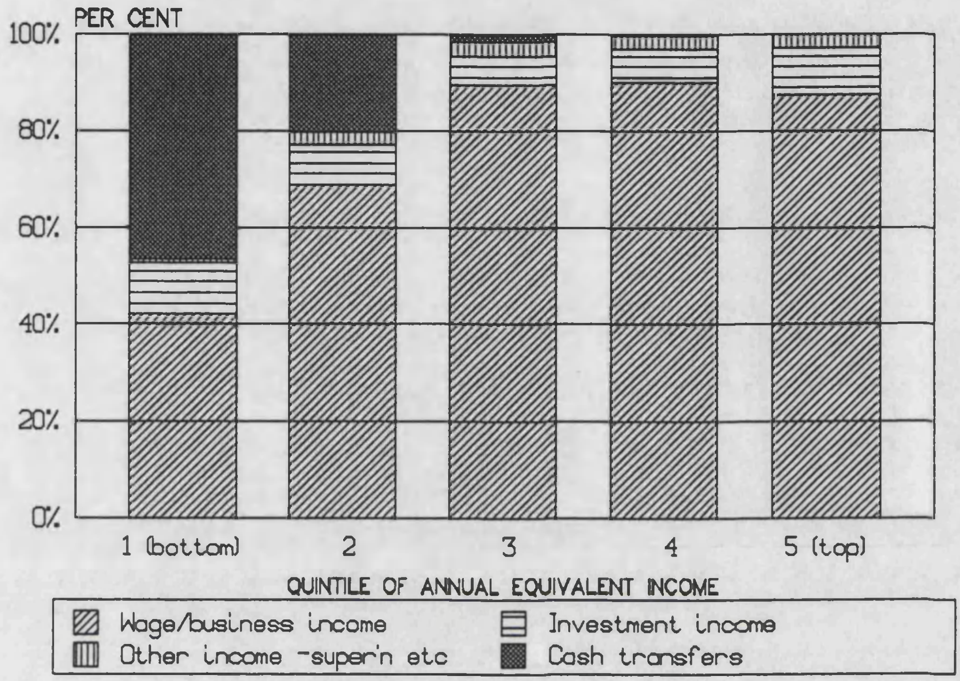
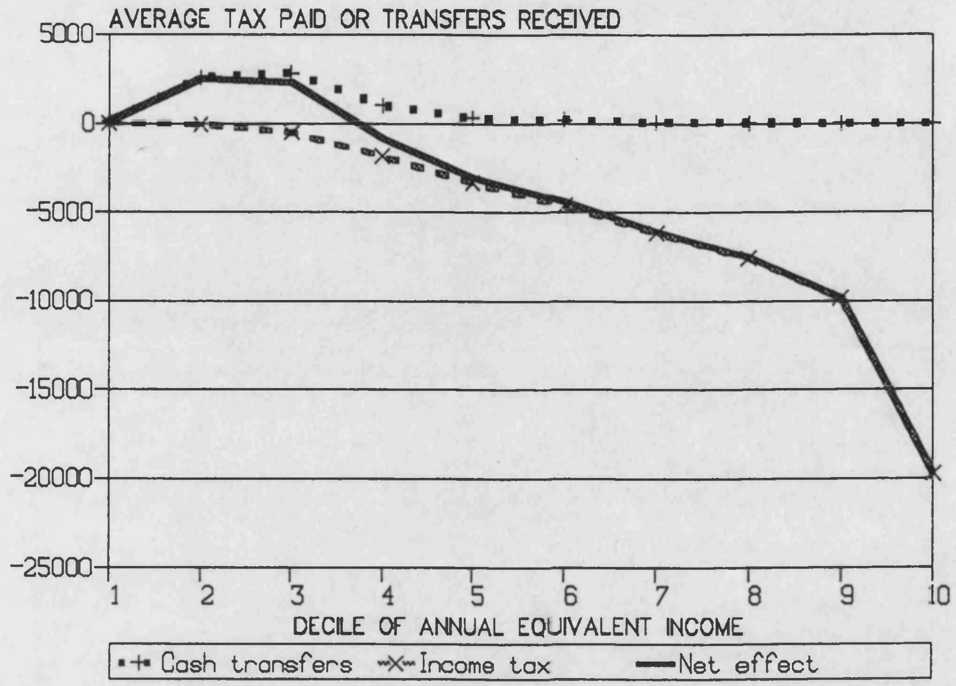
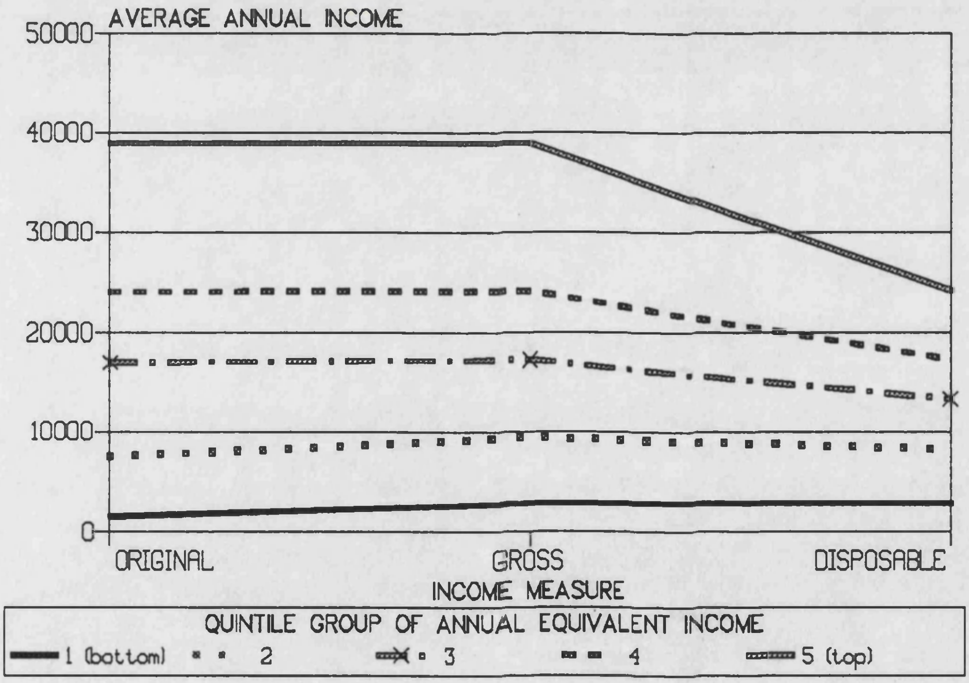


Figure 8.2: Amount of Cash Transfers Received and Income Tax Paid by Men, Ranked by Deciles of Annual Equivalent Income



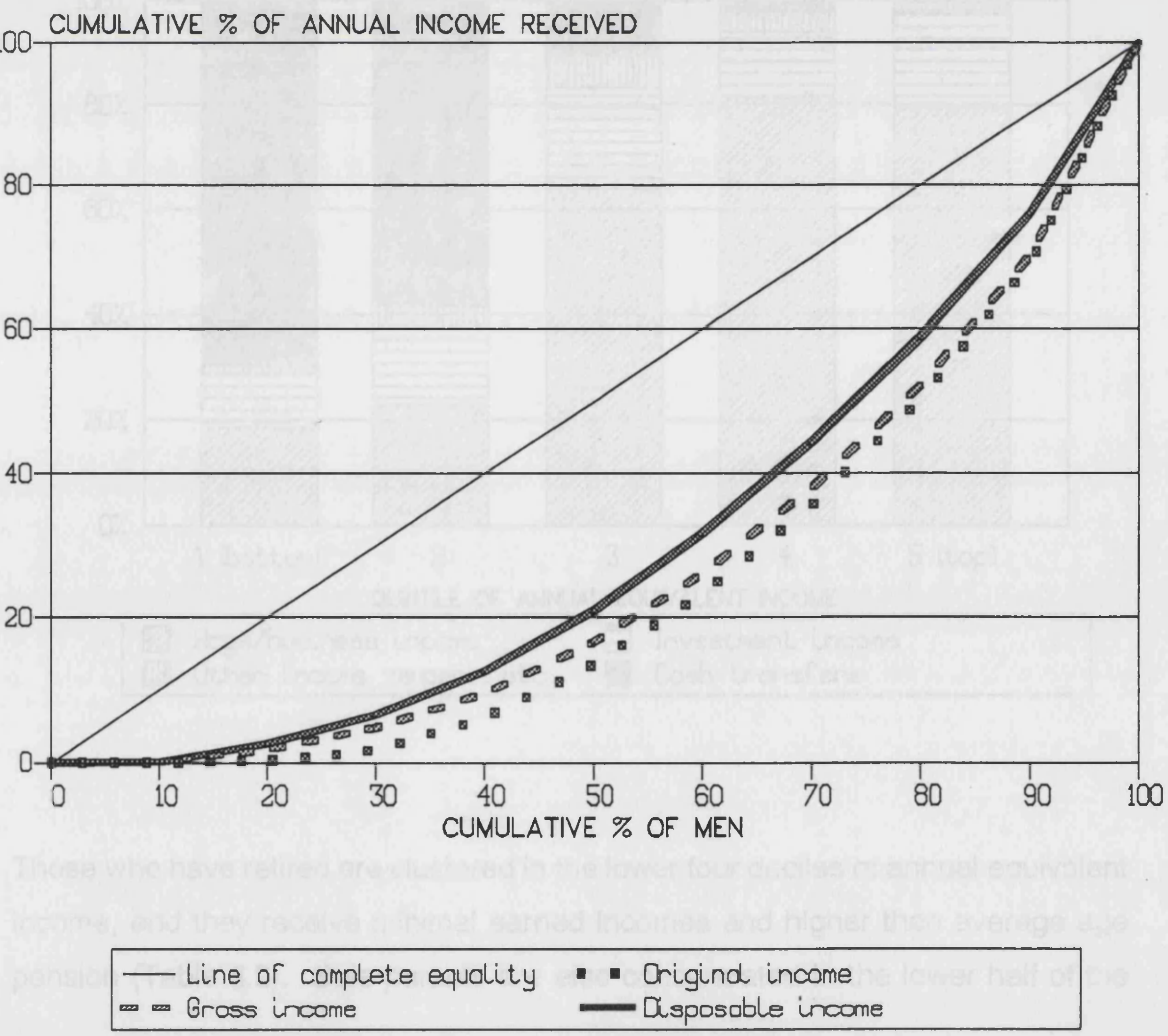
due to the smaller magnitude of transfers received relative to taxes paid. While the *original* annual income of the top quintile is about 19 times greater than that of the bottom quintile of males, their *gross* income after the inclusion of cash transfers is about 10 times greater, while their average annual *disposable* income of around $25,000 is only about 7 times greater than that of the bottom quintile. As comparison with Figure 7.4 demonstrates, this is still a much more unequal distribution of income than that for lifetime income, where the annualised lifetime disposable income of the top quintile was less than three times greater than that of the bottom quintile.

Figure 8.3: The Effect of Cash Transfers and Income Tax Upon the Annual Income Distribution of Men, Ranked by Quintile Groups of Annual Equivalent Income



This effect is also illustrated in Figure 8.4, which plots the Lorenz curves of annual original, gross and disposable income. The curve tracing the distribution of annual *original* income lies well below the comparable curve for annualised lifetime original income plotted in Figure 7.5, and both the annual *gross and disposable* income curves are also well below and to the right of the applicable lifetime curves. While the top 10 per cent of males receive 31 per cent of total original income, they receive only 24 per cent of total disposable income. Similarly, the bottom 20 per cent of males receive less than one per cent of total original income, but 2.7 per cent of total disposable income. Figure 8.4 traces the differential impact of taxes and transfers very clearly, with the equalising impact of transfers being apparent in the significant distance between the curves for original and gross income for individuals at the lower end of the income spectrum, but with income taxes having a much more important impact at higher income levels.

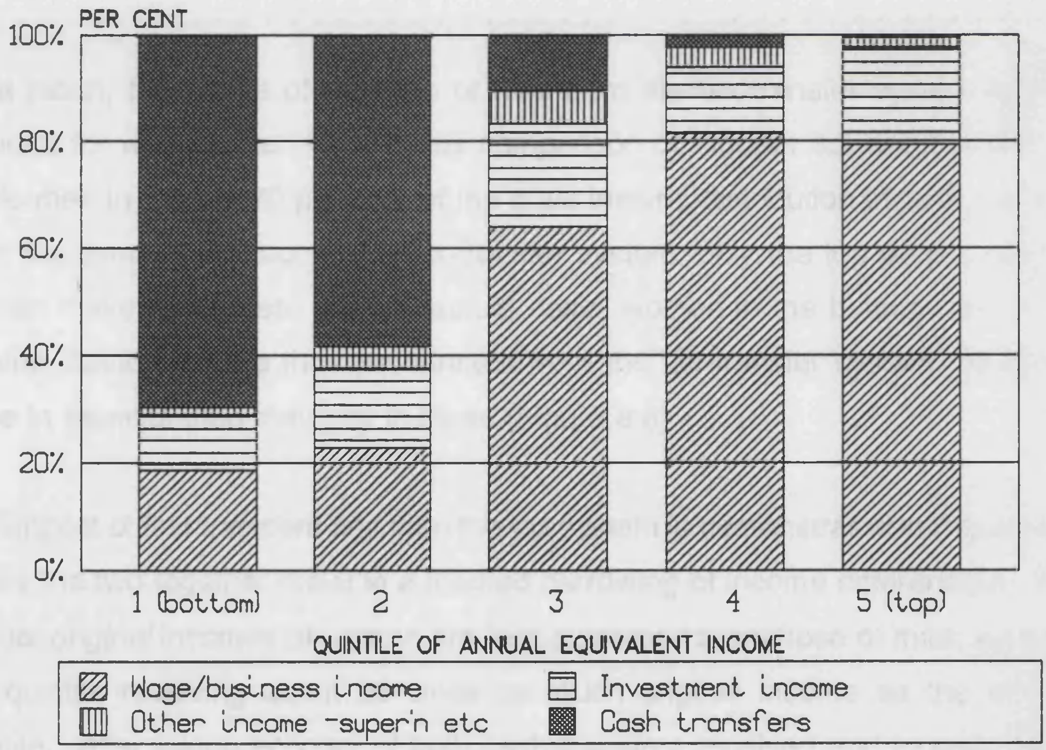
Figure 8.4: Lorenz Curves of Annual Original, Gross and Disposable Income for Men



The Distribution of Women's Annual Income

For women in the lowest two quintiles of annual equivalent income, cash transfers are extremely important, amounting to 70 per cent of all income received for those in the bottom quintile (Figure 8.5). Even though the dollar amount of investment income received by women in the lowest quintile is low, their meagre other income still makes it an important source of income. The lower earnings of women in all deciles makes both investment and superannuation income more significant income sources than for men.

Figure 8.5: Sources of Annual Gross Income for Women, Ranked by Quintile Groups of Annual Equivalent Income



Those who have retired are clustered in the lower four deciles of annual equivalent income, and they receive minimal earned incomes and higher than average age pension (Table 8.2). Sole parents are also concentrated in the lower half of the income distribution, while those in the middle deciles tend to be married women, many of whom have children (Table 8.2). As a result, the average amount of family allowance and FIS received is highest for those in the middle deciles. Students with little or no other income are clustered in the bottom decile.

As one would expect, given the lifetime results, women receive much more benefit from the social security system than men. Although on an annual basis women receive less in unemployment and sickness benefits than men (partly because these benefits are paid to the husband in married couples), they receive higher amounts of age pension on average (because of their lower original incomes and also because more are single) and higher sole parents pension and child related transfers. Because of their lower incomes, women also pay less income tax than men.

As a result, the profile of net gain or loss from the tax-transfer system is very different for women than for men, as comparison of Figures 8.2 and 8.6 shows. While men in the top 70 per cent of the male income distribution incur a net loss from the combined effect of the tax-transfer system, only the top 50 per cent of women make a net loss. On an annual basis, women in the bottom half of the income distribution are thus net winners from the tax-transfer system, receiving more in benefits than they pay in taxes (Figure 8.6).

The impact of first transfers and then the tax system is demonstrated in Figure 8.7, where the two together result in a marked narrowing of income differentials. The annual *original* incomes of women are less dispersed than those of men, with the top quintile receiving about 25 times as much original income as the bottom quintile. After taking account of both cash transfers received and income taxes paid, the *annual disposable* incomes of the top quintile of some $18,000 are only about 6 times greater than those of the bottom quintile. This is far more unequal, however, than the lifetime results shown in Figure 7.9, where women in the top quintile of annualised lifetime equivalent income had disposable incomes which were not even three times greater than those of women in the bottom decile.

Table 8.2: Characteristics of Decile Groups of Women, Ranked by Deciles of Annual Equivalent Income

MEASURE	DECILE OF ANNUAL EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	295	785	760	2,005	4,705	6,920	9,800	13,150	15,400	25,120	7,895
Investment income	310	290	485	1,310	1,470	2,065	1,670	1,755	4,785	4,500	1,865
Superannuation	35	45	25	350	590	435	485	485	295	545	330
ORIGINAL INCOME *	640	1,125	1,300	3,715	6,815	9,465	12,020	15,470	20,525	30,215	10,130
Age and invalid pension	105	2,375	3,390	2,110	610	245	70	5	5	0	890
Unemployment and other benefits	40	135	70	60	55	40	30	20	10	5	45
Sole parents pension #	0	1005	520	535	260	80	35	15	5	5	245
Total child transfers	70	150	100	180	260	240	225	195	130	90	165
Education transfers	60	65	15	35	45	35	20	15	10	5	30
TOTAL CASH TRANSFERS	275	3,770	4,130	2,950	1,250	650	375	250	160	105	1,390
GROSS INCOME	915	4,895	5,425	6,660	8,065	10,115	12,395	15,720	20,685	30,320	11,520
Income tax paid	0	15	105	555	1,050	1,665	2,410	3,505	5,430	10,400	2,515
DISPOSABLE INCOME	915	4,880	5,320	6,110	7,015	8,450	9,985	12,220	15,250	19,915	9,005
Shared disposable income (family unit)	890	5,160	5,695	7,045	8,885	10,600	12,575	14,780	17,315	22,760	10,570
Equivalent disposable income (family unit)	1,535	8,150	9,520	11,405	14,005	17,030	20,355	24,310	29,475	40,790	17,660
Equiv inc - 60:40 split	1,385	7,745	8,815	10,295	12,355	14,900	17,850	21,335	26,105	34,805	15,560
Av no dependent children	0.17	0.39	0.27	0.53	0.78	0.74	0.71	0.63	0.44	0.32	0.50
Per cent married	31.1	26.7	36.8	48.4	58.8	62.6	61.4	61.3	57.6	73.1	51.8
Per cent sole parents	0	11.4	4.0	7.7	8.5	7.5	6.6	5.8	2.5	1.6	5.6
Per cent above legal retirement age	28.5	50.6	69.6	51.1	27.7	21.9	16.1	12.6	19.3	11.6	30.9
Per cent in labour force	25.1	26.0	18.1	34.7	54.0	62.6	71.1	79.2	77.2	88.4	53.6
Average age	40.9	53.4	61.9	53.5	44.4	43.0	42.6	42.7	47.0	47.4	47.7

* Includes maintenance. # Includes widows pension. All income figures rounded to nearest $5. Totals may not sum due to rounding.

Figure 8.6: Amount of Cash Transfers Received and Income Tax Paid by Women, Ranked by Deciles of Annual Equivalent Income

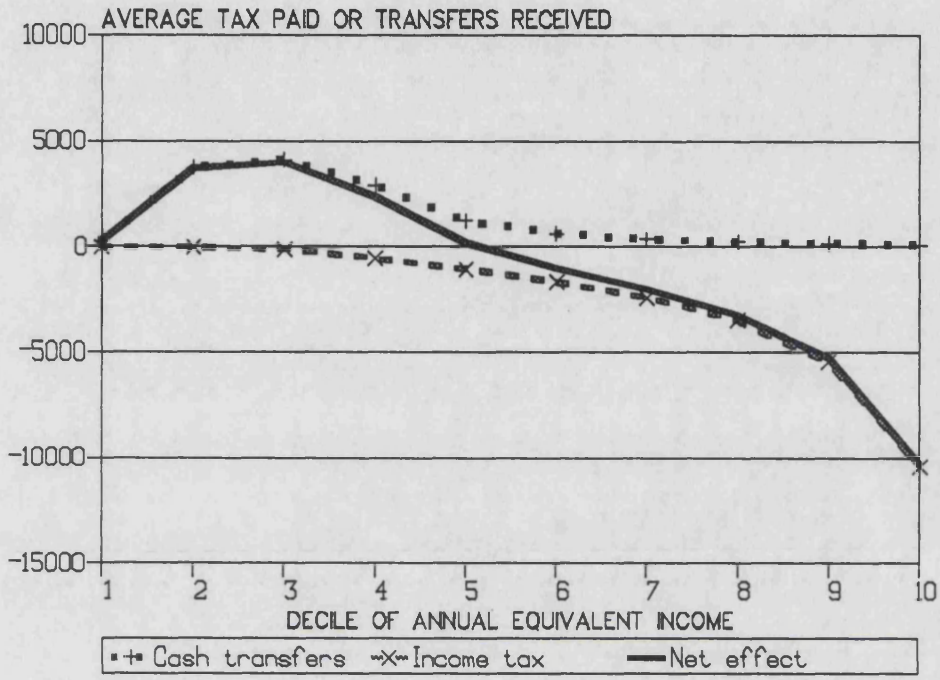
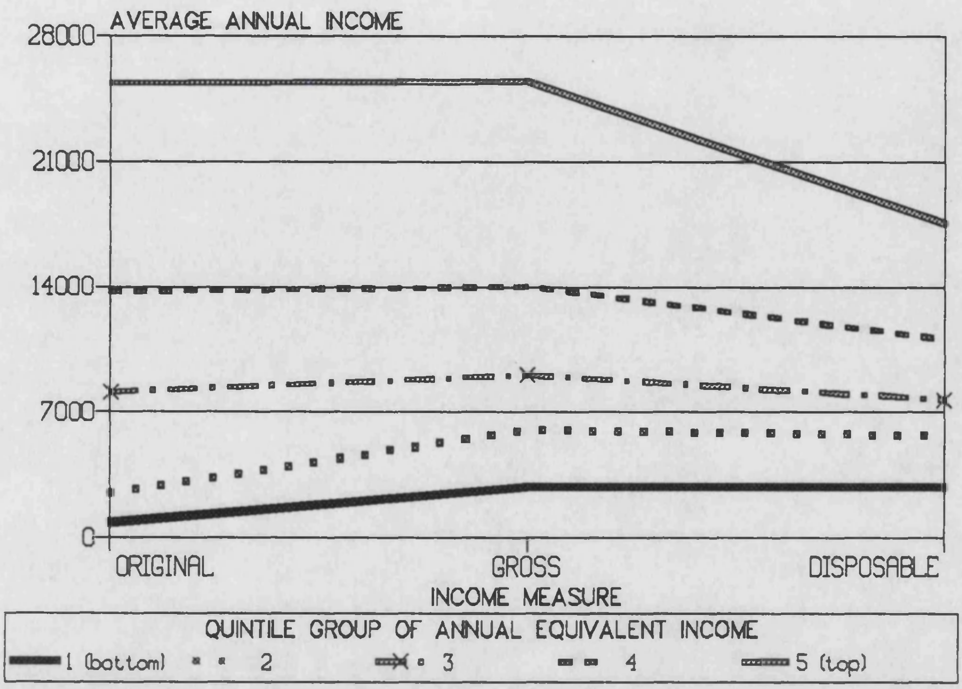
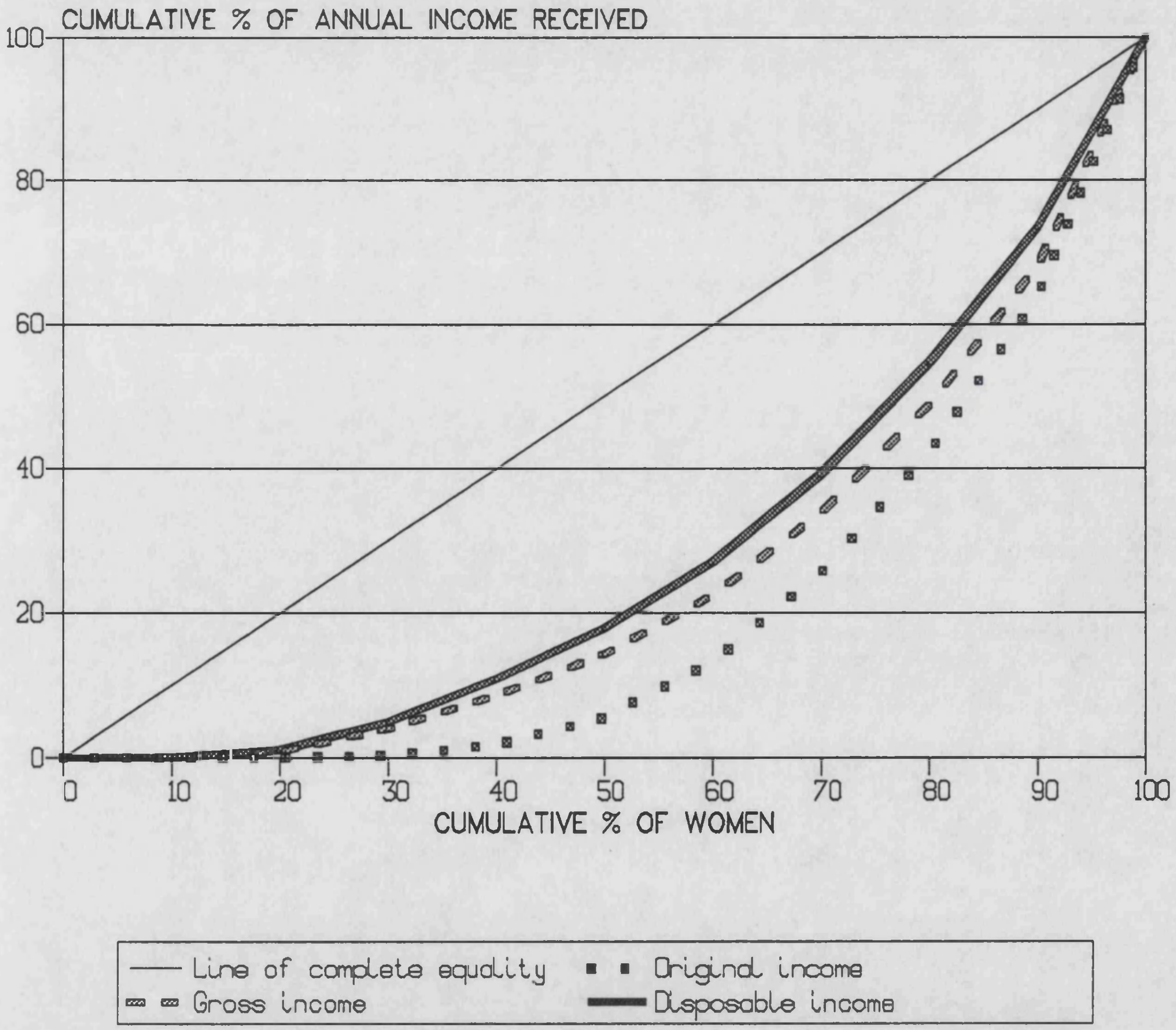


Figure 8.7: The Effect of Cash Transfers and Income Tax Upon the Annual Income Distribution of Women, Ranked by Quintile Groups of Annual Equivalent Income



Although the gap between the average disposable incomes of the top and bottom quintiles of women is lower than the comparable gap for males, women's annual incomes are more unequally distributed than men's, as Figure 8.8 demonstrates. Because such a large proportion of women have little or no personal income, the original income distribution of women is far more unequal. However, cash transfers play a major role in creating a more equal distribution of income among women, as shown by the substantial distance between the original and gross income curves. The top 10 per cent of all women receive 36 per cent of total *original* income, while the bottom 20 per cent receive less than one per cent. After the combined impact of the tax-transfer system, the share of total *disposable* income received by the former group falls to 26 per cent, while the share received by the latter increases to 1.2 per cent.

Figure 8.8: Lorenz Curves of Annual Original, Gross and Disposable Income for Women.



The Distribution of Annual Income for the Whole Population

While the preceding analysis has dealt with men and women separately, it is also possible to combine their records to derive a synthetic cross-section distribution for the entire population. The results are summarised in Table 8.3 and show that, once again, women tend to be clustered in the lower income deciles, even though all individuals have been ranked on the basis of their annual equivalent income. For example, women comprise almost 60 per cent of all individuals in the second, third and fourth bottom deciles.

However, it is interesting to note that women are less concentrated towards the lower end of the income spectrum on an annual basis than on a lifetime basis. For example, while 42 per cent of those in the top decile of *annual* equivalent income are female, only one-third of those in the top decile of *annualised lifetime* equivalent income are female. This suggests that annual income distributions overstate the relative lifetime income position of women, perhaps because the additional years that women spend in receipt of low post-retirement incomes lowers their average lifetime incomes.

The standard lifecycle effects found in all studies of annual income distributions are again apparent, with families with children being concentrated in the middle of the income distribution and the elderly being clustered in the bottom third of the distribution. The average age within deciles varies correspondingly, with the average 39 years for those in the bottom decile reflecting the averaging of the ages of young full-time students and poor elderly people. Age in the second and third deciles averages 54 to 59 years, due to the predominance of retired individuals, and then declines smoothly over the following four deciles as the composition within deciles shifts to middle-aged families with children. Finally, average age rises again for the top two deciles, reflecting the increases in equivalent income which occur when children leave home but parents are still in the labour force. The notable correlation between annual income and labour force participation found in other studies is also evident (CSO, 1990), with labour force participation rates increasing steadily with annual equivalent income, rising from 31 per cent for those in the bottom decile to 92 per cent for those in the top decile.

Social security and education cash transfers are again heavily biased in favour of those in the lower half of the income distribution, with some leakage of child transfers towards those near the top of the income spectrum, due to the non-income-tested nature of family allowances. Income taxes also show great variation, with those individuals in the top decile paying 39 per cent of their total gross income in income tax, while those in the second bottom decile pay less than one per cent of their gross income in tax on average.

The annual income distribution of the entire population is again much more unequal than the lifetime distribution. For example, while the *annual disposable* income of the second bottom decile of just under $5,000 amounts to one-fifth of the annual disposable income received by the top decile, the *annualised lifetime disposable* income of the second bottom decile of about $7,000 amounts to about one-third of the income of the top decile (Table 7.5).

Because both males and females are included in the table, shared disposable income is the same as disposable income, as the losses incurred by males when the income measure is shifted to shared disposable income are exactly counterbalanced by the gains made by females. For the same reason, equivalent income when a 60:40 split within the family is assumed is the same as the standard equivalent income measure, which assumes equal sharing.

The *annual equivalent* income measure shown in Table 8.3 is conceptually comparable to that found in annual income studies which use the family as the income unit (although the definition of even the family income unit is slightly different, because the simulation treats full-time students aged 15 and over as separate income units). However, one can partially eliminate this effect by ignoring the bottom decile, with the annual family *equivalent* income of those in the second bottom decile of $8000 being just under one-fifth of that received by the top decile.

Table 8.3: Annual Income and Other Characteristics of the Population, Ranked by Deciles of Annual Equivalent Income

MEASURE	DECILE OF ANNUAL EQUIVALENT DISPOSABLE INCOME										
	1	2	3	4	5	6	7	8	9	10	Average
Earnings	355	1,320	1,785	4,670	8,760	11,585	14,975	18,150	21,180	33,780	11,655
Investment income	275	325	595	1,180	1,305	1,540	1,475	1,845	3,615	4,870	1,705
Superannuation	20	45	55	420	450	490	565	640	630	885	420
ORIGINAL INCOME *	645	1,695	2,460	6,300	10,545	13,640	17,045	20,670	25,445	39,560	13,800
Pension	45	2,855	3,350	1,760	440	200	30	10	5	5	870
Unemployment and other benefits	40	215	180	140	110	70	50	30	15	5	85
Total child transfers	35	85	70	115	140	125	110	90	60	35	85
Education transfers	65	95	25	30	30	15	10	10	5	5	30
TOTAL CASH TRANSFERS	180	3,245	3,620	2,045	720	410	205	140	85	50	1,070
GROSS INCOME	830	4,945	6,080	8,340	11,265	14,050	17,250	20,805	25,525	39,610	14,870
Income tax paid	0	30	250	995	1,975	2,960	4,135	5,505	7,600	15,340	3,880
DISPOSABLE INCOME	830	4,915	5,830	7,345	9,295	11,090	13,115	15,305	17,930	24,270	10,990
Shared disposable income (family unit)	830	4,915	5,830	7,345	9,295	11,090	13,115	15,305	17,925	24,270	10,990
Equivalent disposable income (family unit)	1,430	8,015	9,785	12,055	14,985	18,160	21,605	25,680	30,900	43,225	18,585
Av no dependent children	0.16	0.35	0.34	0.61	0.79	0.71	0.66	0.55	0.38	0.24	0.48
Per cent married	30.5	32.9	45.1	59.3	65.7	65.0	62.5	60.0	56.9	62.4	54.0
Per cent above legal retirement age	26.1	52.0	64.3	43.5	23.6	20.2	14.4	12.9	15.8	12.8	28.6
Per cent in labour force	30.9	34.6	28.8	50.4	68.6	74.9	82.7	87.0	86.2	92.4	63.6
Average age	39.0	53.8	59.3	50.3	43.0	42.8	42.0	42.7	45.6	47.3	46.6
Per cent female	50.4	58.6	59.1	57.0	53.9	52.3	50.8	48.9	48.8	41.8	52.2

* Includes maintenance. All income measures rounded to nearest $5. Totals may not sum due to rounding

8.3 LIFETIME VS ANNUAL INCOME DISTRIBUTION

Annual and Lifetime Income Distribution

While cross-sectional studies of the income distributions of industrialised countries have typically found income to be very unequally distributed (Sawyer, 1976), suspicions have been voiced that the lifetime distribution of income would be much more equal. Many have pointed out that much apparent income inequality is simply due to the sampled income units being at different stages of their lifecycles and that, for example, one would expect retired households or teenagers just entering the workforce to have substantially lower incomes than those in their peak working years in full-time jobs (Paglin, 1975; Polinsky, 1973; Blinder, 1974:102).

The results reported above suggest that lifetime income is very much more equally distributed than annual income. However, it must be emphasised that the results apply to a steady state world, and simply show the distributions of lifetime and annual income which would exist if current conditions continued for a number of generations. In the real world there is likely to be redistribution between generations (Altmann and Atkinson, 1982).

Table 8.4 reports the Gini coefficients and the coefficient of variation for different types of income, on both an annual and lifetime basis, produced by the simulation model. As suggested by the results presented earlier, the distribution of *annualised lifetime earnings*, as measured using the Gini coefficient, is about 50 per cent more equal than the distribution of earnings revealed in the synthetic annual snap-shot. Because of the substantial number of women with low lifetime earned incomes, the distribution of annualised lifetime earnings is more unequal for women than for men. On a lifetime basis, the substantial gap between the earnings of men and women means that the Gini for the cohort as a whole is higher than for either of the sexes taken separately.

The lifetime *original* income distribution is also much more equal than the annual

Table 8.4: Gini Coefficients and Coefficients of Variation of Selected Annualised Lifetime and Annual Income Measures

MEASURE	ANNUALISED LIFETIME		ANNUAL	
	Gini Coefficient	Coefficient of Variation	Gini Coefficient	Coefficient of Variation
MALES				
Earnings	.286	0.552	.542	1.047
Original income	.320	0.630	.510	0.999
Gross income	.299	0.592	.470	0.930
Disposable income	.232	0.434	.398	0.725
Equivalent income	.200	0.374	.356	0.656
FEMALES				
Earnings	.333	0.643	.685	1.466
Original income	.352	0.671	.606	1.239
Gross income	.296	0.567	.507	1.035
Disposable income	.246	0.450	.447	0.827
Equivalent income	.183	0.332	.349	0.644
ALL				
Earnings	.353	0.686	.623	1.260
Original income	.363	0.719	.568	1.142
Gross income	.323	0.645	.501	1.017
Disposable income	.259	0.485	.433	0.799
Equivalent income	.193	0.360	.354	0.653

distribution produced by the synthetic cross-section, with the Gini coefficient for *annualised lifetime original* income for males of 0.320 being some 37 per cent lower than the Gini of 0.510 found for annual original income of males. The lifetime distribution of original income is *more unequal* than that of earnings, because investment income and superannuation are more unequally distributed across lifetime income deciles than are earnings, so the Gini for annualised lifetime original income is higher than that for lifetime earnings. However, the reverse is true for the annual distribution, where the Gini for annual original income is lower than that for earnings, because of the number of elderly with lower incomes receiving investment and superannuation income. In other words, in the annual income distribution, investment and superannuation income tend to offset the inequalities in earned income, while in the lifetime income distribution they reinforce the inequalities in earned income.

As noted earlier, the *original* income distribution of *females* is much more unequal than that of males, because of the significant proportion of women with little or no personal income. This is reflected in the higher values of the Gini coefficients for both the annual and annualised lifetime original incomes of women. Once again, however, the distribution of lifetime original income is massively more equal than the distribution of original income captured in the synthetic cross-section snapshot, with the relevant Gini for annualised lifetime original income of 0.352 being about 42 per cent lower than the comparable annual Gini for female original income.

The distribution of both annual and lifetime *gross* income for *males* is more equal than that of original income, reflecting the equalising effect of cash transfers. Such transfers result in an 8 per cent decline in the Gini for annual gross income and a 6.5 per cent decline in the Gini for lifetime annualised gross income, to 0.470 and 0.299 respectively. The inequality of incomes is further reduced by income taxes, with the Gini coefficient for *annual disposable* income for males falling to 0.398. Once again, the distribution of *annualised lifetime disposable* income is far more equal, as demonstrated by the Gini coefficient of 0.232 - amounting to only 58 per cent of the value of the relevant annual Gini.

The enormous importance of cash transfers to *women* was again emphasised by the sharp decline in the Gini coefficient when the *gross* income distribution of women was considered. The perhaps suprising extent to which cash transfers help to equalise the income distribution of women was demonstrated in the 16 per cent decline in both the annual and lifetime Ginis when moving from the original to gross income measures, although the marked disparity between the inequality of annual and lifetime income remained.

Income taxes again reduced the inequality of income, resulting in a Gini of 0.246 for the *annualised lifetime disposable* income distribution of women. This was slightly more unequal than the comparable distribution for men, as shown in the Lorenz curves upon which these coefficients were based, which were plotted in Figure 7.11.

While the equivalent income measure is not strictly comparable, as it effectively switches from using the individual as the income unit to using the family as the income unit, the *equivalent* income of males is again more equally distributed than any of the personal income measures, with a Gini for annualised lifetime equivalent income of 0.2. Similarly, while all the above figures on the personal incomes received by women suggested that the lifetime standards of living experienced by women would differ greatly, the disparities apparent in personal income were reduced once income sharing within households was considered, with the Gini for *annualised lifetime equivalent* income for women falling to 0.183. Thus, many of those women with low personal incomes belonged to families where the spouse received substantial income.

When the *cohort as a whole* was considered, the *lifetime* income distribution was more unequal than the lifetime income for either sex considered separately, as there was a larger gap between the incomes of low income women and high income men. However, on an *annual* basis, combining men and women tended to average the Gini coefficients apparent for each sex. The Gini for *annualised lifetime original* income of 0.363 was slightly more than 60 per cent of that for annual original income. A similar gap was observed between the annualised lifetime and annual Gini coefficients for the other income measures.

How do these findings compare with those of other studies? Davies et al observe that on the basis of existing estimates "about one-half of annual earnings inequality (according to conventional measures) disappears when one looks at lifetime earnings" (1984:635). Using longitudinal data for a sample of American males born between 1917 and 1925, Lillard found that "inequality in earnings at any stage of the lifecycle for men over 30, as measured by either the coefficients of variation of the Gini coefficient is 50 per cent larger than inequality in human wealth" (with the latter being his term for lifetime earnings)(1977:49). This relative gap seems comparable to that produced in the simulation for males.

Blomquist simulated lifetime earnings and income for Sweden, based upon two sample surveys six years apart of the same respondants, and found that the Gini coefficient for simulated pre-tax lifetime income was also about half that of annual income (with the precise figure ranging from 44 to 53 per cent depending upon the income concept used and the age of those in the annual income distribution) (1976:249). However, while this would support the finding in the HARDING model of a substantial gap between the inequality of lifetime and annual income, the inequality of lifetime income simulated by Blomquist was much lower than that found in the current study, with his Gini co-efficient for pre-tax income of 0.122 being less than half that of the 0.299 Gini found for male annualised lifetime gross income in the model.

Soltow's study of the Norwegian city of Sarpsborg found that while annual Gini ratios averaged 0.183 over the period 1928-1960, the 33 year Gini for the same sample was 0.134 - about 27 per cent less (cited in Blinder, 1974:103). Blinder himself, based on his 1974 simulation, suggests that the Gini ratio for lifetime income "might be around 0.25 to 0.30" of that for annual income, and for the 'egalitarian society' version of his model found the lifetime Gini to be 0.295, compared to an annual Gini of 0.43 (1974:104,137). Bourguignon and Morrison found less difference than this, but their sample only included relatively elite workers and also did not include the years immediately following labour force entry, both of which would reduce the apparent inequality of lifetime earnings (1983:68).

On the whole, the magnitude of the difference between lifetime and annual income produced by the model does not appear out of step with existing studies, although the relative inequality of both seems somewhat higher than found in some studies. On the other hand, when used to simulate a synthetic cross-section distribution, the Canadian DEMOGEN lifetime model produced Gini coefficients for annual earnings which were very close to those generated by the HARDING model (Wolfson, 1988:231). As Wolfson observed, "the Gini coefficients for earnings may appear a bit high, but it should be noted that they are computed across all individuals in each age-sex group, not just those with positive earnings" (1988:232).

It thus seems likely that the observed differences between the magnitude of the Gini coefficients produced by the model and found in some other lifetime studies may be due to variations in the definition of the income unit or in the sample considered. For example, both the annual and lifetime samples in the model included the records of students aged 15 and over with little or no other income who had not yet entered the workforce, and this group are often excluded from lifetime studies. It would be possible at some stage in the future to delete those records, and examine the resultant effect upon the relevant Ginis, but there is no obvious reason, apart from the desirability of checking comparable results against those of other studies, why years with little or no income should be excluded from the calculation of lifetime income.

Annual-Lifetime Transition Matrices

The above results therefore suggest that much of the inequality apparent in annual income distributions is due to the sampled income units being at different stages of their lifecycles. A corollary is that many of those in the bottom decile of income in a cross-section survey will not remain in the bottom decile once lifetime income is considered. Another way of examining the issue is therefore to construct transition matrices, which show how many of those in a particular decile in the synthetic cross-section sample remain in the same decile of lifetime income.

Males

The results indicate that the decile of *annual* equivalent income achieved by males in a cross-section survey does provide some indication of their relative position in the distribution of annualised *lifetime* equivalent income. As Table 8.5 shows, almost one-fifth of males remained in the same decile of both annual and lifetime income, while 44 per cent either remained in the same decile or moved up or down by only one decile. As with all transition matrices, there was less movement at the extremes of the income distribution. For example, of those males who were in the *bottom decile of annual equivalent income*, almost 46 per cent were placed in the bottom three deciles of lifetime equivalent income. The position of males who were in the *top decile* of annual equivalent income was even more stable, with almost half remaining in the top decile of lifetime income and about 85 per cent achieving a place in the top three deciles of lifetime income. Thus, for about half of those males captured in a cross-section study who are in the top decile of annual equivalent income (presumbly because they are of prime working age and earning high incomes), their privileged annual position provides an accurate guide to their relative lifetime position.

Table 8.5: Transition Matrix of Decile of Annual Equivalent Income by Decile of Annualised Lifetime Equivalent Income for Males

Decile of Male Annualised Lifetime Equivalent Inc	Decile of Male Annual Equivalent Income									
	1	2	3	4	5	6	7	8	9	10
1	**22**	23	18	14	10	6	4	2	0	0
2	14	**18**	16	14	13	11	8	4	1	0
3	10	15	**15**	14	14	12	10	7	3	0
4	10	12	13	**12**	12	11	12	10	7	1
5	9	9	11	11	**12**	12	13	12	9	3
6	8	7	10	11	10	**11**	13	14	11	5
7	8	6	7	10	10	10	**11**	14	15	8
8	7	5	5	7	8	11	11	**14**	19	13
9	6	3	3	5	7	10	11	13	**19**	23
10	5	2	1	2	3	5	7	9	17	**48**

Females

Do the same conclusions apply to women? The relative position of women in a cross-section study appears to provide a slightly less accurate indicator of their relative lifetime position than for men, but the difference is very marginal. Some 17.5 per cent of women remained in both the same annual and lifetime income decile, compared to 18.2 per cent of men (Table 8.6). About 44 per cent either remained in the same decile or moved up or down by only one decile. However, those women who were in the bottom decile were more likely to stay there than men, with 27 per cent failing to improve their relative position, while those women in the top decile of female annual equivalent earnings were less likely to maintain their relative advantage than men in the top decile, with just under two-fifths of those in the top decile of annual income also being placed in the top decile of annualised lifetime equivalent income.

Table 8.6: Transition Matrix of Decile of Annual Equivalent Income by Decile of Annualised Lifetime Equivalent Income for Females

Decile of Female Annualised Lifetime Equivalent Inc	Decile of Female Annual Equivalent Income									
	1	2	3	4	5	6	7	8	9	10
1	**27**	17	16	11	12	8	5	3	1	0
2	14	**16**	19	13	13	11	9	5	2	0
3	10	13	**17**	13	12	12	11	8	3	0
4	9	12	13	**12**	12	12	12	10	5	2
5	9	10	11	12	**11**	11	11	12	9	4
6	7	8	8	13	10	**10**	12	13	12	7
7	7	9	6	10	9	11	**11**	13	14	11
8	6	6	4	8	9	10	12	**13**	17	14
9	5	5	3	5	8	10	11	12	**18**	23
10	4	3	2	3	4	6	7	11	19	**40**

Whole Population

Finally, does it make any difference if the entire population is considered, rather than just males or females? Table 8.7 indicates that considering both sexes together does not markedly alter mobility patterns, with 18.1 per cent remaining in the same decile of lifetime income and 44 per cent either staying in the same position or moving up or down by only one decile. This suggests again that although cross-section income surveys provide some guide to the likely relative income position of respondents during their entire lifetimes, it can certainly not be assumed that those who have high incomes - or more particularly, very low incomes - in a cross-section survey will remain rich or poor respectively during their entire lifetimes.

The extent of 'slippage' appears, however, to again be greater for those with low incomes than for those with high incomes in cross-section surveys. Thus, five per cent of those who were placed in the bottom decile of annual income managed to achieve the top decile of lifetime income, although one-quarter of those in the bottom decile still remained in the bottom decile of lifetime income. Similarly, the high incomes recorded by some of those who made the top decile of annual income represented a brief period of relative wealth (perhaps due to a few years of high employment income), with almost 10 per cent of these slipping into the bottom half of the income distribution once lifetime income was considered. For 44 per cent of those in the top decile of annual income, however, their relative advantage was maintained during their lifecycle and they thus achieved the top decile of lifetime income.

Table 8.7: Transition Matrix of Decile of Annual Equivalent Income by Decile of Annualised Lifetime Equivalent Income for Whole Population

Decile of Life Time Annualised Equivalent Inc	Decile of Annual Equivalent Income									
	1	2	3	4	5	6	7	8	9	10
1	**25**	20	18	12	11	7	4	2	0	0
2	13	**17**	18	13	13	10	8	5	2	0
3	11	14	**16**	13	12	12	11	7	3	1
4	9	11	13	**13**	12	12	12	10	6	2
5	9	10	11	12	**11**	11	12	13	12	6
6	8	8	9	11	11	**11**	12	13	12	6
7	7	7	7	10	9	11	**12**	14	14	9
8	7	5	4	7	9	11	11	**13**	17	14
9	6	4	3	5	7	9	11	13	**19**	22
10	5	2	1	2	3	5	7	10	17	**44**

8.4 LIFETIME VS ANNUAL TAX-TRANSFER INCIDENCE

Fiscal incidence studies of the impact of taxes and transfers during a single year have repeatedly found the incidence of cash transfers and income taxes to be progressive (Reynolds and Smolensky, 1977; Ross, 1980; ABS, 1987b). However, many have argued that such snapshot analyses of incidence were likely to overstate the redistributive impact of the state, and that over a longer time period the contribution made by taxes and transfers to equalising income distribution might be much less significant. The results of this model certainly suggest this is the case, perhaps to a much greater extent than was anticipated.

Cash Transfers

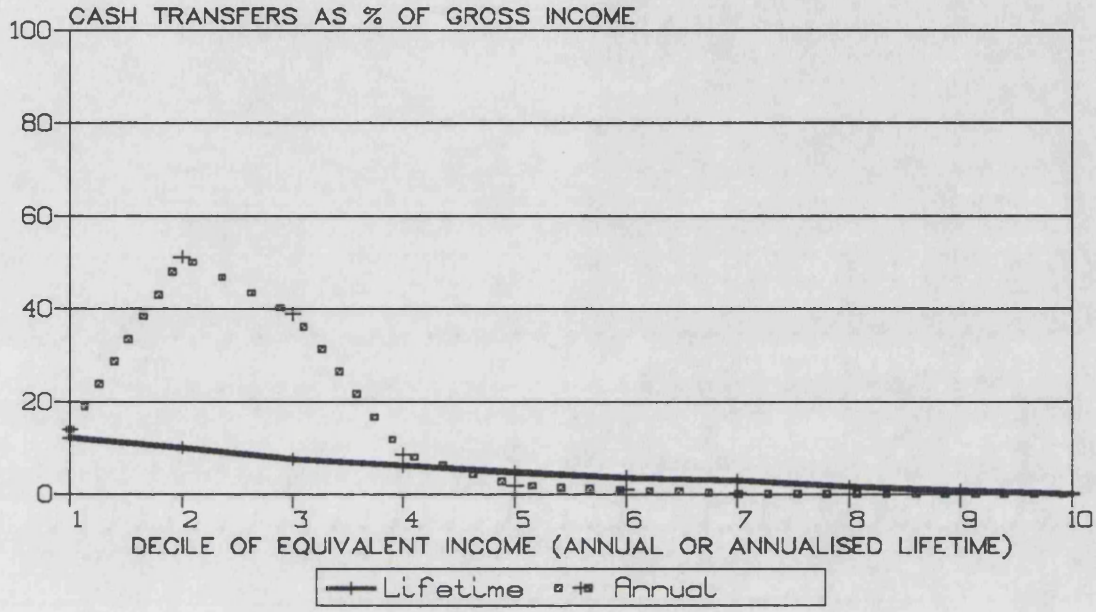
The lifetime and annual incidence of *cash transfers* for men and women is shown in Figure 8.9. For both sexes, cash transfers appear far more progressive on an annual basis than on a lifetime basis. For men, annualised *lifetime* cash transfers are progressive, amounting to about 12 per cent of annualised lifetime gross income for those in the bottom decile of annualised lifetime equivalent income and declining to well under 1 per cent of income for those in the top decile. The *annual* incidence is far more striking, with cash transfers comprising more than half of the income of those in the second decile of annual equivalent income (dominated by age pensioners) but less than two per cent of gross annual income for those in the top half of the annual equivalent income distribution.

For women, cash transfers are even more important, reaching 30 per cent of annualised gross income for those in the bottom decile of annualised *lifetime* equivalent income. However, on an *annual* basis the apparent redistributive impact of cash transfers is remarkably different, with such transfers reaching about 75 per cent of gross income for those in the second and third deciles of annual equivalent income. (As discussed earlier, many of those in the bottom decile of annual income for both men and women are full-time students with little or no private income who are not receiving education cash transfers.)

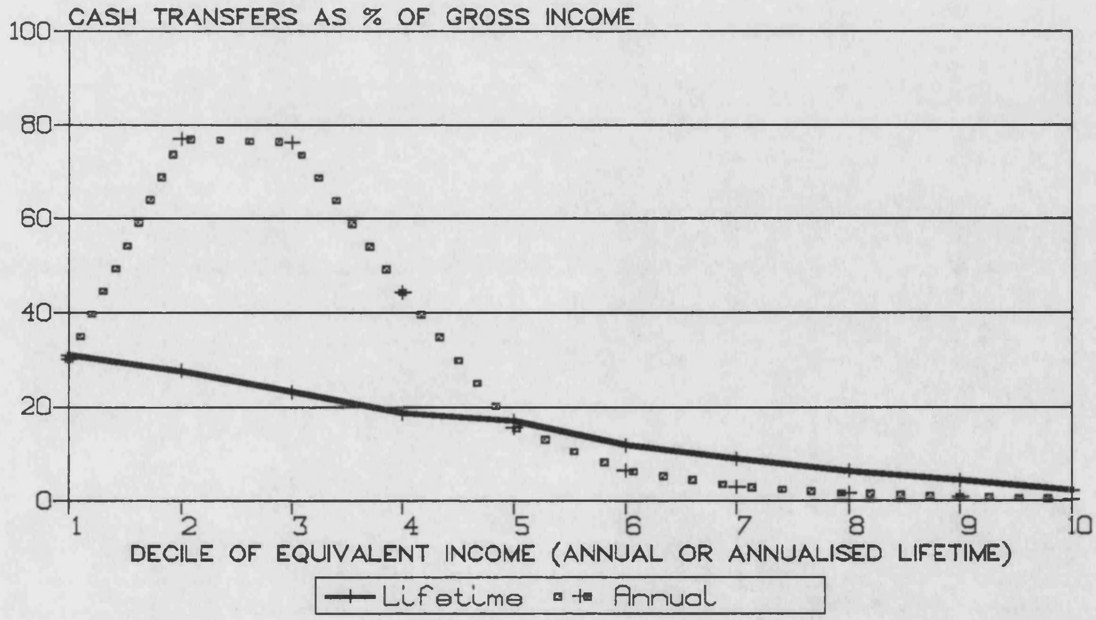
It is also possible to contrast the difference between the lifetime and annual distribution of transfers by constructing *concentration* curves of transfers received. Such curves are similar to Lorenz curves for income, but instead plot the cumulative percentage of transfers received against the cumulative percentage of individuals. It is important when interpreting the curves to appreciate that the vertical axis shows the cumulative percentage of individuals, who are not ranked into income deciles or ranked on the basis of their income, but who are ranked by the *amount of cash transfers received.*

Figure 8.9: Lifetime and Annual Incidence of Cash Transfers by Sex

MEN



WOMEN



As Figure 8.10 shows, on an *annual* basis a striking 70 per cent of men receive no cash transfers at all during the year. Amongst all men, 70 per cent of all transfers paid out during the year are chanelled towards only 10 per cent of men. However, during their entire *lifetimes* only 7 per cent of men receive no cash transfers at all.

The bottom 10 per cent of men, ranked by amount of annualised lifetime cash transfers received, gain only 0.1 per cent of total cash transfers received by all men during their entire lives. The bottom 50 per cent receive 13 per cent of total cash transfers, while those in the top 10 per cent of cash transfer recipients receive just over one-quarter of lifetime cash transfers paid to men.

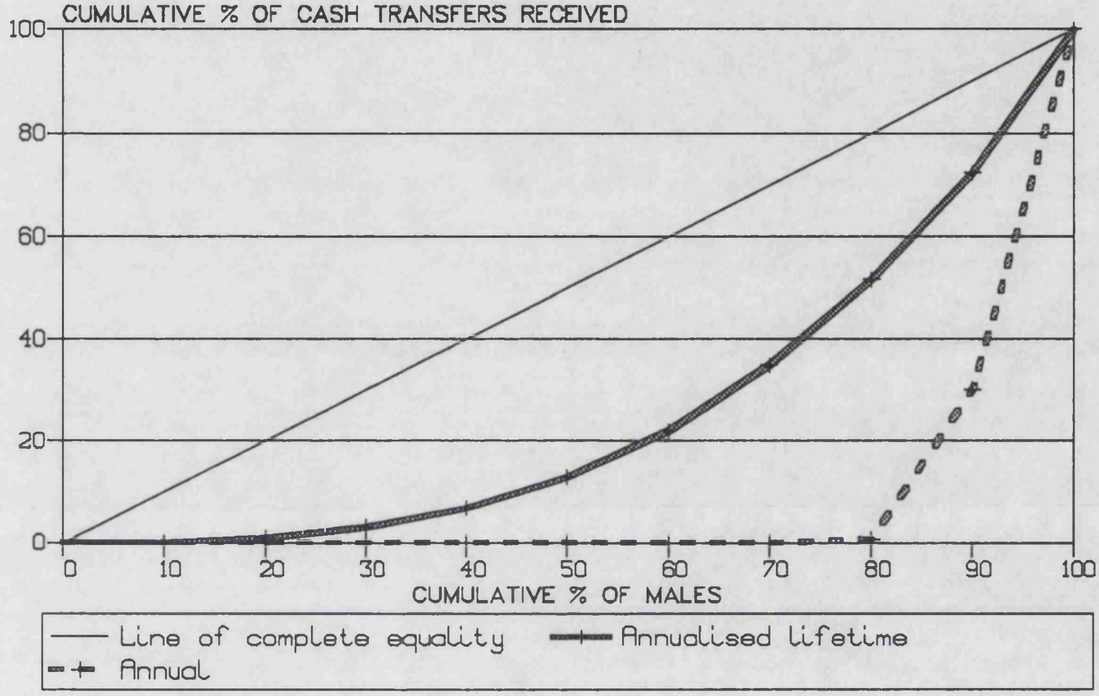
For women, the *annual* distribution of cash transfers is more equal, reflecting in part the pervasiveness of child transfers, although 30 per cent of women still receive no cash transfers at all during a single year. Those in the fourth decile receive only 1.2 per cent of all cash transfers, while those who are among the top ten per cent of cash transfer receivers gain slightly more than 40 per cent of all cash transfers.

The *lifetime* distribution of cash transfers is very much more equal, with only 0.005 per cent of women receiving no cash transfers during their entire lives and those in the bottom 10 per cent of cash transfer receivers gaining 1.1 per cent of total transfers. Of all cash transfers paid to women during their entire lives, those in the top 10 per cent of recipients take 23 per cent of total transfers.

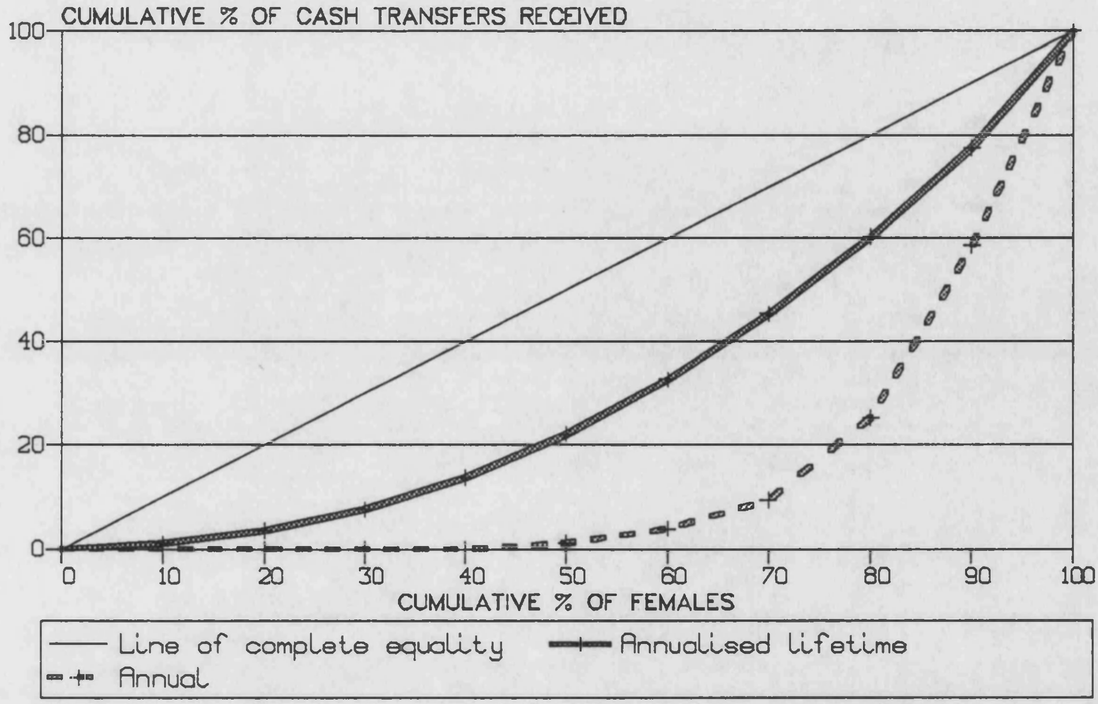
Can these results be compared with any other lifetime studies? The above results cannot be directly contrasted with those produced by Davies et al, as the incidence of cash transfers produced by their microsimulation model is not reported, but they also find that "over the lifetime transfers are less heavily concentrated in the bottom two deciles of the population than in the annual data" and that "the decline in the relative importance of transfers as income rises is also less marked" on a lifetime than on an annual basis (1984:640). (Their model does not include any full-time students so their bottom two deciles of annual income consist largely of the elderly, who are concentrated in deciles two and three in Figure 8.9.)

Figure 8.10: Concentration Curves of Lifetime and Annual Cash Transfers Received for Men and Women

MEN



WOMEN



Income Tax

Figure 8.11 traces the lifetime and annual incidence of *income taxes* for men and women. When assessed against *annual* income the incidence of taxes appears highly progressive, rising from zero per cent of gross income for those in the lowest annual equivalent income decile to more than 40 per cent of gross income for those in the top 10 per cent of the distribution. This 40 per cent figure appears quite high, perhaps because, as described in Chapter 5, no explicit account is taken of possible tax evasion. In addition, although the impact of tax avoidance should be partially captured through the taxable investment incomes imputed in the model being lower than they would be in the absence of tax avoidance, it is possible that the original IDS data tape from which investment incomes were estimated did not measure such incomes very accurately (due, for example, to respondents understating the extent of negative gearing or other negative taxable investment income).

On a *lifetime* basis, annualised lifetime income taxes are much less progressive but nonetheless do still contribute to a more equal income distribution, rising from about 14 per cent of annualised lifetime gross income for the decile of males with the lowest lifetime standard of living, to 41 per cent of gross income for the most affluent decile. However, the annual and lifetime incidence by decile of equivalent disposable income is strikingly similar from the sixth decile onwards, and the proportion of gross income paid in tax by the top decile is much the same on both a lifetime and annual basis.

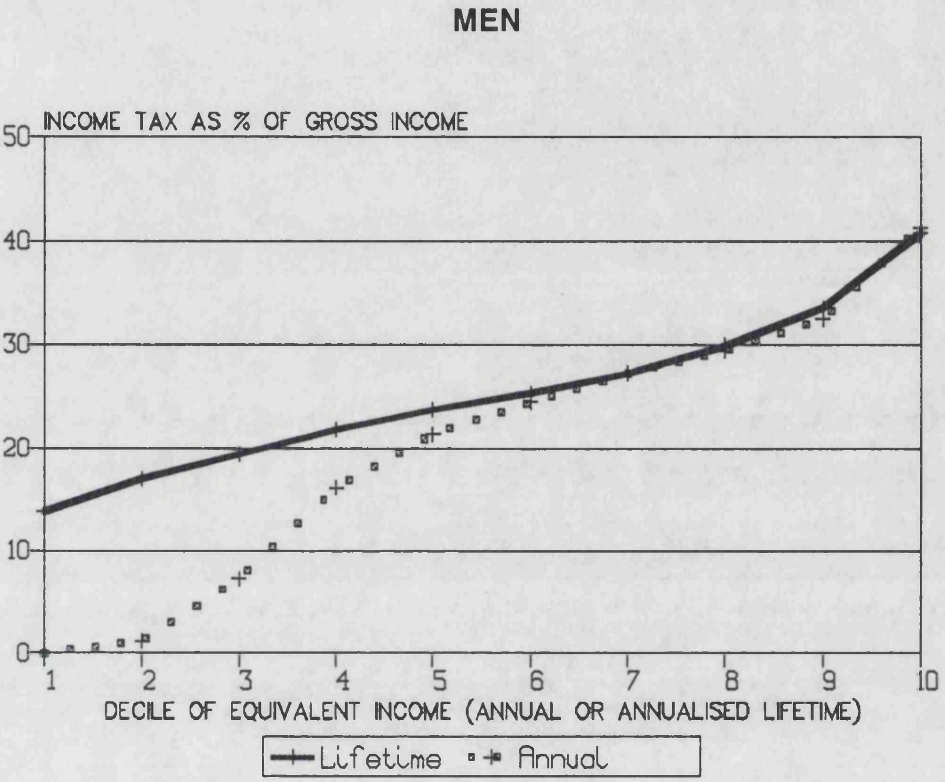
For *women*, the bottom quintile of women pay a negligible proportion of their gross income in tax during the single year captured in the synthetic cross-section snapshot. The percentage of gross income paid in tax rises sharply as annual equivalent income increases, reaching about 33 per cent for the top 10 per cent (significantly lower than for men because of women's lower taxable incomes). When the basis of measurement is changed to *annualised lifetime* gross income, the annualised lifetime income tax paid by the decile of women with the lowest lifetime standard of living averages 10 per cent of their gross income, while the top decile pay slightly more than three times this amount.

The above results are comparable to those of Davies et al, who also found that on a lifetime basis the top decile of income units paid about three times as much of their gross income in income tax as the bottom decile (1984:643). However, income tax as a percentage of gross income was lower in their simulation, amounting for both males and females to 7.3 per cent for the bottom decile and 20.5 per cent for the top decile (compared with 12 per cent and 38 per cent respectively for the HARDING model - Table 7.5). It is not clear whether this is due to differences in the income tax systems in Canada and Australia, to different income simulation (for example, their model excluded superannuation), or other unknown factors.

Figure 8.12 traces the *concentration curves* of lifetime and annual income tax paid, and shows that, on an annual basis, 30 per cent of men and 40 per cent of women contribute almost no income tax. The top 10 per cent of female income tax payers contribute just over half and the top 10 per cent of male taxpayers about 45 per cent of all income tax collected in a single year from each sex. Once again, on a lifetime basis the burden of income tax is more equally spread, and in the lifetime simulation there are no men or women who live past the age of 20 who do not pay any income tax during their entire lives. Individuals in the lower half of the lifetime income tax distribution contribute just under 20 per cent of all annualised lifetime income tax collected, while those in the top 20 per cent contribute just over half of all income tax raised.

These results are also outlined in Table 8.8, which shows the concentration coefficients (conceptually similar to the Gini coefficients presented earlier for income) of cash transfers and income tax. For men, the concentration coefficient for *annual cash transfers* of 0.85 emphasises the skewed distribution of cash transfers reported earlier, where about 70 per cent of men receive no cash transfers at all. The coefficient for lifetime cash transfers is about 40 per cent lower, at

Figure 8.11: Lifetime and Annual Incidence of Income Tax for Men and Women



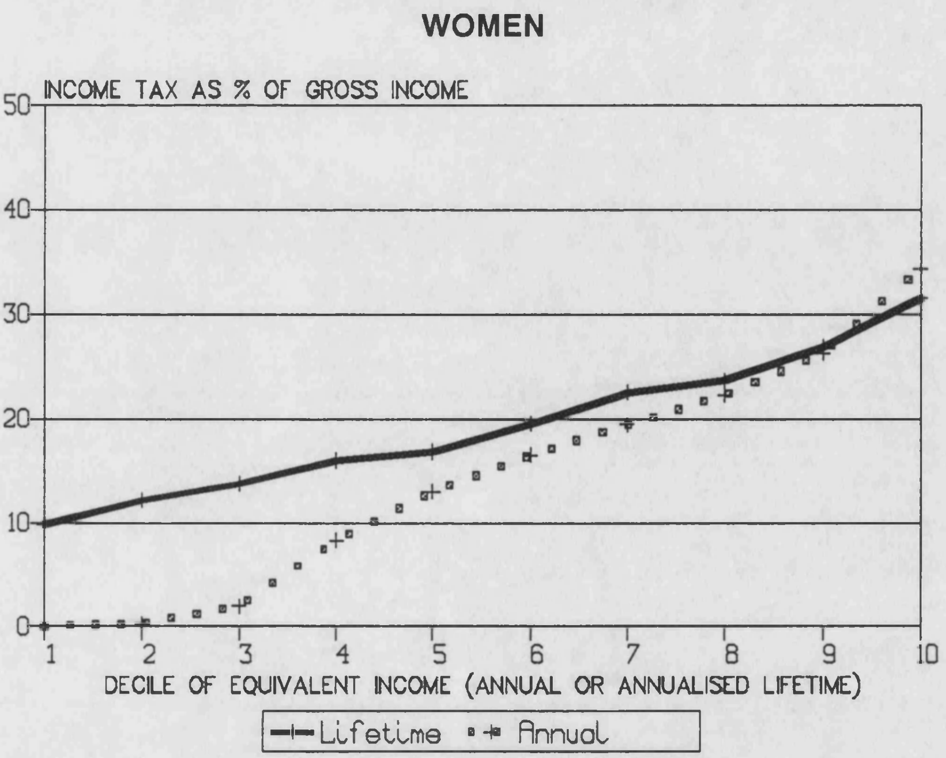
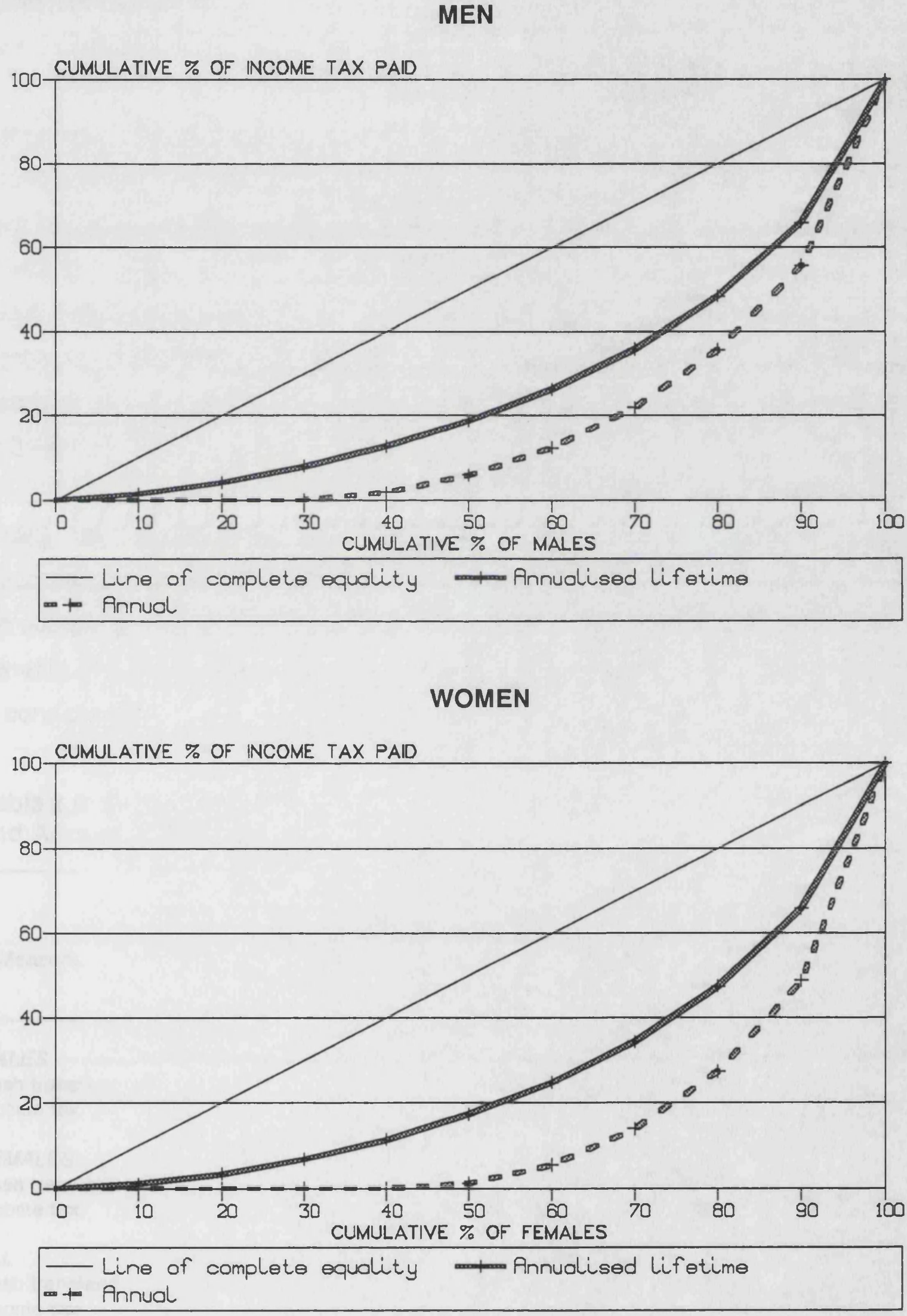


Figure 8.12: Concentration Curves of Lifetime and Annual Income Tax Paid by Men and Women



0.496. The coefficient for *annual income taxes* for men is lower, reflecting the more equal distribution of tax burdens than of cash transfer receipts, but is still 40 per cent higher than the coefficient for annualised lifetime income taxes for men.

For women, the coefficient for *annual cash transfers* is lower than for men because such transfers are more equally distributed among women, but is a striking 89 per cent higher than the coefficient for *lifetime cash transfers*, recognising that almost all women receive cash transfers at some point during their lifecycle. On the other hand, both annual and lifetime *income taxes* are less equally distributed among women than among men, although the relative gap between the lifetime and annual distributions is similar, with the concentration coefficient for lifetime income taxes of 0.484 amounting to about two-thirds of the comparable annual coefficient.

Finally, for the population as a whole, the lifetime coefficient for cash transfers amounted to just under 60 per cent and that for income taxes about 70 per cent of the comparable annual coefficients, emphasising the more equal distribution of the benefits of cash transfers and the burden of income taxes when the entire lifetime is considered.

Table 8.8: Concentration Coefficients and Coefficients of Variation for Lifetime and Annual Distributions of Cash Transfers and Income Taxes

Measure	ANNUALISED LIFETIME		ANNUAL	
	Concentration Coefficient	Coefficient of Variation	Concentration Coefficient	Coefficient of Variation
MALES				
Cash transfers	.496	0.671	.852	2.255
Income tax	.465	0.683	.648	1.514
FEMALES				
Cash transfers	.377	0.664	.713	1.486
Income tax	.484	1.034	.726	1.951
ALL				
Cash transfers	.458	0.829	.780	1.775
Income tax	.505	1.130	.698	1.753

8.5 CASH TRANSFERS AND ADJUSTED INCOME TAXES

While the above analysis has suggested that annual incidence studies overstate the degree of income redistribution achieved by government taxes and transfers, and that both transfers and taxes are accordingly less progressive when measured against lifetime than against annual income, the precise direction and magnitude of income redistribution achieved is masked by the amount of income taxes paid greatly exceeding the amount of cash transfers received. Because income taxes help to finance a wide range of other publicly provided goods and services, in addition to cash transfers, they necessarily exceed cash transfers.

One way around the problem is to calculate the total amount of cash transfers received by the entire cohort during their whole lifetimes, and then work out the percentage of total income taxes collected which would exactly finance those transfers. In the event, 27.6 per cent of total lifetime income taxes collected from both males and females equalled total lifetime cash transfers received by males and females, so in the following analysis 27.6 per cent of income tax paid (termed *adjusted income tax*) has been compared with the cash transfers received by each decile and by each sex. This is equivalent to assuming that this proportion of the income tax paid by each individual is expressly devoted to the provision of cash transfers, and that the proportion does not vary by amount of income tax paid or other characteristics. The ambiguities involved with making this sort of assumption have been eloquently spelled out by Le Grand (1987).

Disregarding these theoretical difficulties for the present, Figure 8.13 shows the lifetime pattern of redistribution for males, ranked by deciles of annualised lifetime equivalent income. For example, the bottom decile received $985 on average in cash transfers and contributed $305 of the income tax used to finance all cash transfers, resulting in the net gain shown in the horizontally striped section of Figure 8.13 of almost $700. Similarly, the top decile of males received only $100 in annualised cash transfers (Table 7.1) but paid $4,660 in adjusted annualised income tax, leaving the net loss shown in the vertically striped section of Figure 8.13 of just over $4,500. Only the bottom 30 per cent of all males received more in transfers each year than they paid on average in adjusted income taxes .

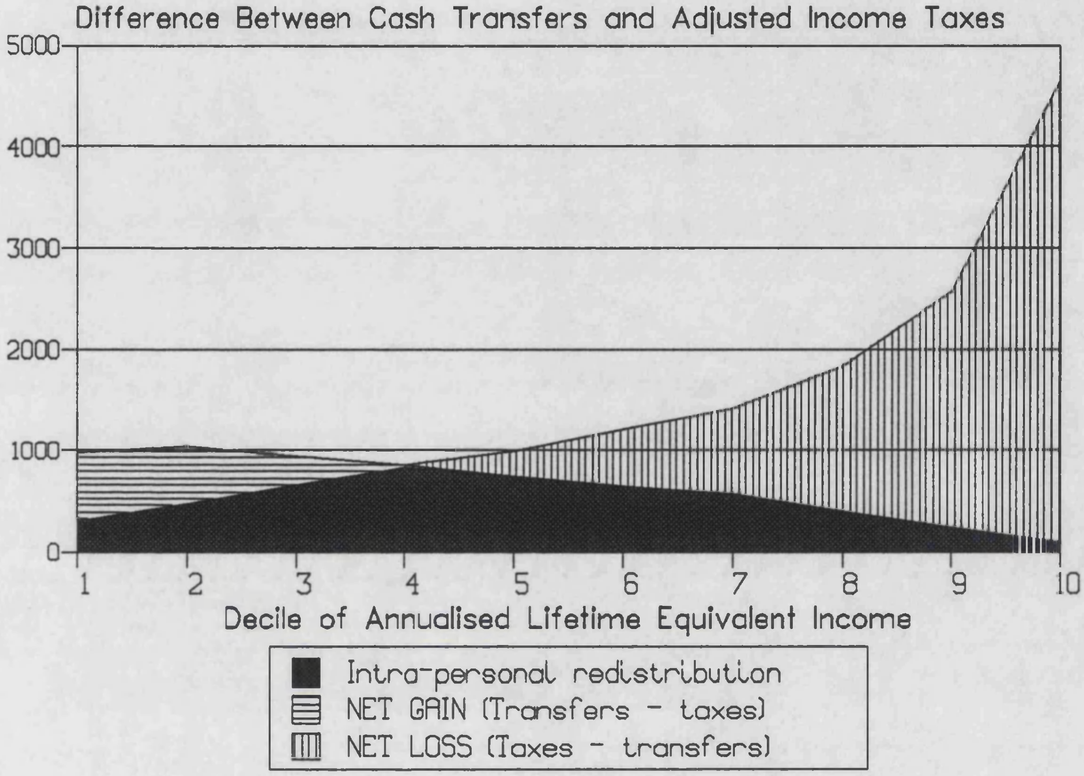
The profile for women is very different, as shown in the bottom graph in Figure 8.13. While the bottom decile of women, ranked by female annualised equivalent income, received $1,630 in annualised cash transfers they paid only $145 in adjusted annualised income tax, resulting in a net gain of some $1,500. However, as the figure illustrates, the bottom 70 per cent of women emerged as winners when cash transfers were compared with those income taxes which financed them. There is clearly, therefore, substantial redistribution of income from men to women during the lifetime.

The picture for the entire population is shown in Figure 8.14. In addition to redistribution from men to women, there is also redistribution of income from those with higher to those with lower lifetime incomes. The bottom sixty per cent of all individuals make a net gain when the cash transfers received on average each year are subtracted from adjusted income taxes paid, with these gains being matched by the absolute losses made by the top forty per cent of individuals. However, as the solid coloured area in Figure 8.14 demonstrates, a significant proportion of income taxes paid during the lifetime are returned to the *same individuals* in the form of cash transfers during some other period of their lifecycle.

This average picture, however, disguises the major differences apparent within income deciles. For example, for those individuals in the bottom decile of annualised lifetime equivalent income, all of the adjusted income taxes paid out during the years of higher income are recouped through cash transfers received at some other point during their lifetimes. Even for those in the fifth decile of annualised lifetime equivalent income, some 45 per cent of adjusted annualised lifetime income taxes paid are devoted to intra-personal redistribution and returned to them via cash transfers, with the remaining 55 per cent being channelled towards other individuals with lower lifetime incomes.

Figure 8.13: Difference Between Average Annualised Cash Transfers Received and Average Annualised Adjusted Income Taxes Paid, by Sex and Decile of Annualised Lifetime Equivalent Income

MALES



FEMALES

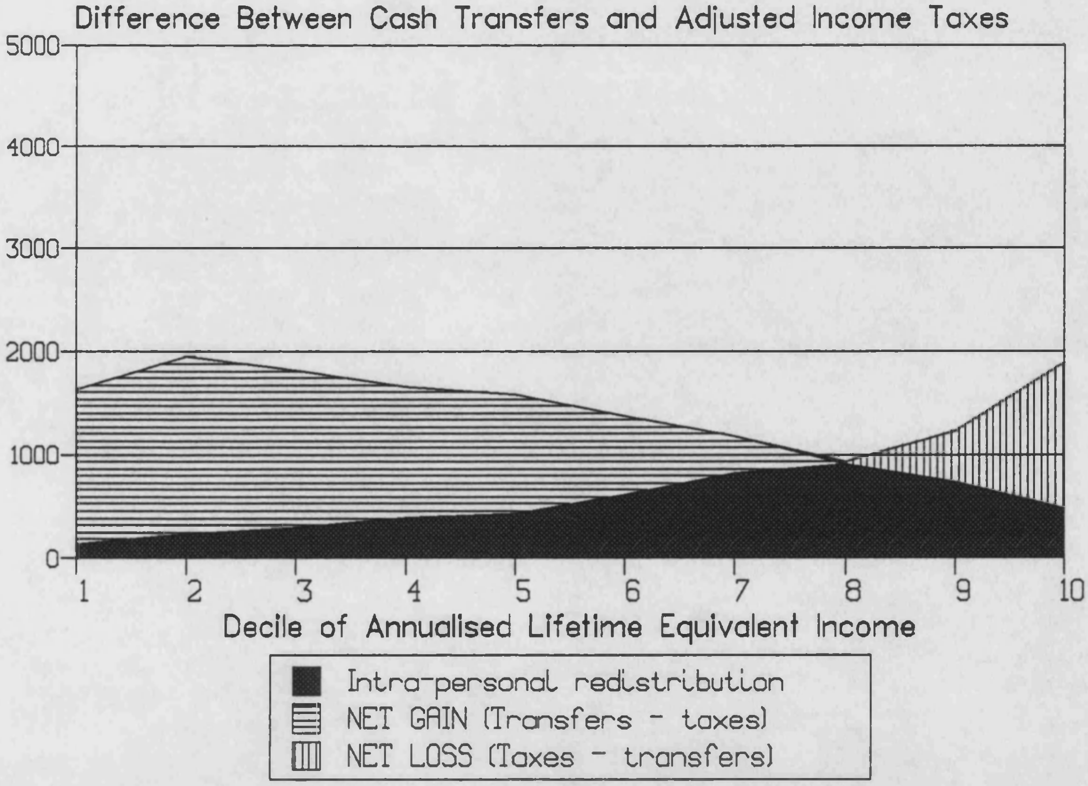
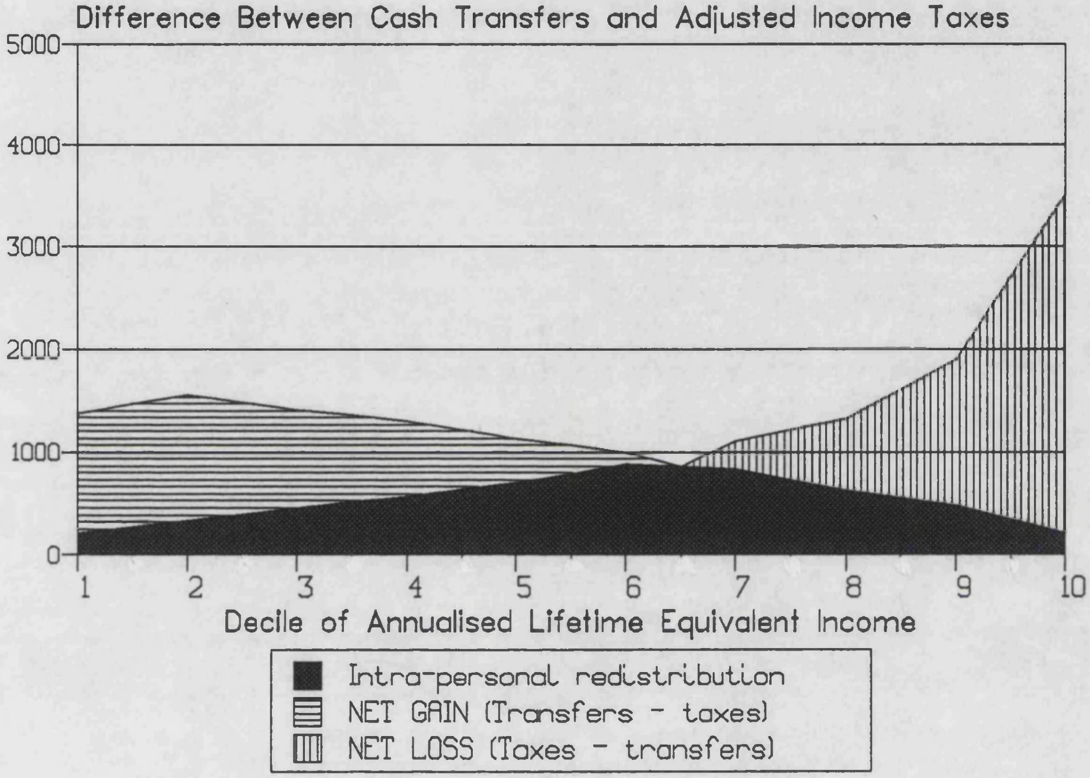
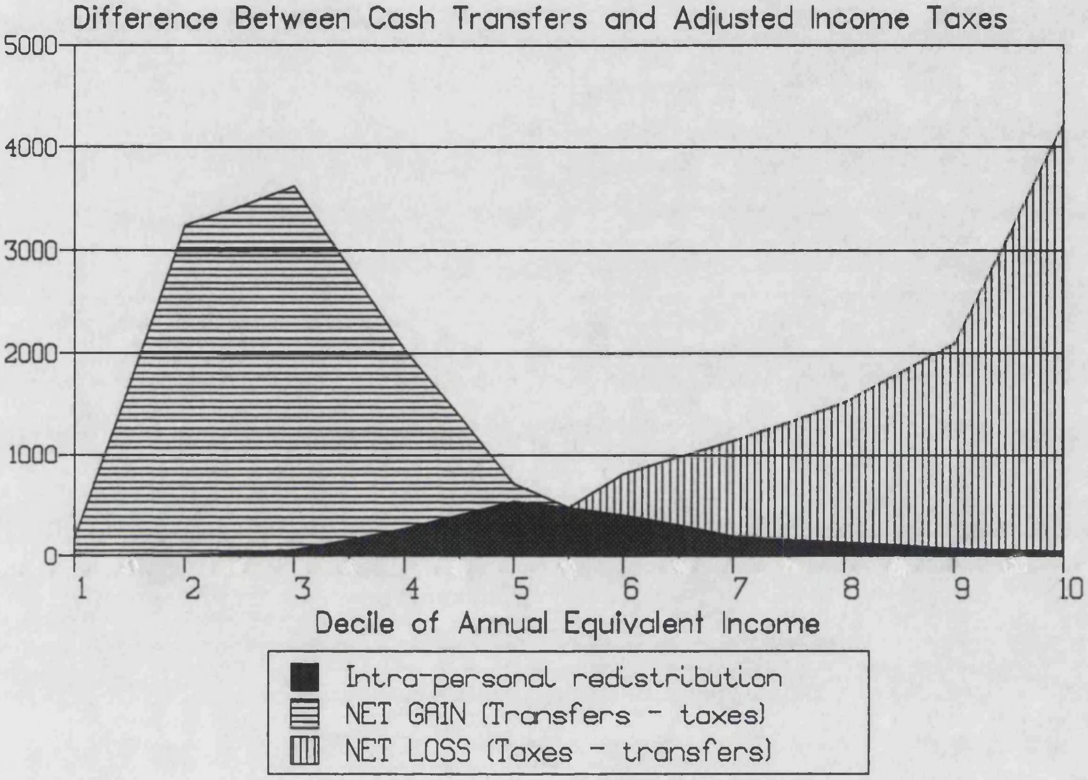


Figure 8.14: Difference Between Average Annualised Cash Transfers Received and Average Annualised Adjusted Income Taxes Paid, by Decile of Annualised Lifetime Equivalent Income



The extent to which *annual* snap-shots of tax-transfer incidence overstate the degree of inter-personal redistribution and understate the magnitude of intra-personal redistribution is emphasised in Figure 8.15, which compares average cash transfers received during a single year with the adjusted income taxes paid during that year. As comparison with Figure 8.14 illustrates, the apparent gains made by those in the bottom half of the income distribution on an annual basis are susbstantially reduced once the entire lifetime is considered. This indicates that many of those appearing as net beneficiaries from the tax-transfer system in any given year become net payers during other years of their life and, conversely, many of those paying high income taxes in Figure 8.15 would change to net beneficiaries if sampled 10 or 20 years later.

Figure 8.15: Difference Between Average Annual Cash Transfers Received and Average Annual Adjusted Income Taxes Paid, by Decile of Annual Equivalent Income



8.6 LIFETIME VS ANNUAL INCIDENCE OF EDUCATION OUTLAYS

While the preceding discussion has dealt exclusively with the incidence of taxes and cash transfers, the annual and lifetime incidence of education outlays has been a subject of considerable debate in Australia, due to the recent and controversial introduction of the Higher Education Contribution Scheme (effectively a scheme for making tertiary students pay for their studies later in life). The higher incomes of graduates have always been apparent, and concern about the extent to which the state should subsidise the attainment of degrees which markedly improve the lifetime circumstances of recipients has been fuelled by a number of studies suggesting that tertiary outlays are monopolised by higher income groups.

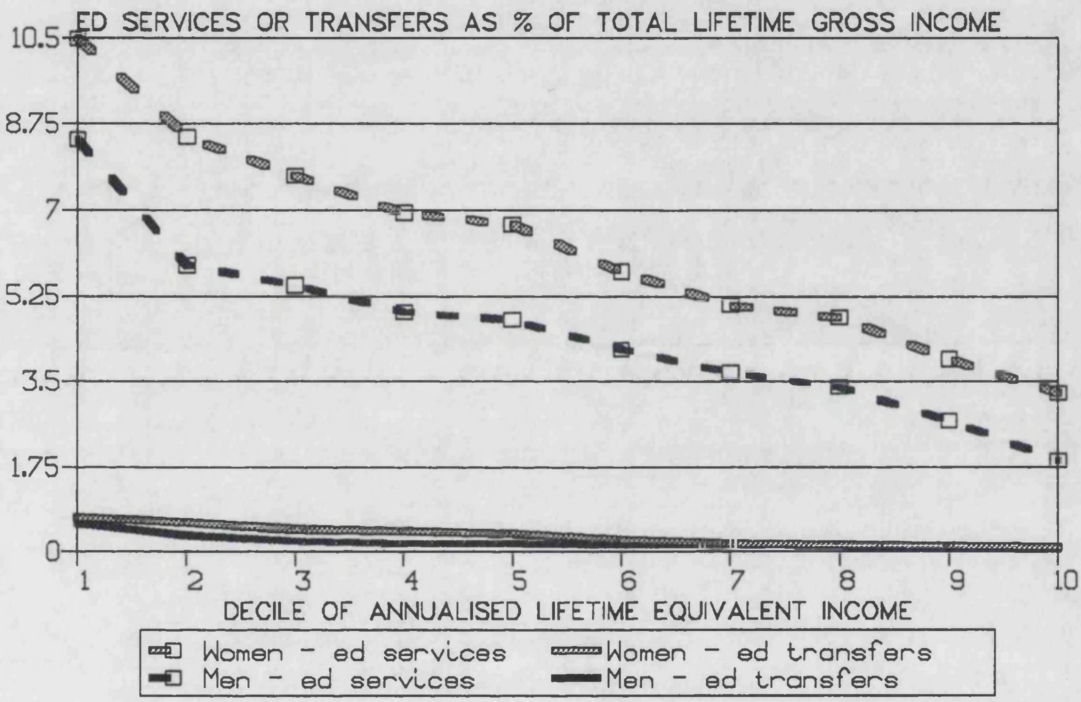
After studying evidence about the distribution of benefits in kind in the UK, for example, Barr concluded that "middle-class children receive a disproportionate share of educational resources" and that "the finance of university education is almost certainly regressive" (1987:419). Similarly, Le Grand argued that education outlays in the UK show "a distribution which is markedly pro-rich" (1982:57).

This conclusion was disputed by Harding, using Australian data, who argued that although higher income groups received more dollars of education spending than lower income groups, such outlays amounted to about the same *proportion of income*, so that the incidence of education outlays was proportional and left the income distribution basically unchanged (1984:64). However, both authors pointed out that because of data limitations their results only considered education outlays as a percentage of *gross household income*, and suggested that because higher income households with children tended to be concentrated towards the middle and upper ends of the annual income spectrum, an analysis based on *equivalent household income* or some other measure might produce quite different results.

The results reported below in Figures 8.16 and 8.17, which suggest that outlays on both education services and education transfers are progressive when measured against lifetime equivalent income, are thus of considerable interest. Taking all outlays on *education services* first, Figure 8.16 shows that the imputed total (not annualised) value of such services received over the course of the entire lifetime amounted to about 10.5 per cent of the total gross lifetime income of women in the bottom decile of female annualised lifetime equivalent income and just over 8.5 per cent of the total gross lifetime income of men in the comparable bottom deciles of males.

Although the sexes received fairly equal dollar amounts of education services income, the lower earned incomes of women meant that education services amounted to a higher percentage of the lifetime gross incomes of women than of men, but appeared equally progressive for both sexes. Similarly, although *education transfers* amounted to only a small proportion of gross lifetime income, their net effect appeared to be progressive on a lifetime basis.

Figure 8.16: The Lifetime and Annual Incidence of Education Cash Transfers and Imputed Education Services Income by Sex



However, this only shows the *net effect* of all education outlays. It is possible that, for example, the progressive effect of outlays on schooling might be partially offset by regressive outlays on tertiary education. Consequently, the incidence of each of the components of education outlays for the cohort as a whole are examined in Figure 8.17. The results suggest that outlays on primary schooling (including pre-schools), and secondary schooling are both progressive on a lifetime basis.

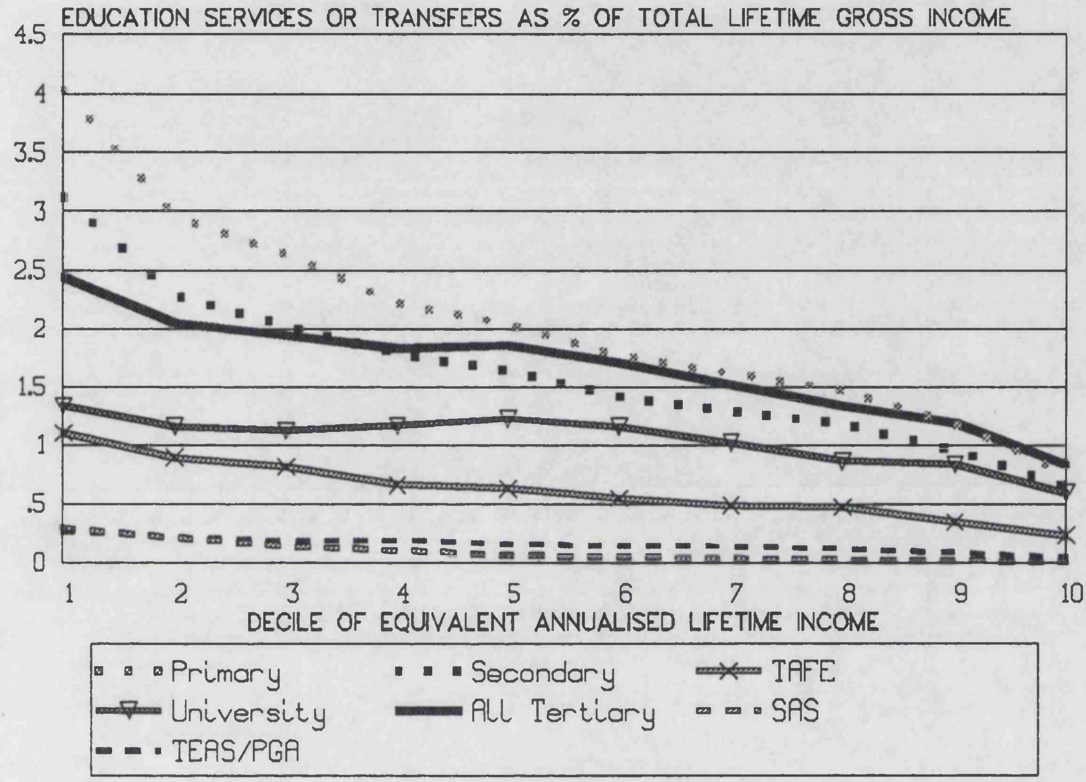
Outlays on TAFE are also progressive, declining from about 1.1 per cent of the gross lifetime income of those in the bottom decile of lifetime annualised equivalent income to only 0.25 per cent of the income of the top decile. The picture for outlays on universities (including colleges of advanced education) is not, however, as clear cut. Although such outlays do decline from about 1.3 per cent of the total lifetime gross income of the bottom decile to 0.6 per cent of the income of the top decile, for those in the bottom 60 per cent of the income distribution such outlays are roughly proportional to income. The combined effect of all tertiary outlays, comprising outlays on TAFE and universities, is also shown in Figure 8.17 and is again progressive, although the incidence is roughly proportional for those in the middle of the income spectrum.

Moving from education services to *education cash transfers*, outlays on SAS are progressive, as would be expected since they are provided to lower income families while their children are at school. Outlays on TEAS and Post-Graduate Awards, however, are roughly proportional across most of the income spectrum, indicating that many of those who benefit from such income-tested allowances while they are students go on to earn high lifetime incomes.

Although the incidence of education services outlays is therefore progressive on a lifetime basis, such outlays are not as progessive as outlays on social security and education cash transfers. In addition, the progressive incidence does not imply that lower income groups receive more dollars in education services than higher income groups - indeed, as shown in Table 7.5, those in the top decile of annualised lifetime equivalent income receive about $6,000 more in imputed lifetime education services income than those in the bottom decile.

Although the results for the *annual* incidence of education outlays for individuals are not presented below, such outlays and transfers appear highly progressive on an annual basis, as they are primarily received by students with little or no other income. However, such results cannot be compared with other annual studies of education incidence which do not regard such students as separate income units, or which do not use the individual as the income unit.

Figure 8.17: The Lifetime Incidence of Education Cash Transfers and Imputed Education Services Income



8.7 CONCLUSION

The results of the model suggest, as has long been suspected, that in a steady-state world, lifetime income in Australia would be much more equally distributed than annual income. Although the precise results depend upon the income measure used, the annualised lifetime disposable incomes of both men and women appear to be about 40 per cent more equal than annual disposable incomes. For example, the Gini coefficient for the distribution of male annualised lifetime disposable income of 0.232 amounts to only 60 per cent of the relevant Gini coefficient for annual income.

This suggests that much of the inequality apparent in annual cross-section surveys is due to the sampled income units being at different stages of their lifecycle. The results of a transition matrix confirmed this, with just under 20 per cent of individuals remaining in the same deciles of both annual equivalent income and annualised lifetime equivalent income, and about 45 per cent either remaining in the same decile or moving up or down the income distribution by only one decile.

Although the lifetime incidence of both cash transfers and income taxes was progressive, such goverment programs were much less redistributive than annual incidence studies would suggest. The lifetime concentration coefficients for cash transfers and income taxes amounted to about 60 and 70 per cent respectively of of the relevant annual coefficients. For the cohort as a whole, cash transfers amounted to 21 per cent of the annualised gross income of the bottom decile, declining to well under one per cent of the gross income of those ranked in the top 10 per cent of annualised lifetime equivalent income. Similarly, income taxes accounted for only 12 per cent of the gross lifetime income received by those in the bottom decile of annualised equivalent income, rising to 38 per cent of annualised gross income for those in the top decile.

Despite this progressivity, much of the income redistribution achieved was intra-personal, transferring resources from one part of an individual's life to another, rather than representing inter-personal redistribution from those with higher to those with lower lifetime incomes. Analysis of the redistributive impact of cash transfers against the volume of income taxes which exactly financed those cash transfers, suggested that there was marked income redistribution from men to women, as well as from those indiviudals in the top four deciles of annualised lifetime equivalent income to those in the bottom six deciles.

Finally, analysis of education outlays suggested that such outlays were progressive on both an annual and lifetime basis, but that outlays on tertiary education services and tertiary cash transfers were much less progressive than those on school services and SAS.

The above results therefore contrast the lifetime distribution of income with the synthetic annual income distribution generated by the model, and analyse the lifetime and annual incidence of government income taxes and cash transfers. Such results tell us nothing, however, about how different types of individuals fared *during their lifecycles*, only about the final result. The next chapter therefore turns to consideration of the years of poverty and years of plenty which occur during the lifecycle.

CHAPTER 9: INCOME DISTRIBUTION AND REDISTRIBUTION OVER THE LIFECYCLE

9.1 INTRODUCTION

While Chapter 6 analysed the lifetime incomes of those with various lifetime characteristics and Chapters 7 and 8 contrasted the lifetime and synthetic cross-section income distributions, it is also possible to examine the records during every year of life for those with particular lifetime characteristics and thus derive a picture of *lifecycle* income distribution and redistribution.

In Section 9.2, the lifecycle profiles of those with different lifetime standards of living are discussed, and the extent of intra-personal and inter-personal income redistribution is examined. In Section 9.3 the variations in lifecycle income patterns by lifetime marital and child status are compared and, for example, the varying fortunes of the never married are contrasted with those who married and raised large families. Finally, in Section 9.4 the variation in lifecycle profiles by highest educational qualification achieved is analysed.

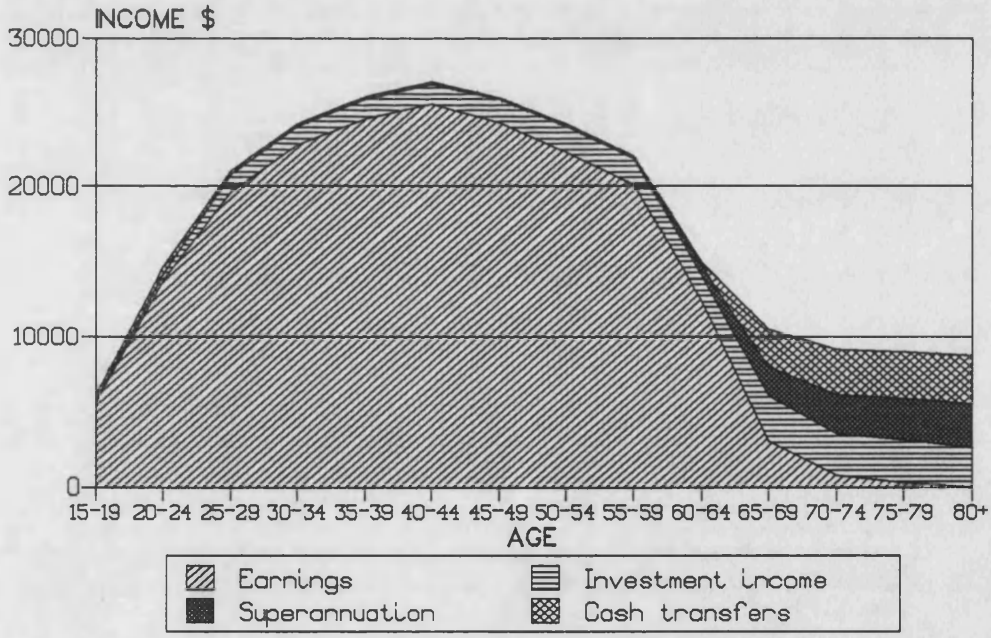
9.2 LIFECYCLE INCOME BY LIFETIME STANDARD OF LIVING

The Lifecycle Income of Males

As many studies of earnings profiles have found, the earnings of males increase sharply during their twenties and early thirties, with the accumulation of human capital and increasing age and experience (Blanchflower and Oswald,1990). The rate of increase slows during the thirties and forties and, as Figure 9.1 shows, the annual earnings and income of males in the simulation peak at ages 40 to 44. During the fifties and early sixties, average annual income declines, due not only to the declining hourly wage rates traced in Table 9.1 [1], but also to reductions in hours worked and to voluntary or involuntary withdrawal from the labour force.

While some males are still working in their late sixties, with earnings averaging about one-quarter of the average annual income of males aged 65 to 69, earnings are negligible during the seventies. Income during retirement drops steeply, with average income being about one-third of that achieved during peak working years. Sources of income also show dramatic change, with income from age 70 onwards being fairly equally split between investment income, private occupational superannuation, and cash transfers from the state in the form of age pension.

Figure 9.1: Average Amounts of Income Received Each Year by Age by Males



(1) Some longitudinal studies have found that the earnings of males increase constantly until retirement due to the effect of economic growth each year upon real earnings (Ruggles and Ruggles, 1977). However, the earnings of younger cohorts increase at a faster rate and the *relative* wages of older workers therefore decline. As discussed in Chapter 4, the model abstracts from economic growth, and it is this relative decline which is therefore picked up in the simulation.

The average picture for men, however, disguises major variations in lifecyle income by those who achieve different standards of living during their lifetimes. It is possible to isolate those whose lifetime income placed them in the bottom 10 per cent of males, after taking account of variations in family circumstances, and then go back and identify what happened to those males during each year of life. Figure 9.2 takes those in the lowest decile of males, ranked by *annualised lifetime equivalent income*, and shows the amount of income they received by source of income during their lifetimes.

For those in the *bottom decile*, earnings and income peak somewhat earlier, at ages 35 to 39, reflecting their lower educational achievement. Although the vertical axis in Figure 9.2 is scaled differently to that in Figure 9.1, the peak income of around $12,500 of the bottom decile is about half that of all males. Further, while cash transfers were such an insignificant source of income for males on average that they could not even be identified in Figure 9.1 for those below retirement age, for males in the bottom decile cash transfers made a minor contribution to income even during the prime working years, reflecting the greater incidence of unemployment and sickness.

The disadvantage experienced by the bottom decile continued into retirement, where occupational superannuation was non-existent and investment income minimal. They thus relied on age pension after retiring from the workforce, which provided an average income of around $4,500 - about half of the average retirement income enjoyed by males on average.

This lifecycle profile stands in stark contrast to that of males in the *top decile* of annualised lifetime equivalent income, whose income peaked later at ages 45 to 49 and who benefited from high incomes during their thirties, forties and fifties (Figure 9.3). The peak income received by the top decile was more than twice that received by males on average and more than four times that received by the bottom decile. Investment income formed a more significant source of income during their entire lives and contributed about a third of total income during retirement, with the balance coming from occupational superannuation.

Table 9.1: Income and Other Characteristics of Males by Age

	AGE													
MEASURE	15-20	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+
Earnings	5,660	13,775	19,605	22,780	24,600	25,600	24,320	22,300	20,150	12,360	3,065	810	305	20
Investment inc	185	425	1,205	1,265	1,315	1,325	1,535	1,760	1,745	1,625	3,020	2,800	2,850	2,630
Superannuation	0	0	0	0	0	0	0	0	15	730	1,940	2,555	2,735	2,910
TOTAL ORIGINAL	*5,845*	*14,200*	*20,810*	*24,040*	*25,915*	*26,920*	*25,850*	*24,060*	*21,910*	*14,715*	*8,025*	*6,165*	*5,890*	*5,555*
Pension	10	5	10	5	5	15	10	35	35	115	2,495	2,960	3,090	3,230
Benefit	205	400	195	140	105	110	120	95	95	95	0	0	0	0
Education trans	115	95	20	10	15	15	20	15	5	5	0	0	0	0
*TOT TRANSFERS***	*330*	*505*	*220*	*160*	*125*	*135*	*155*	*150*	*135*	*215*	*2,495*	*2,960*	*3,090*	*3,230*
GROSS INCOME	6,175	14,705	21,035	24,200	26,040	27,060	26,005	24,210	22,045	14,925	10,520	9,125	8,980	8,790
Income tax	1,060	3,254	5,790	7,225	8,190	8,760	8,540	7,850	6,990	4,415	2,265	1,735	1,620	1,445
DISPOSABLE INC	*5,115*	*11,450*	*15,245*	*16,975*	*17,850*	*18,295*	*17,465*	*16,360*	*15,050*	*10,510*	*8,255*	*7,390*	*7,360*	*7,345*
EQUIVALENT INC	8,384	17,775	21,405	21,385	22,300	24,570	25,470	26,120	24,620	18,105	14,950	13,690	13,155	12,540
% Married	2.1	22.1	51.4	67.7	72.3	73.2	73.0	71.6	69.9	68.1	65.1	60.9	53.0	37.8
Av no children	0.018	0.226	0.662	1.218	1.386	1.115	0.648	0.230	0.061	0.015	0	0	0	0
% in Labour Force	68.0	95.4	98.0	98.5	99.2	99.0	95.7	92.8	89.8	60.9	24.1	6.2	2.9	0.4
% Work F.T.*	70.0	89.4	94.7	95.5	95.8	96.1	95.4	90.8	85.4	80.9	72.6	58.6	53.1	62.5
% Exp Any Unemp#	25.1	22.0	10.5	6.6	5.9	6.4	7.1	6.1	5.7	6.1	0	0	0	0
Hourly wage rate*	6.75	8.75	9.90	11.15	11.95	12.45	12.65	12.80	13.05	13.00	10.65	12.45	10.10	5.60
Av hrs worked pa*	1366	1711	2063	2116	2118	2131	2125	2045	1979	1912	1278	1142	1128	1053
% with degree	0	8.1	15.1	17.1	18.3	19.0	19.0	19.0	19.1	19.0	19.0	19.8	20.5	24.0
% sec sch only	42.5	39.3	24.8	16.9	11.8	9.1	8.9	8.9	8.8	9.0	8.9	9.4	9.6	9.0

Notes; * denotes average for those in the labour force (**not** average for whole age group).
Per cent unemployed is the percentage experiencing **any** unemployment during a year, and thus looks higher than standard cross-section unemployment rates during a single point in time.
** Includes small amount of child transfers for male sole parents.

Figure 9.2: Average Amounts of Income Received Each Year by Age by Males Placed in the Lowest Decile of Annualised Lifetime Equivalent Income

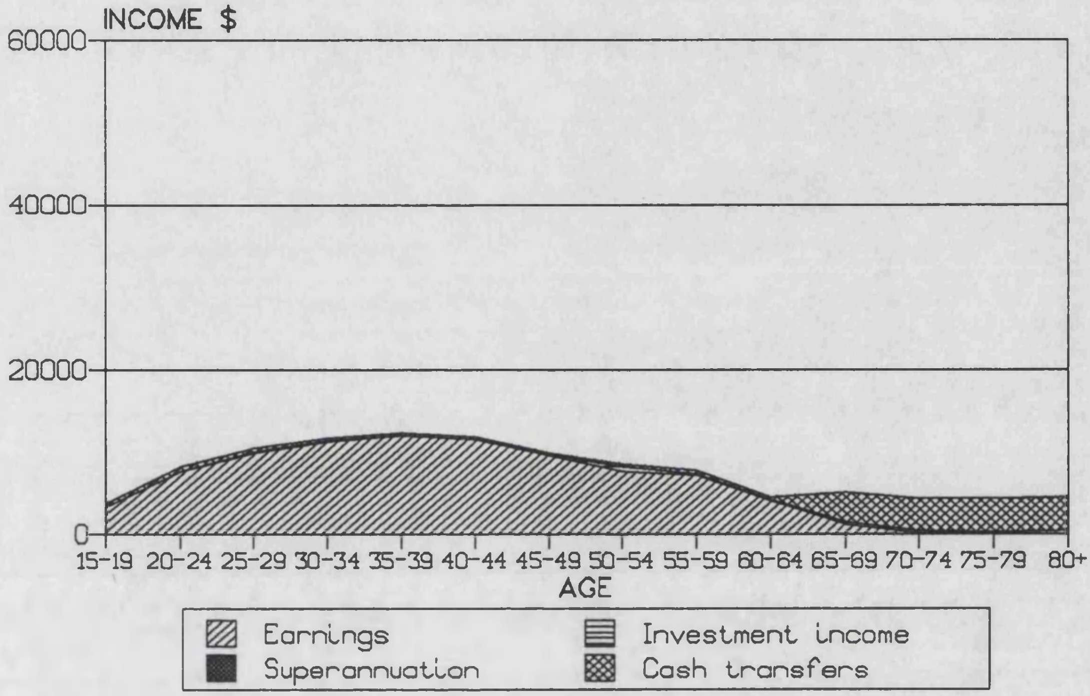
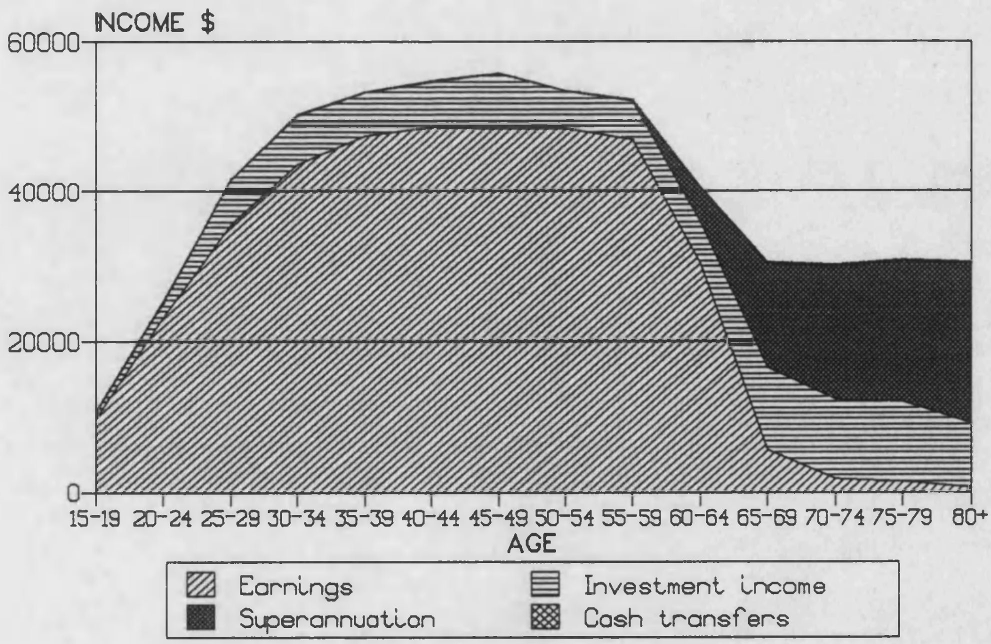


Figure 9.3: Average Amounts of Income Received Each Year by Age by Males Placed in the Highest Decile of Annualised Lifetime Equivalent Income



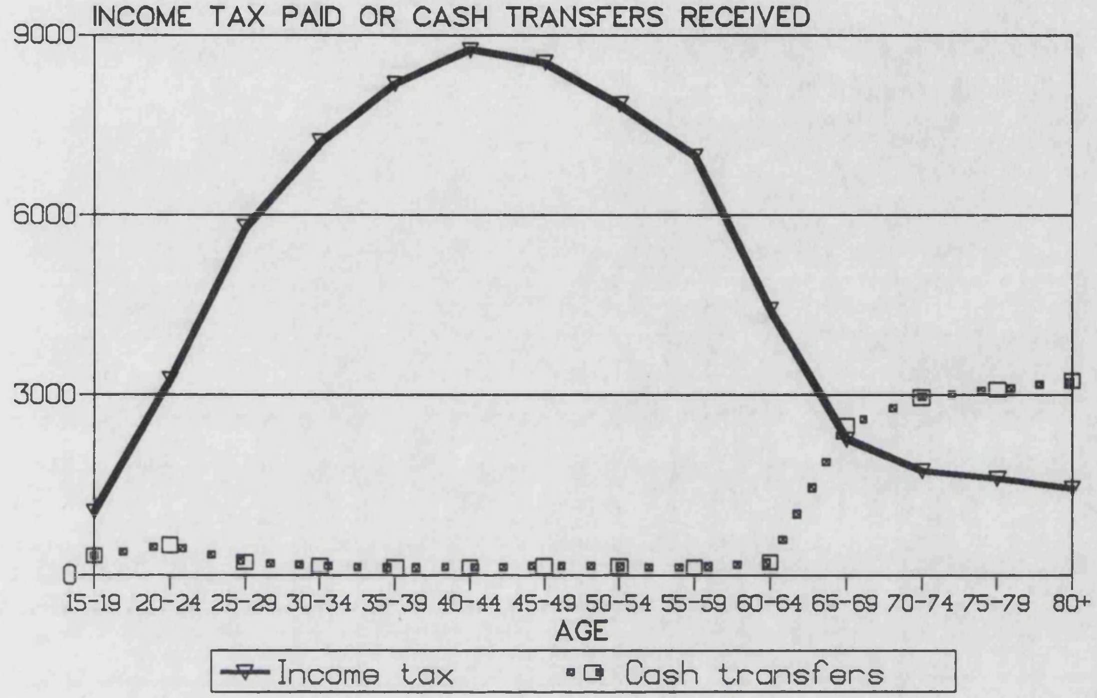
The standard of living achieved by the top decile during retirement was also far higher, with the average income after age 65 of around $30,000 being more than three times as much as that achieved by males on average. The relative drop in standard of living in retirement was also less, due to the cushioning impact of superannuation, with average retirement incomes being well over half the income achieved during the peak working years. (As age pension in Australia is income-tested on current income, and bears no relationship to past earnings, the top decile of males received no cash transfers in retirement.)

The preceding figures simply trace *gross* income received during the lifecycle, thereby taking account of transfers but not taxes. One would expect the relative advantage enjoyed by the affluent during their lifecycles to be reduced once income taxes were deducted from income. In addition, one of the interesting questions which can be analysed using the simulation is the extent to which the state redistributes income across the lifecycle of individuals, taxing individuals during the relatively affluent peak working years and redistributing this income via cash transfers to the leaner years of retirement.

The average picture for all males is shown in Figure 9.4, where income taxes from labour force entry until retirement massively exceed transfers, but transfers exceed taxes from age 65 onwards. It must be emphasised that although average taxes are far greater than average cash transfers received during the lifetimes of men, this does not mean that the welfare state is 'failing': income taxes are used to finance a very wide range of other services, such as education, health, housing, transport and defence, and many of these services provide a direct benefit to individuals which a broader incidence study would incorporate. The current study merely shows how *cash income* is redistributed across the lifecycle and, as a result, taxes necessarily exceed transfers because they finance so many other services.

Once again, the picture for those with varied lifetime standards of living is markedly different. For those with the *lowest lifetime standard of living*, the income tax paid

Figure 9.4: Average Income Tax Paid or Cash Transfers Received by Age by Males



out during the working years was almost fully recouped during retirement (as was shown in Table 7.1, where average taxes were only slightly higher than average transfers received during each year of life by the bottom decile). While Figure 9.5 initially appears to suggest that total transfers received during retirement by those in the lowest decile of annualised lifetime equivalent income are actually *greater* than taxes paid in earlier years, this is not the case. As demonstrated in Chapter 7, the average age of death for men in this decile is 71.6 years and thus, in practice, many of them do not live long enough to more than recoup their income tax.

The lifecycle pattern of taxes and transfers for those in the top decile of annualised lifetime equivalent income is plotted in Figure 9.6. Cash transfers are negligible throughout the entire lifecycle, while average income taxes peak at around $25,000 a year while the top decile are in their late forties, and decline to an average $10,000 a year when they retire.

Figure 9.5: Average Income Tax Paid or Cash Transfers Received by Age by Males Placed in the Lowest Decile of Annualised Lifetime Equivalent Income

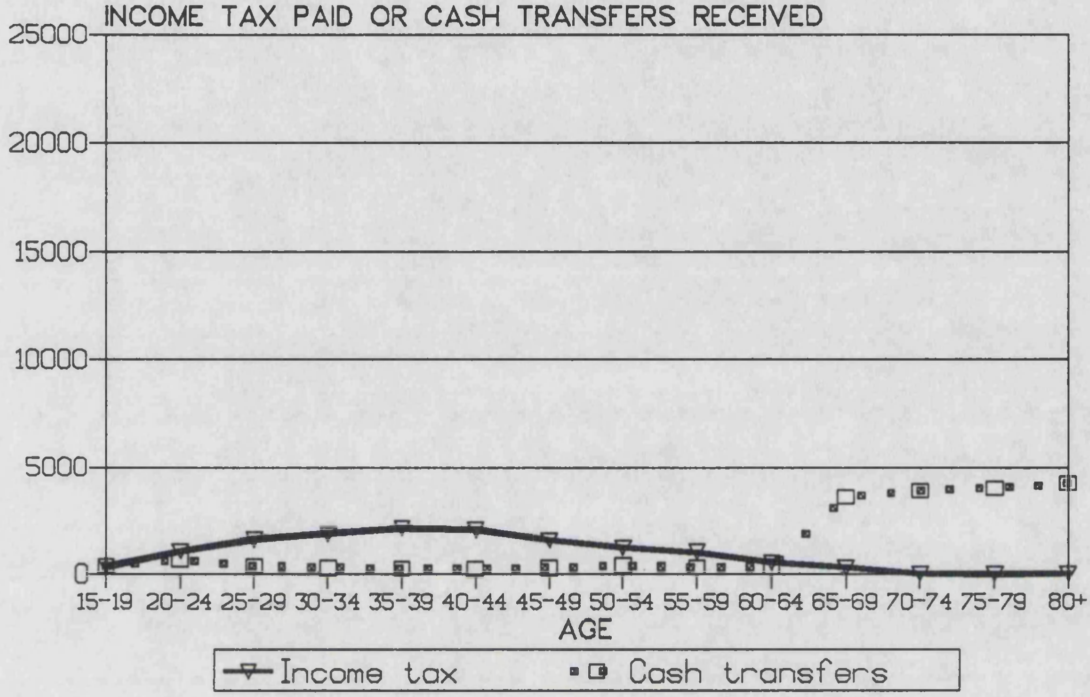
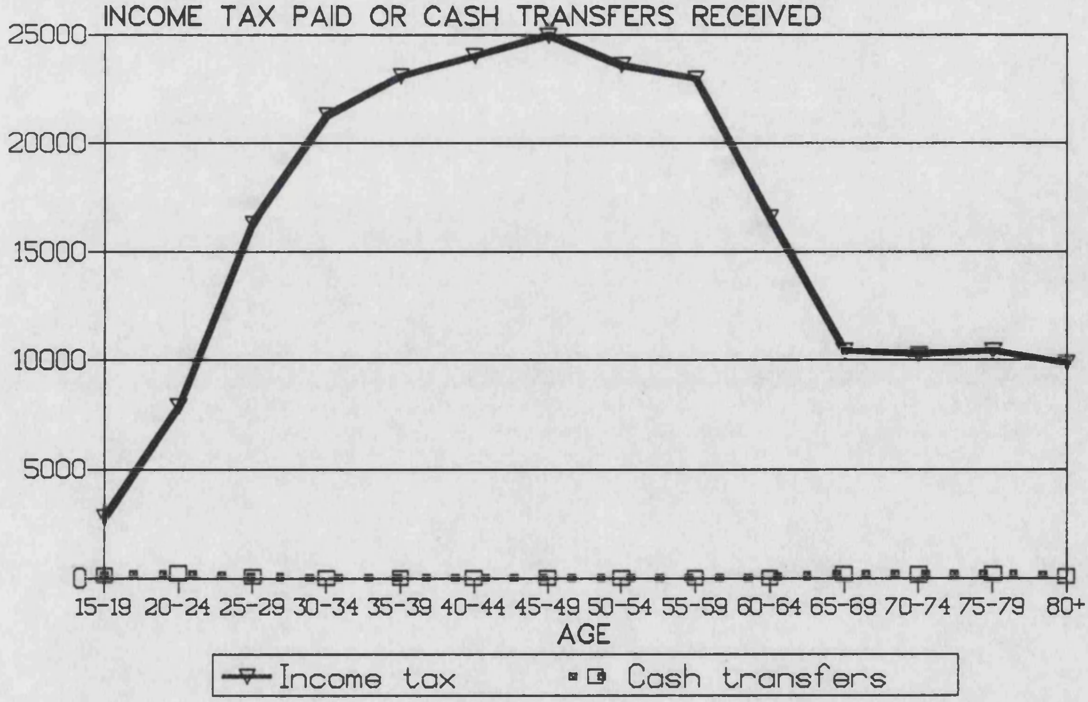


Figure 9.6: Average Income Tax Paid or Cash Transfers Received by Age by Males Placed in the Highest Decile of Annualised Lifetime Equivalent Income



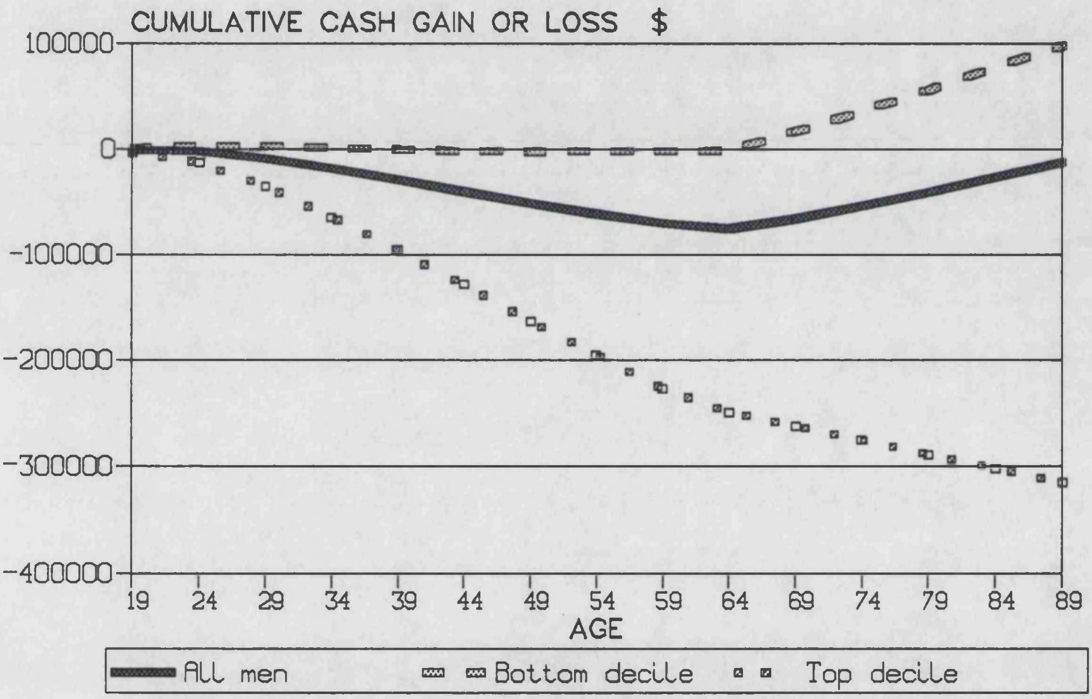
As discussed in Chapter 8, it is difficult to measure accurately the degree of intra and inter-personal income distribution achieved by income taxes and transfers, because income taxes so greatly exceed transfers. Once again, in an attempt to identify the direction and magnitude of redistribution more clearly, 27.6 per cent of the amount of tax paid by all taxpayers has been calculated for every year (termed *adjusted income tax*). At this level, the absolute amount of all income tax paid by all men and women in the simulation *exactly equals* the amount of all cash transfers received by all men and women.

It is then possible to calculate the cumulative amount of adjusted income tax paid by particular groups and deduct the cumulative amount of cash transfers received, thereby showing the net cumulative gain or loss at different stages of the lifecycle. As Figure 9.7 demonstrates, for men as a whole, cumulative adjusted income tax exceeds cumulative cash transfers, unless such men live beyond the age of 90. As the average age of death for all men is about 74 years of age, on average men make a net loss of around $50,000 during their lifetimes. In other words, at death men have on average paid out just under $90,000 in adjusted income tax and received just under $40,000 in cash transfers. For all males, therefore, about 45 per cent of their adjusted income tax payments are devoted to *intra-personal redistribution*, or the transfer of income from one part of their life to another; the remaining 55 per cent represents *inter-personal redistribution*, from men to women.

Although this represents the average picture for males, there are significant differences among males. (It should also be remembered that this only represents the average picture for survivors: those males who die before retirement age experience a net loss.) Figure 9.7 also shows the average profiles for those in the top and bottom deciles of annualised lifetime equivalent income. Males in the bottom decile essentially break even during the working years, moving ahead only in retirement. As the average age of death for men with the lowest lifetime standard of living is about 72 years, men in this decile on average receive about $38,000 more in cash transfers during their lifetimes than they pay out in adjusted income tax.

In contrast, men in the top decile, who die at the average age of about 72.5 years, have on average paid out about $260,000 more in adjusted income tax during their lifetimes than they have received in cash transfers. For men in this decile, only about two per cent of the adjusted income tax which they pay during their lifetimes is received back in the form of cash transfers, so that intra-personal redistribution for those in this decile is minimal.

Figure 9.7: Cumulative Gain or Loss From Taxes and Transfers During the Lifecycle for Males



Note: The average age of death is 73.7 yrs for all males, 71.6 yrs for males in the lowest decile and 72.5 yrs for men in the top decile.
The graph shows cumulative annualised cash transfers received by a given age minus cumulative adjusted annualised income taxes paid by the same age.

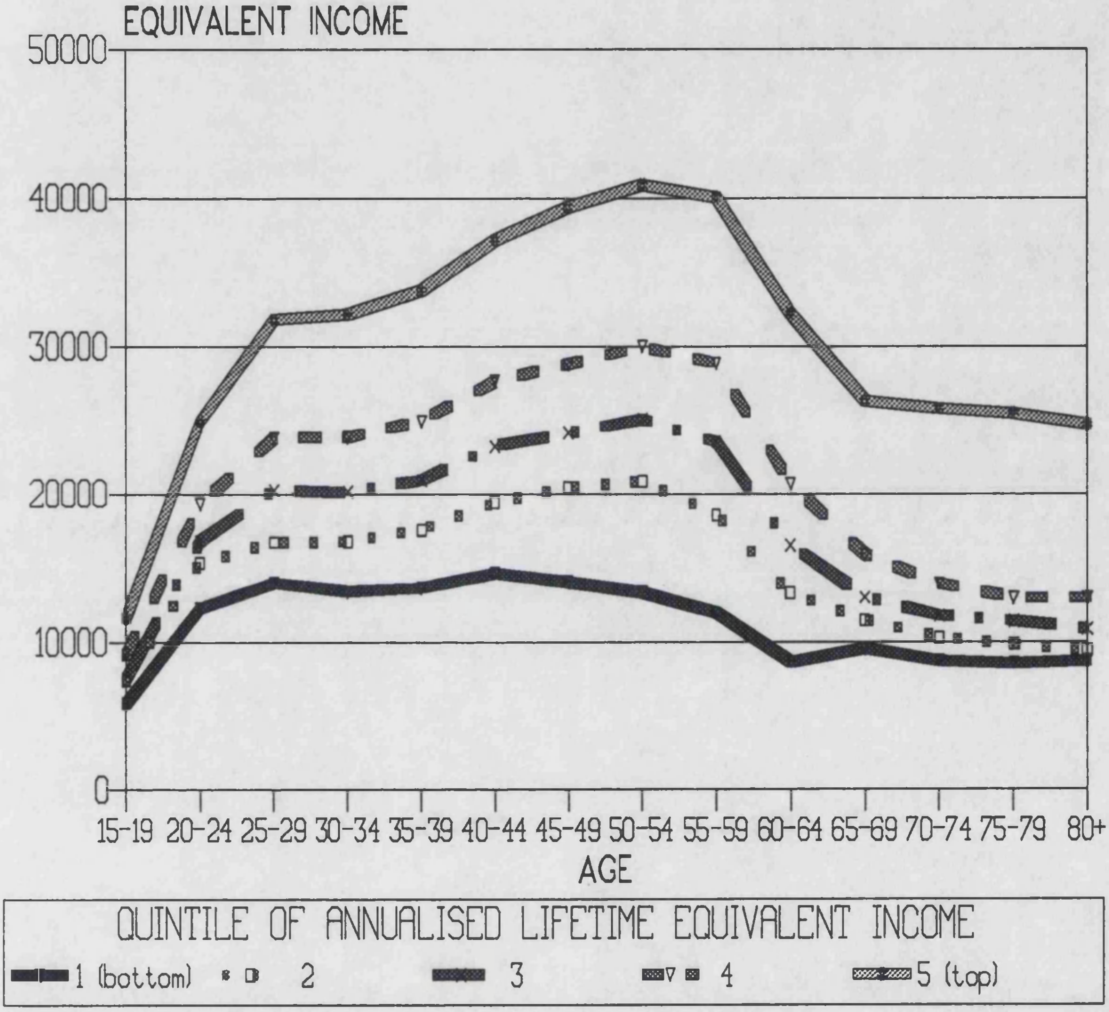
Despite these apparently very major transfers of income from men with high lifetime standards of living to men with low lifetime standards of living, the distribution of income remains very unequal over the lifecycle. A clearer picture of the extent to which *living standards* across the lifecycle are being equalised is provided in Figure 9.8, which traces the equivalent income per year of males ranked into quintiles on the basis of their annualised lifetime equivalent family income. In other words, the total amount of equivalent income received by all males during their lifetimes was first calculated; second, this was divided by years of life minus 15 to derive annualised equivalent income, and third, all males were then ranked by ascending amount of annualised lifetime equivalent family income and divided into five equal groups. After all males were assigned to one of these groups, it was then possible to go back and re-examine the income received by those in each group during each year of life, taking full account of transfers received in that year, income taxes paid in that year and the number of adults and children being supported by that income in that particular year.[1]

Once account was taken of needs, the disparity between living standards before and after retirement was somewhat reduced, thereby indicating that, during the peak working years, the advantage of higher income was partly offset by the need to support more people with that income. Equivalent income during retirement amounted to about 52 per cent of peak equivalent income received during the working years for males on average; for those in the top and bottom fifth of the lifetime distribution of equivalent income, equivalent income amounted to about 63 and 60 per cent respectively to the highest equivalent income achieved while in work.

Living standards were most unequal during the late forties and early fifties, when those in the top quintile benefited from an annual equivalent income which was about three times greater than that of the bottom quintile. In retirement, the differences in living standards narrowed, with the bottom eighty per cent of the population having a relatively comparable standard of living, but the gap between the top 20 per cent and the rest of the population widening.

(1) As discussed in Chapter 5, it is the equivalent income of the income unit which is calculated and attributed to all adults within the income unit. This means that during the years when a male is part of a married couple, any income of the wife is included in the calculation of equivalent income. During the years when the male is single, his equivalent income is simply his own income after application of the relevant equivalence scale.

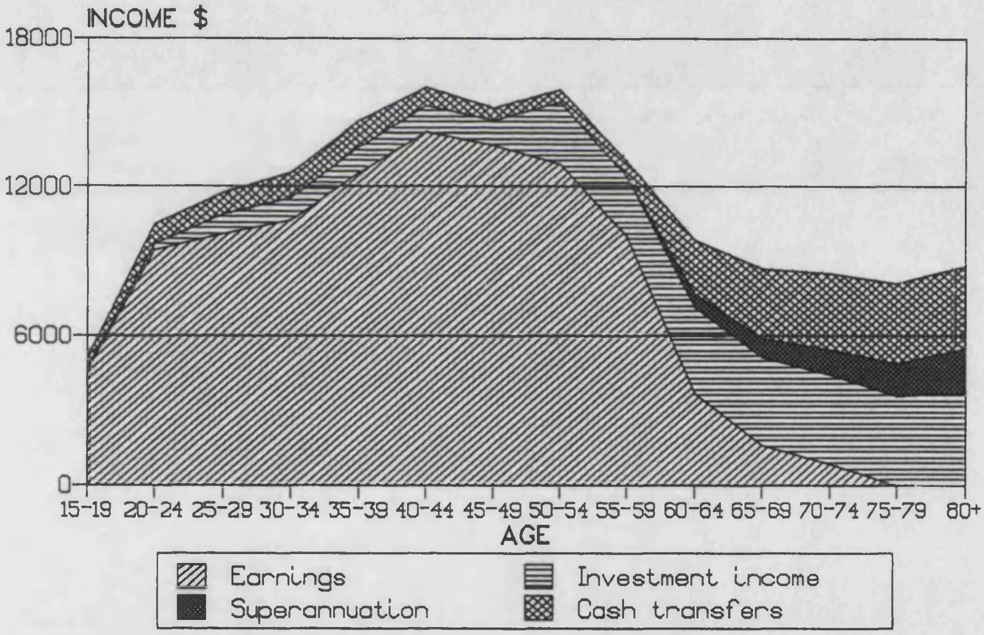
Figure 9.8: Annual Equivalent Income by Age For Males, Ranked by Quintile of Annualised Lifetime Equivalent Income



The Lifecycle Income of Females

As with males, the average earnings of females increase sharply during their twenties and thirties, peaking at ages 40 to 44 (Figure 9.9). However, even though the average hourly wage rate of females rises steadily during their twenties and thirties (Table 9.2), average annual earnings dip during the early thirties, in response to the declines in labour force participation during the peak child bearing and raising years. Investment income increases during the early fifties, as the family responsibilities of women decrease and more income is available for investment, remaining at about the same level until retirement from age 60 onwards, when both the absolute level of investment income and its relative contribution to total income increase again.

Figure 9.9: Average Amounts of Income Received Each Year by Age by Females



Cash transfers remain a more significant source of income during the entire lifecycle for women than for men, due principally to the payment of child-related cash transfers to mothers rather than fathers. During the peak working years, women's personal incomes are much lower than men's: while Figures 9.1 and 9.9 are drawn to different scales on the vertical axis, at their height the average incomes of women are about 60 per cent of those of men. In retirement, however, the average incomes of men and women are much more equal, at about $9,000 a year. While males surviving past the age of 70 receive higher superannuation payments than women, the absolute amount of investment income received by women is slightly higher, as they inherit income-producing assets from their husbands.

Once again, the aggregate picture glosses over the enormous differences in income during the lifecycle for women at different ends of the income spectrum. Figure 9.10 shows the lifecycle pattern for women whose lifetime income and family circumstances placed them among the *bottom 10 per cent* of all women, ranked by annualised lifetime equivalent income. Such women received very low earned incomes, peaking at only $6,000 a year, with average earnings slumping during their late twenties and thirties as they remained at home with children.

Average yearly investment income was also negligible, at a few hundred dollars a year, and superannuation in retirement almost non-existent. Cash transfers remained an important source of income during their lifetimes, rising in the late twenties and thirties with child transfers, declining in the fifties as children left home, and rising again in retirement, when they formed by far the most significant component of post-retirement income.

For those women in the *top decile* of annualised lifetime equivalent income, cash transfers were an insignificant source of income during both pre and post-retirement (Figure 9.11). The earnings profile was much more similar to that of all males where, despite the slight dip caused by family responsibilities in the early thirties, earnings continued to rise to peak at just over $25,000 in the forties, roughly the same absolute level as was achieved by males on average (Figure 9.1). Although the average invesment income for women in the top decile was lower than that for men in the top decile, it was a very important source of income, with both investment income and superannuation rising in the eighties as spouses died and the surviving wives inherited assets and occupational pension entitlements. Women in the top decile were also more likely than other women to remain in the labour force after the statutory retirement age was reached, with some 21 per cent still working on a full or part time basis in their late sixties.

Figure 9.10: Average Amounts of Income Received Each Year by Age by Females Placed in the Lowest Decile of Annualised Lifetime Equivalent Income

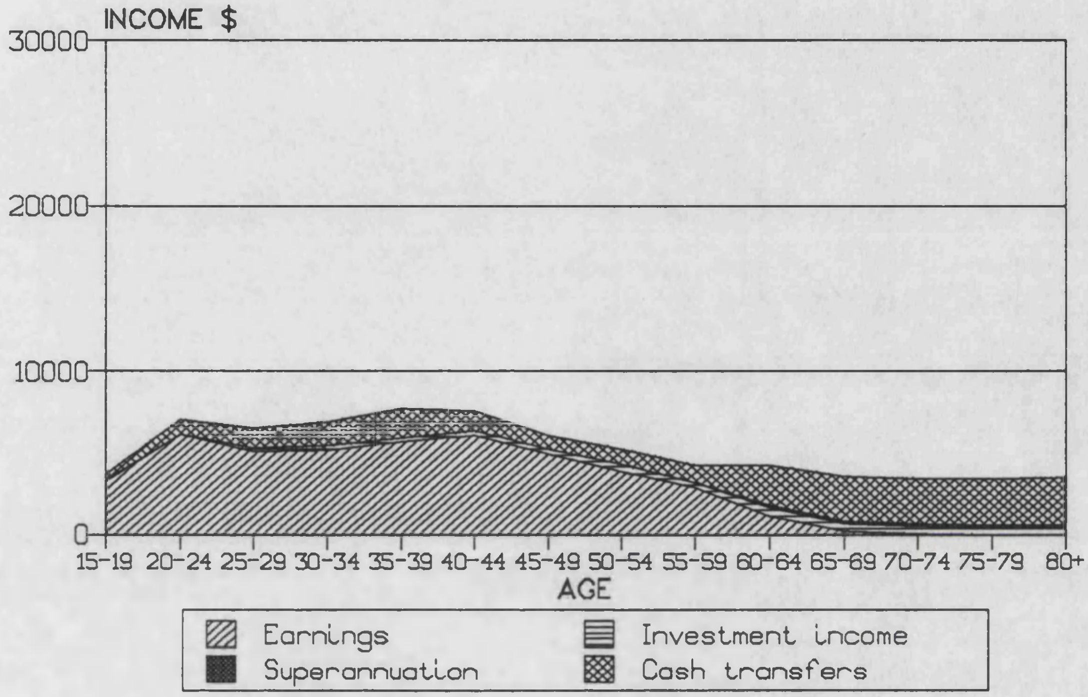


Figure 9.11: Average Amounts of Income Received Each Year by Age by Females Placed in the Highest Decile of Annualised Lifetime Equivalent Income

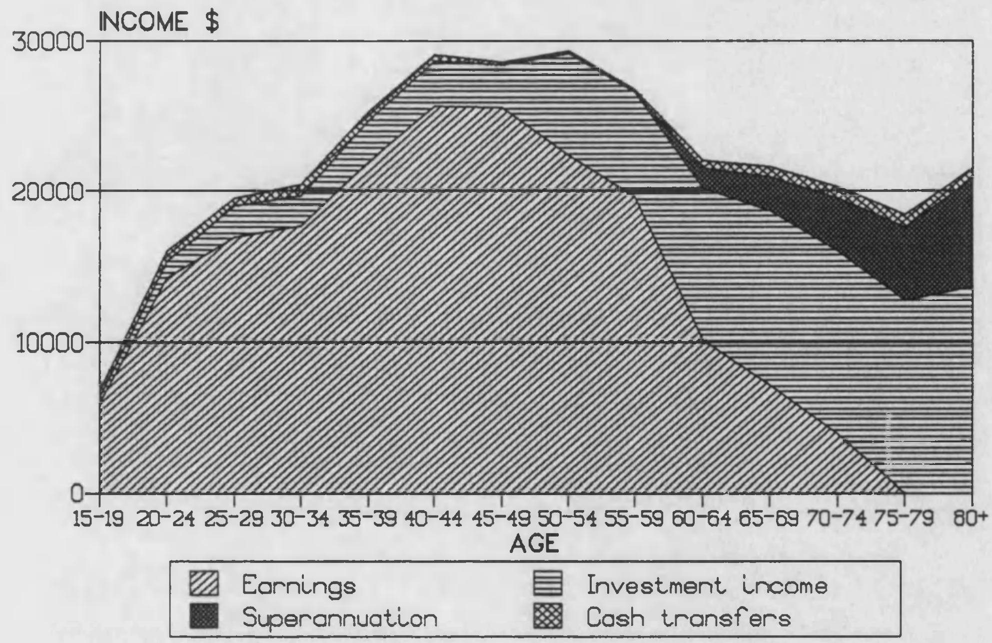


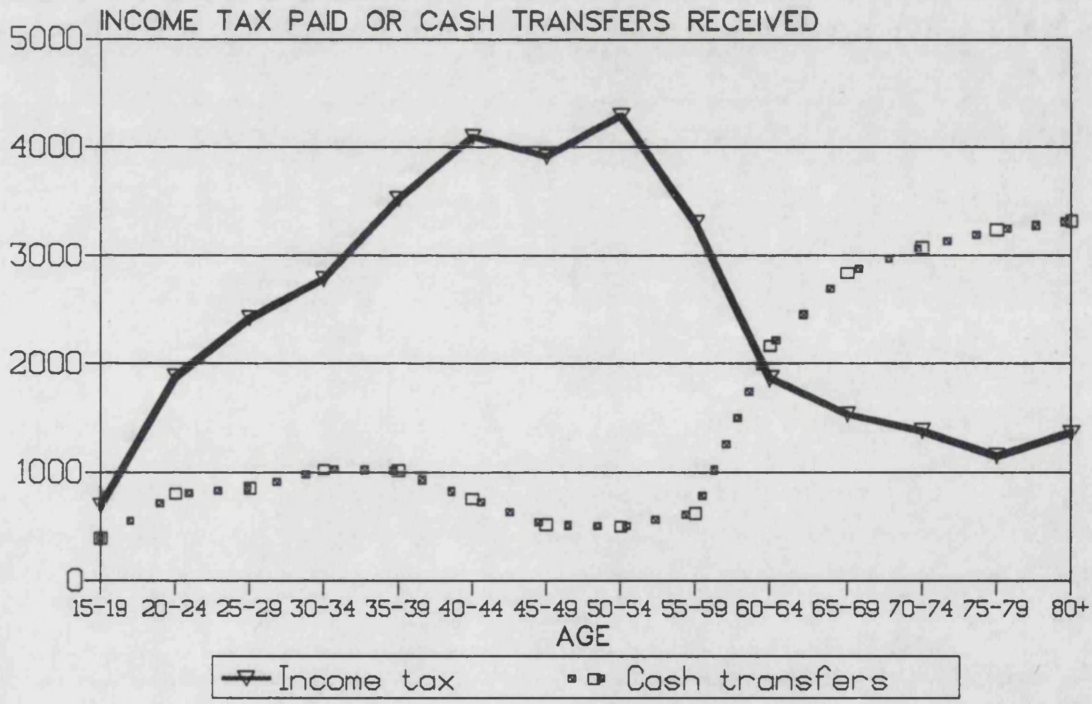
Table 9.2: Income and Other Characteristics of Females by Age

MEASURE	AGE 15-20	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+
Earnings	4,605	9,420	10,025	10,575	12,450	14,115	13,550	12,865	10,005	3,675	1,600	860	0	0
Investment income	135	255	815	875	1,055	1,045	1,015	2,515	2,390	3,455	3,495	3,550	3,565	1,765
Superannuation	0	0	0	0	0	0	0	0	0	550	790	1,005	1,290	3,720
*TOTAL ORIGINAL***	*4,745*	*9,685*	*10,885*	*11,540*	*13,635*	*15,275*	*14,675*	*15,420*	*12,410*	*7,680*	*5,880*	*5,420*	*4,850*	*5,490*
Pension	95	355	410	430	430	330	290	425	595	2,165	2,835	3,075	3,230	3,315
Benefit	160	225	75	30	20	20	40	10	10	0	0	0	0	0
Education transfers	110	75	20	20	40	50	45	25	5	5	0	0	0	0
Child transfers	25	140	350	540	525	350	145	40	10	0	0	0	0	0
TOT TRANSFERS	*390*	*800*	*850*	*1,020*	*1,015*	*750*	*515*	*500*	*620*	*2,165*	*2,835*	*3,075*	*3,230*	*3,315*
GROSS INCOME	5,135	10,485	11,735	12,560	14,650	16,025	15,190	15,920	13,030	9,850	8,715	8,490	8,085	8,805
Income tax	690	1,875	2,420	2,780	3,520	4,100	3,915	4,295	3,300	1,865	1,530	1,380	1,150	1,365
DISPOSABLE INC	*4,440*	*8,610*	*9,315*	*9,780*	*11,130*	*11,920*	*11,275*	*11,625*	*9,730*	*7,985*	*7,185*	*7,110*	*6,935*	*7,440*
EQUIVALENT INC	7,880	16,365	18,750	19,295	21,010	23,225	23,825	24,565	21,200	15,660	13,310	12,810	12,460	12,860
% Married	7.4	34.2	58.9	69.2	71.5	71.9	69.9	68.2	64.5	59.7	52.3	42.6	29.8	12.0
Av no children	0.087	0.438	1.008	1.519	1.521	1.109	0.538	0.166	0.041	0.007	0.001	0	0	0
% in Labour Force	62.0	84.8	75.3	72.5	77.0	81.2	77.7	70.2	59.3	27.3	9.9	5.5	0	0
% Work F.T.*	49.2	79.5	73.1	70.3	74.0	77.8	78.4	88.5	88.7	87.7	83.5	85.9	0	0
% Exp Any Unemp#	20.2	21.0	14.9	11.8	10.4	10.1	10.6	5.9	6.7	0	0	0	0	0
Hourly wage rate*	6.75	8.30	9.40	10.20	10.60	10.95	10.80	10.30	9.50	8.15	10.65	10.35	0	0
Av hrs worked pa*	1182	1433	1513	1511	1617	1684	1704	1849	1849	1758	1786	1858	0	0
% with degree	0	9.1	15.1	16.7	18.0	18.7	18.7	18.7	18.9	19.3	19.6	19.7	19.9	22.0
% sec sch only	37.6	42.8	32.0	23.9	17.5	13.4	12.5	12.5	12.4	12.6	12.7	12.7	12.6	11.5

Note: * denotes average for those in labour force.
** Includes maintenance. All income figures rounded to nearest $5. Totals may not sum due to rounding.
# % unemployed is % experiencing any unemployment during year.

The tax-transfer system generates a significant amount of lifecycle income redistribution for women, providing transfers during the twenties and thirties, when family responsibilites are at their height, and after retirement in the early sixties. As a comparison of Figures 9.4 and 9.12 demonstrates, cash transfers are more important for women than for men during working years, although in retirement the average value of cash transfers is similar. The amount of income tax paid during the lifecycle is much lower, reflecting the reduced taxable incomes of women compared to men, and peaks at only around $4,000, less than half of the peak for men.

Figure 9.12: Average Income Tax Paid or Cash Transfers Received by Age by Females



The lifecycle pattern of taxes and transfers for those with the highest and lowest levels of lifetime standard of living is strikingly at odds with the picture on average. As Figure 9.13 illustrates, women in the *lowest decile* of lifetime equivalent income received much more in transfers during their lifetimes than they paid in taxes and, with the exception of the 45 to 49 years age range, received more in transfers than they paid in income tax during every year of their life.

The profile for women in the *top decile* is again more similar to that of males in the top decile, with income tax rising steeply during the twenties and thirties and declining in retirement. The characteristic twin-humped pattern of cash transfers for women in again evident, although cash transfers remain very low, never exceeding $1,000 (Figure 9.14).

As with men, it is possible to compare cumulative *adjusted income tax* with cumulative cash transfers received - ie. to compare the amount of cash transfers received against the amount of income tax devoted to the provision of cash transfers (27.6 per cent of all income tax paid by men and women). Interestingly, the picture for all women is similar to that of men in the bottom decile of annualised lifetime equivalent income, in that cumulative adjusted taxes paid essentially equal cumulative transfers received during the working years, but net gain increases sharply in retirement, when transfers outpace adjusted taxes.

The average age of death for all women is around 79 years, so on average women make a net gain of about $40,000. (This is lower than the male average loss of $50,000 which finances the $40,000 gain of women; because women live on average for five years longer than men, the net loss of men has to be shared between more women). This means that, for women in general, *all* adjusted income tax payments contribute to intra-personal income redistribution; looked at from a lifecycle perspective, all taxes collected during the peak working years are redistributed backwards to the years of child rearing and, far more importantly, forwards to the years of retirement.

For women belonging to the *bottom decile* of annualised lifetime equivalent income, cash transfers exceed adjusted income tax throughout the lifecycle. At the average age of death of 81.6 years, women in this decile have received about $100,000 more in cash transfers than they have paid in income tax. As Figure 9.15 shows,

Figure 9.13: Average Income Tax Paid or Cash Transfers Received by Age by Females in the Lowest Decile of Annualised Lifetime Equivalent Income

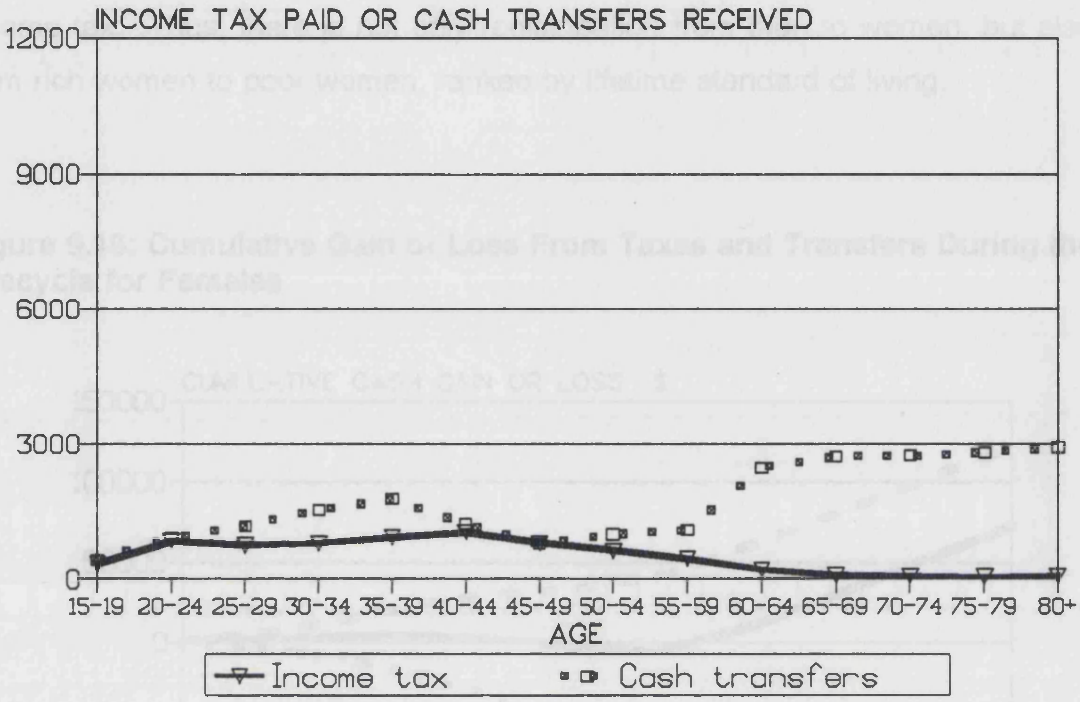
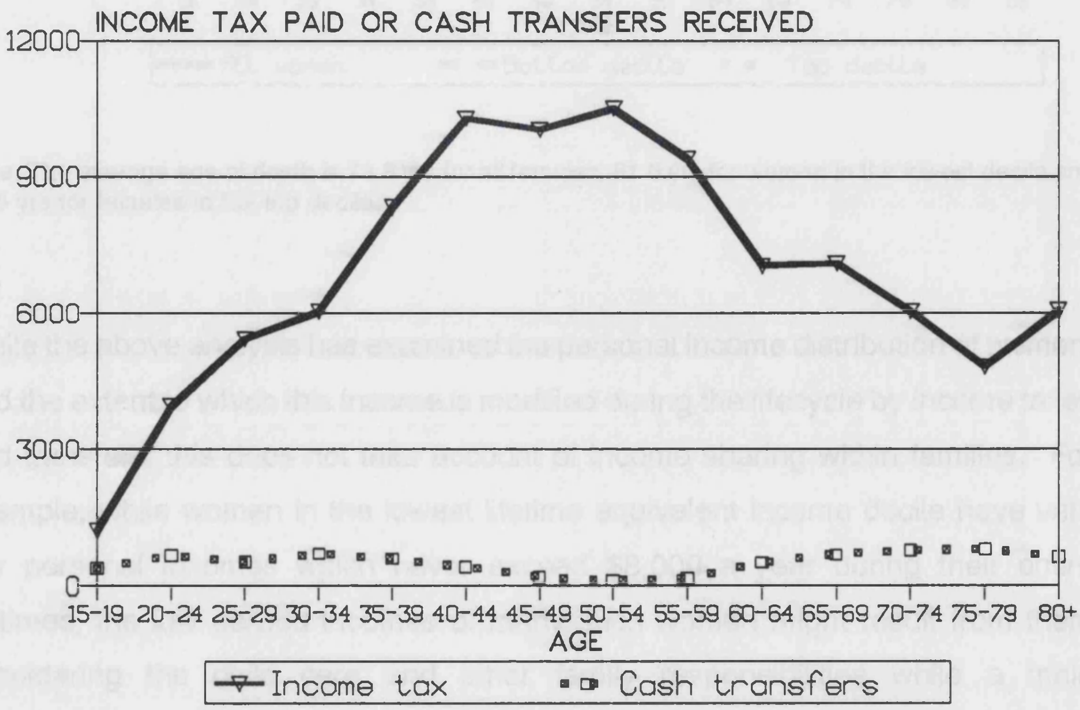
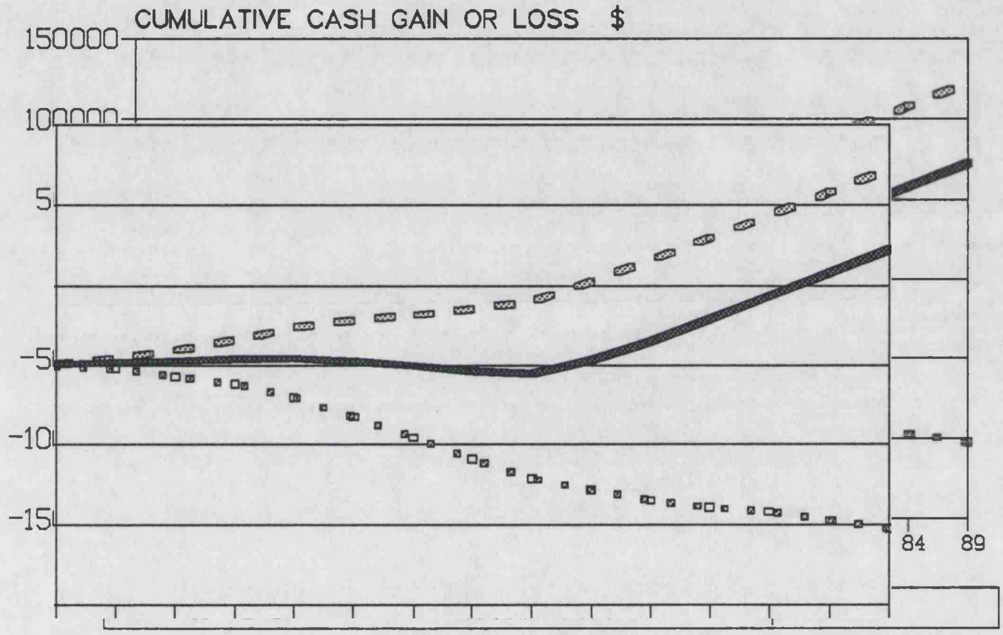


Figure 9.14: Average Income Tax Paid or Cash Transfers Received by Age by Females in the Highest Decile of Annualised Lifetime Equivalent Income



there is no point in the lifecycle when women with the highest lifetime standards of living have received more in cash transfers than they have paid in adjusted income tax. Thus, there is not only redistribution from men to women, but also from rich women to poor women, ranked by lifetime standard of living.

Figure 9.15: Cumulative Gain or Loss From Taxes and Transfers During the Lifecycle for Females



Note: The average age of death is 78.8 yrs for all females, 81.6 yrs for women in the lowest decile and 76.5 yrs for females in the top decile.

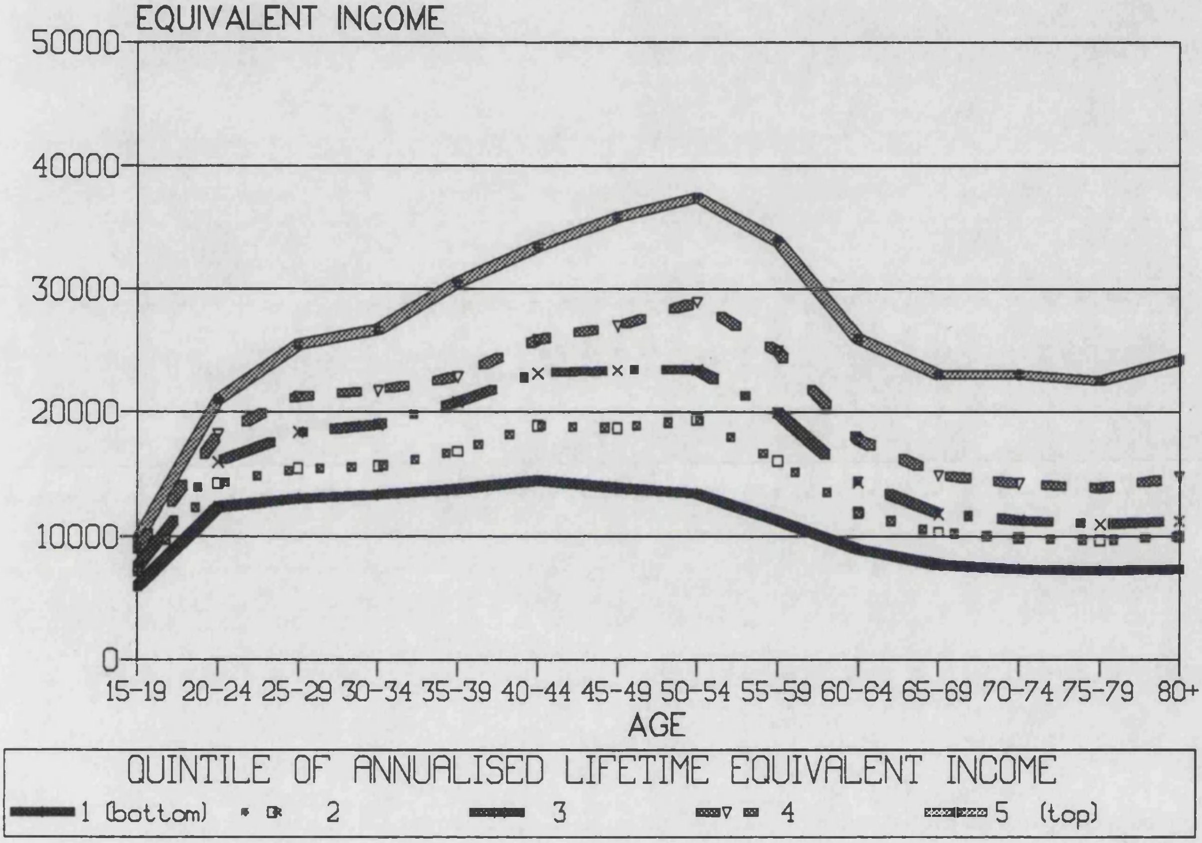
While the above analysis has examined the personal income distribution of women, and the extent to which this income is modified during the lifecycle by income taxes and transfers, this does not take account of income sharing within families. For example, while women in the lowest lifetime equivalent income decile have very low personal incomes which never exceed $8,000 a year during their entire lifetimes, the low earned incomes of many such women might result from them shouldering the child care and other family responsibilities while a male breadwinner provides income for the family.

To compare the *standard of living* achieved by different women during their lifecycles, rather than to just compare their income, equivalent income must be used. In Figure 9.16, women have been divided into quintiles on the basis of their annualised lifetime equivalent income, and then the annual equivalent income of each quintile during every year of life has been plotted. As comparison with Figure 9.8 demonstrates, the standard of living achieved by women during their lifetimes is fairly similar to that of men. The standard of living of those in the bottom quintile does not show great variation across their lifecycle, although the flatness of the line should not disguise the fact that equivalent income during retirement is still only 53 per cent of the highest equivalent income achieved during the peak working years.

The impact of children upon lifetime standards of living is again clearly apparent, as the increases in earned income during the twenties and thirties are offset by the greater number of people amongst whom that income must be shared, resulting in slow growth in living standards during the late twenties and thirties. For the top four quintiles, living standards peak in the early fifties, after child-related responsibilites have eased but before the drop in average earnings really begins to make an impact. During retirement, real standards of living decline, with equivalent income averaging some 53 per cent of the peak level achieved only 15 years earlier, and the standard of living achieved being somewhat lower than that won during the early twenties.

While the equivalent incomes of most quintiles of women at a given age are somewhat lower than the equivalent incomes of men in comparable quintiles (due, for example, to single men typically having higher incomes than single women), the difference is far less pronounced than examination of personal incomes would suggest. However, the disparity between the equivalent incomes of men and women in their top respective quintiles is greater than the difference apparent at lower quintiles. For example, the peak equivalent incomes of men in the top quintile are 10 per cent higher than the peak equivalent incomes of women in the top quintile.

Figure 9.16: Annual Equivalent Income by Age For Females, Ranked by Quintile of Annualised Lifetime Equivalent Income



9.3 LIFECYCLE INCOME BY LIFETIME FAMILY STATUS

Males

For males, marital status and the presence of children made relatively little difference, in comparison to women, to either sources or amount of income received, or to the amount of income tax paid or cash transfers received. However, while all married males had fairly similar income profiles, never married males received less income during their lifetimes than ever married males.[1] For example, Figures 9.17 and 9.18 show the amount of income received by age by never married men, and by married men who spent more than 21 years in a family with dependent children. The peak incomes of the latter are a few thousand dollars higher than those of the former, and the hump shaped pattern of earnings is more pronounced for the ever married group during their forties.

In addition, while there is little difference in the pattern of receipt of transfers or payment of taxes amongst married males, never married males pay less income tax than married males, due to their lower taxable incomes (Figures 9.19 and 9.20). Never married males also receive higher cash transfers in retirement than married males, presumably because the age pension for single people is higher than half the married pension, and because spouse income does not result in any reduction of pension.

A clearer picture of redistribution between males by marital and child status can be gained by comparing their cumulative cash transfers received during their lifetimes with the cumulative income tax required to finance all cash transfers (ie.by taking the standard 27.6 per cent of all income taxes paid). Figure 9.21 traces the cumulative loss of never married males and those who married and spent more than 21 years in families with dependent children. Once again, such males pay more in adjusted income taxes during their prime working years than they receive in cash transfers, so their cumulative net loss increases steadily until retirement age is reached. In retirement, the net loss of the never married group is reduced at a faster rate than that of the ever married group, due to their higher age

(1) During construction of the model, the marital status of males was not used as an explanatory factor affecting *labour force participation* (due both to the problems of adding an additional explanatory factor and to tests suggesting that marital status was not a significant factor, once education and age had been controlled for - see Chapter 4). However, whether males were married or divorced was used in the simulation of hourly wage rates, with the wage rates of both married and divorced men generally being higher than those of unmarried men. Marital status was also used in the simulation of investment income and divorce emerged as a significant explanatory variable in the modelling of superannuation receipt for males.

Figure 9.17: Average Income Received Each Year by Age by Never Married Males

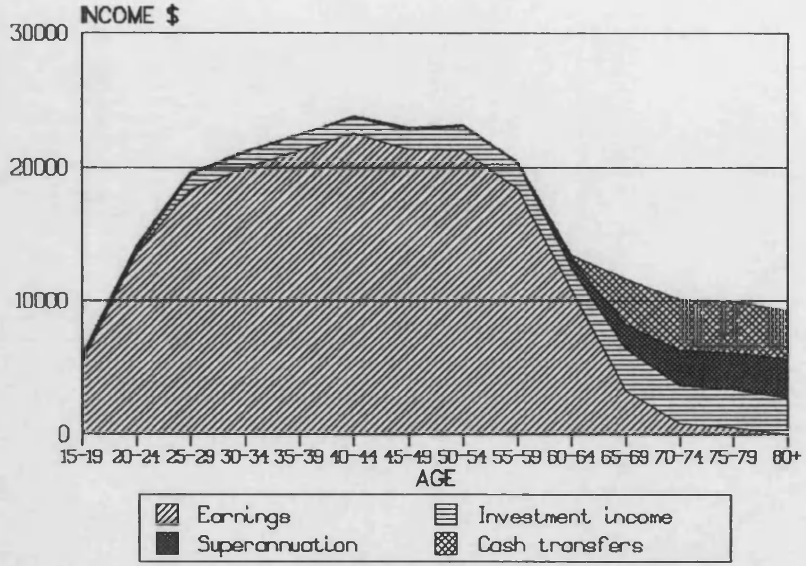


Figure 9.18: Average Income Received Each Year by Age by Ever Married Males Who Spent 21 or More Years in a Family With Dependent Children

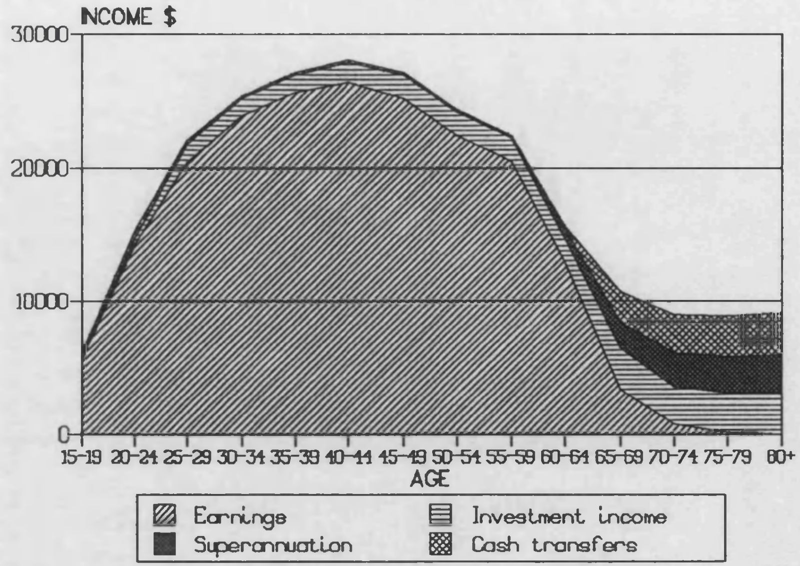


Figure 9.19: Average Income Tax Paid or Cash Transfers Received by Age by Never Married Males

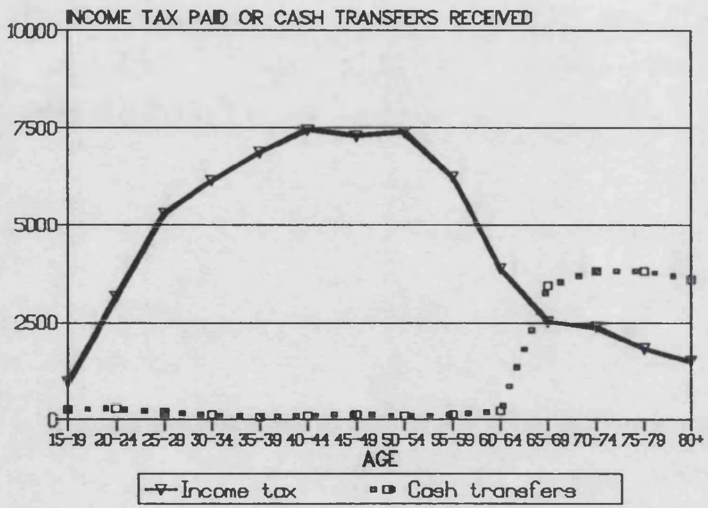
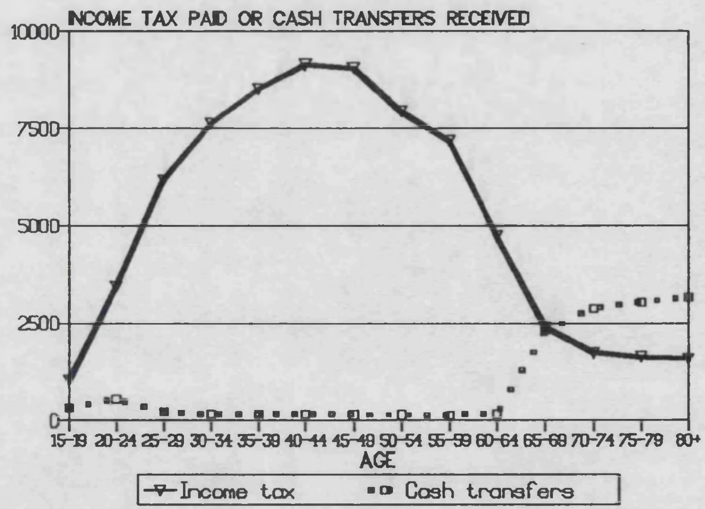
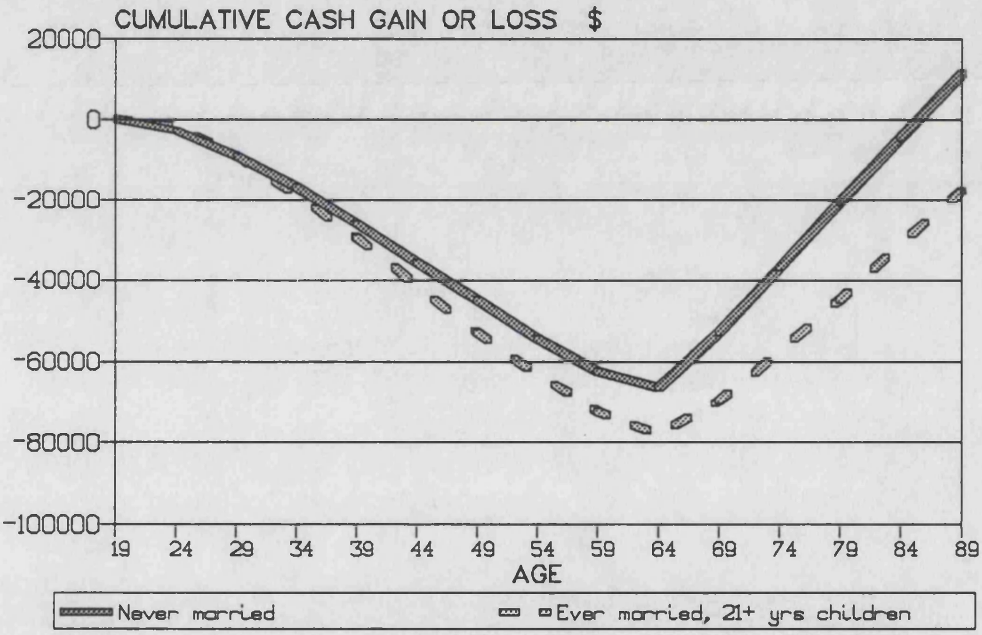


Figure 9.20: Average Income Tax Paid or Cash Transfers Received by Age Ever Married Males Who Spent 21 or More Years with Dependent Children



pension. However, at the average age of death, of 70.6 years for the never married group and 75.5 years for the ever married group who spent more than 20 years in families with dependent children present, both groups have still incurred a substantial net loss. The figures suggest that there is a minor amount of redistribution from married to never married males.

Figure 9.21: Cumulative Gain or Loss from Adjusted Taxes and Transfers During the Lifecycle for Never Married Males and Married Males With More Than 20 Years in Families With Dependent Children

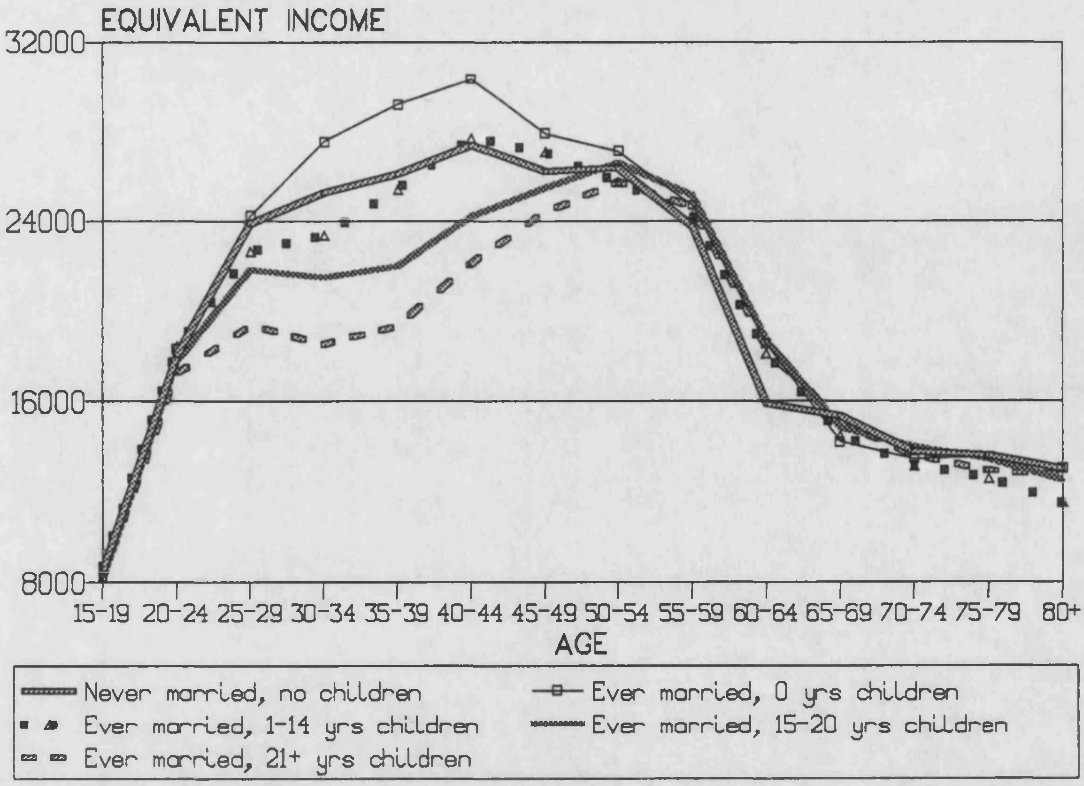


Note: The average age of death for never married men is 70.6 years and 75.5 years for ever married men with 21 or more years with dependent children.

There are, however, major differences in the equivalent income during the lifecycle of men by lifetime marital and child status (Figure 9.22). As one would expect, for men with children, roughly the same amount of income is shared amongst more people, and their equivalent income is commensurately lower. The impact of dependent children and, to a lesser extent spouses, is particularly marked for men from ages 25 to 55, when the equivalent income of ever married men with no children and, to a reduced extent, of never married men without children, is significantly higher than that of men with children.

The equivalent income of men with children declines smoothly with the number of years spent in a family with dependent children, with those who spent more than 20 years in such a family experiencing the lowest equivalent income during the 30 years from ages 25 to 55. From age 25 to 40, the equivalent incomes of men who spent 15 or more years with dependent children does not increase, and even declines in the early thirties despite increases in earned income, reflecting the demands placed upon family income during the years of family formation and growth. In contrast, the equivalent income of ever married men without children continues to increase rapidly during this period, as increases in earned income are directly reflected in rising living standards. From age 55 onwards, when the impact of children has faded, the equivalent incomes of men by their lifetime marital and child status are very similar.

Figure 9.22: Annual Equivalent Income by Age For Males by Lifetime Family Status



Females

The personal incomes of women, on the other hand, show the impact of lifetime marital and child status far more clearly than those of men. Figure 9.23 traces the average incomes received by ever married women who never had children. The dip in earnings apparent in Figure 9.9 for all women no longer exists, as those without children remain in the labour force for extended periods and have an earnings profile like that of males. Investment income picks up in the fifties and remains at much the same level until retirement, when it shows further growth.

The incomes during the lifecycles of ever married women who had three or more children are plotted in Figure 9.24; the dip in earnings during the twenties and early thirties is once again apparent, and the earned incomes of such women remain low relative to those of other women during all of their lives. Child transfers are significant during the 30 years after age 20, with cash transfers dropping only in the fifties before increasing again because of age pension during the sixties.

Figures 9.25 and 9.26 contrast the average income tax paid and cash transfers received each year by ever married women with no and three or more children. The twin peaks of cash transfers are clearly apparent for women with three or more children, while the profile of cash transfers for those with no children is essentially flat until retirement age. Those with no children pay substantially more income tax due to their higher earned incomes in particular, and their income tax payments peak at an earlier age than those for women with three or more children, reflecting the delayed labour force entry or re-entry of those with such heavy family responsibilties.

Once again, to isolate the direction of redistribution *between* women it is necessary to compare cumulative transfers received with the income taxes used to finance them. Figure 9.27 plots the extent to which cumulative taxes exceed cumulative transfers, and shows clearly that there is redistribution from women without children towards those with children. Sole parents who never marry receive the highest net gain, having received some $90,000 more in transfers during their lifetime than they paid in adjusted income tax by the time they died at the average age of 75.

Figure 9.23: Average Income Received Each Year by Age by Ever Married Females With No Children

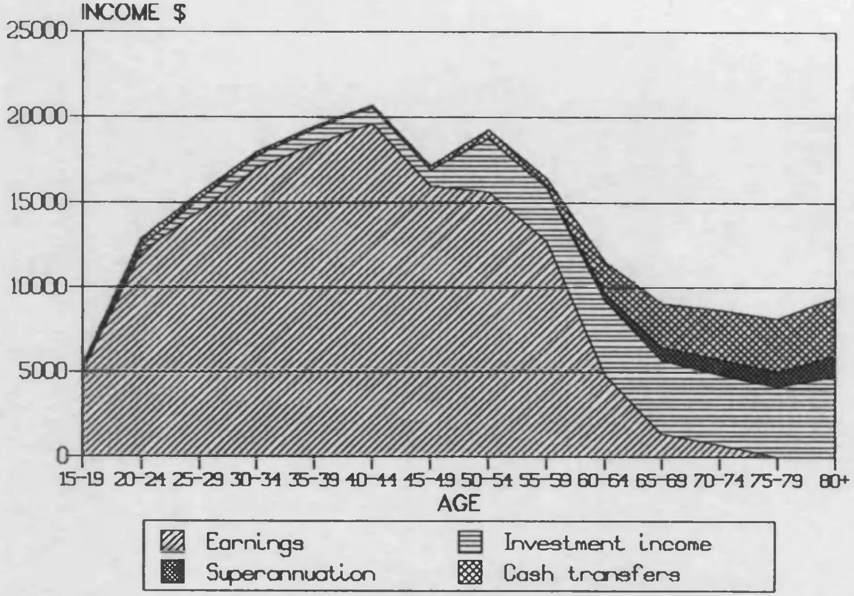


Figure 9.24: Average Income Received Each Year by Age by Ever Married Females With Three or More Children

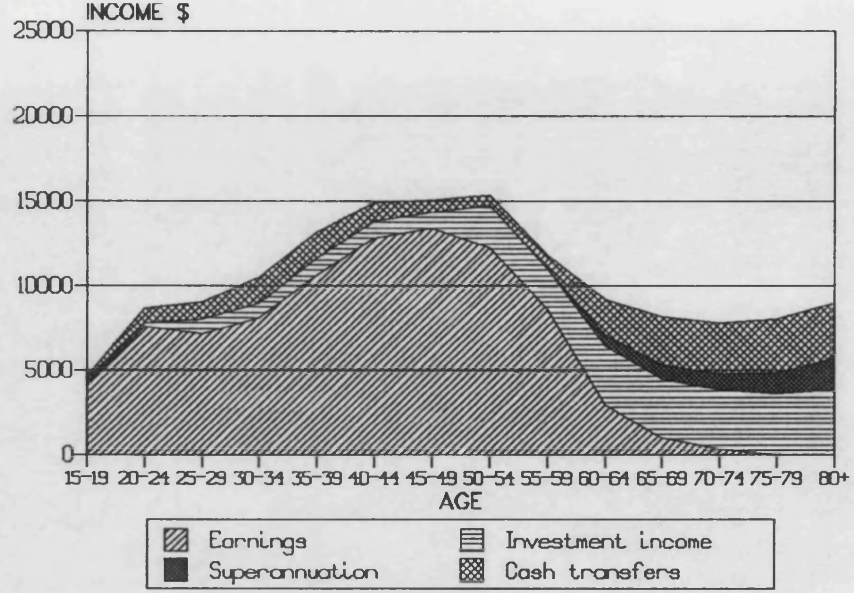


Figure 9.25: Average Income Tax Paid or Cash Transfers Received by Age by Ever Married Females With No Children

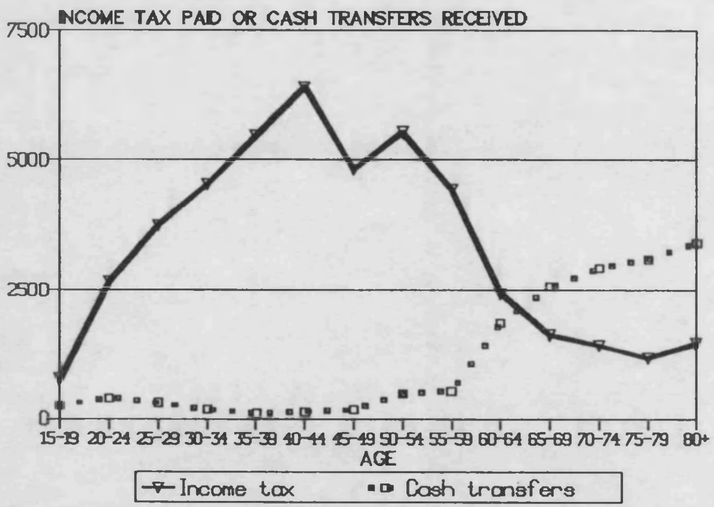
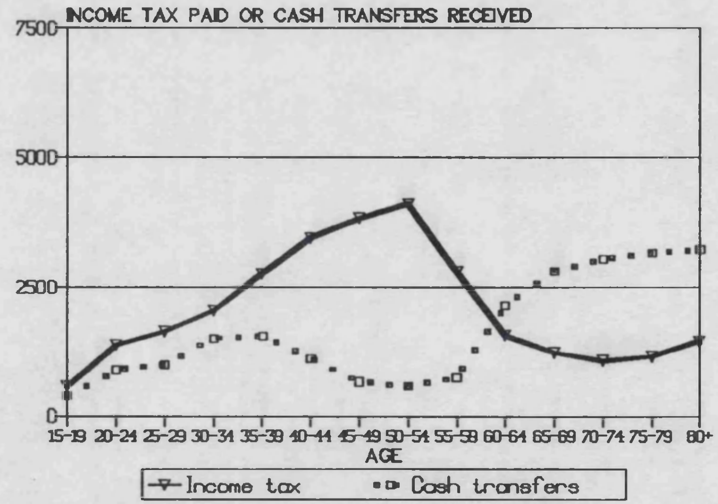
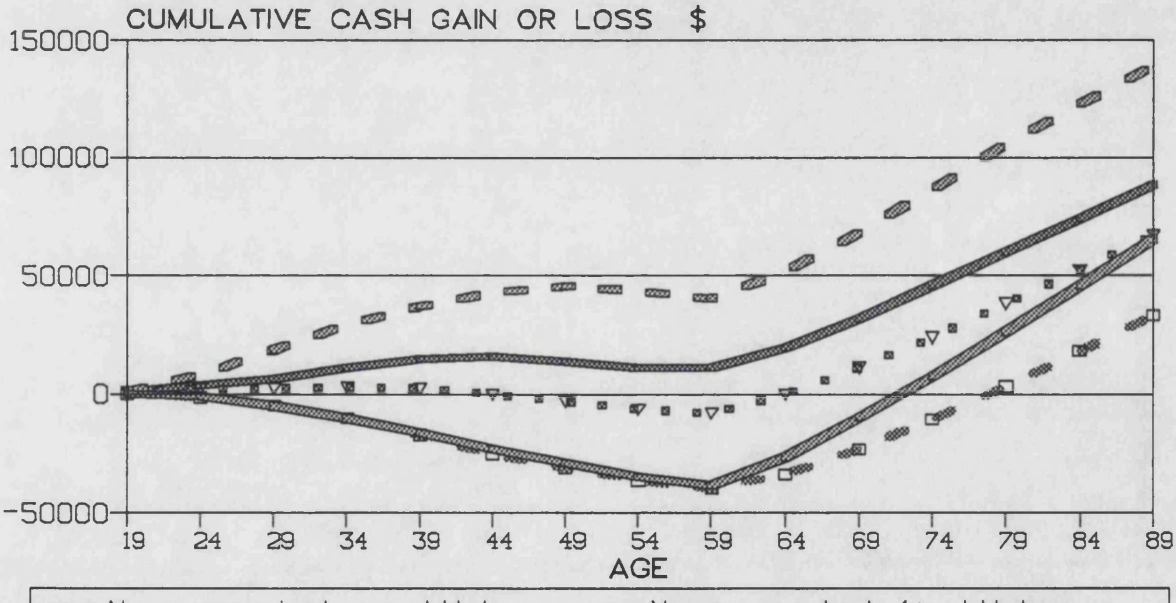


Figure 9.26: Average Income Tax Paid or Cash Transfers Received by Age by Ever Married Females with Three or More Children



Similarly, during their whole lifetimes, there is no point at which the cumulative average adjusted income taxes paid by married women with three or more children exceed their average cash transfers received. Both married and unmarried women without children have similar net loss profiles until retirement, when single women move ahead because of the family structure of age pension. Ever married women without children are the only group not to make a substantial net gain; on average, they die at about age 80, just at the point when cumulative cash transfers marginally exceed the same level as cumulative adjusted income tax payments.

Figure 9.27: Cumulative Gain or Loss From Adjusted Income Tax and Cash Transfers During the Lifecycle, for Females Ranked by Family Status



Note: The average age of death for never married women without children is 76.6 years; for never married women with children is 74.6 years; for ever married women without children is 80.3 years; for ever married with one or two children is 79 years and for ever married with three or more children is 78.9 years (Table 6.5).

Nonetheless, despite these transfers, ever married women without children enjoy higher standards of living than any of the other groups considered during the lifecycle. The equivalent incomes each year of women with different lifetime marital and child profiles are traced in Figure 9.28. Those who became *sole parents* and never married have the lowest equivalent incomes for three decades from age 20 onwards, which suggests that the substantial social security and tax assistance received by this group does not begin to compensate them fully for the additional costs involved with the sole support of children.

Ever married women without children achieve the highest standard of living, and fare better on average than any of the other categories of women during every year in their entire lifecycles. Although never married women without children attain a higher standard of living during their twenties and thirties than married women with children, they are outpaced during their forties, when the children of such married women leave home but they continue to benefit from the higher incomes of their husbands.

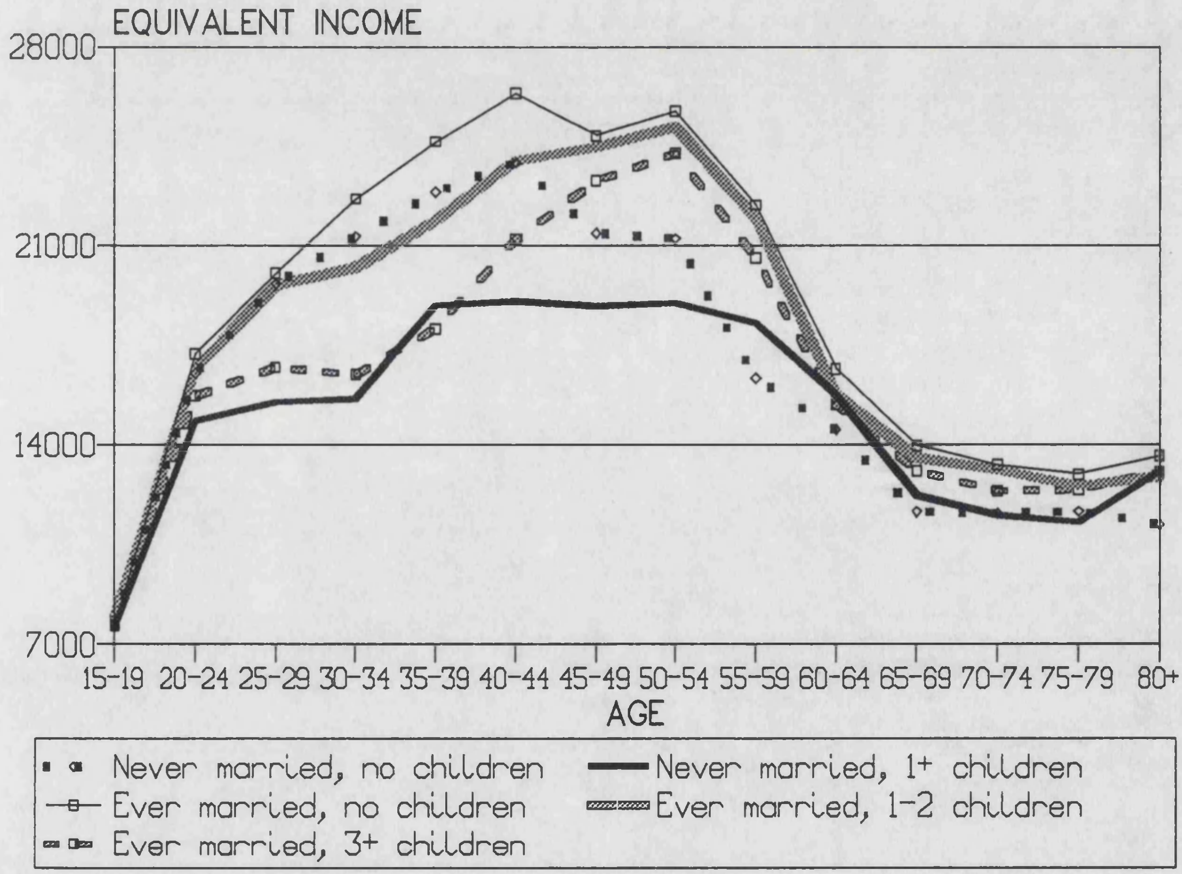
The impact of large family size upon living standards is pronounced, as shown by the very low growth in the standard of living of women with three or more children during their twenties and thirties. However, the equivalent incomes of such women rise rapidly during their forties as their children leave home and they enter the labour force, and by the age of 50 the equivalent incomes of women who had large families is almost at the same level as those married women who had no or less than three children.

In retirement, ever married women also fare better then never married women, as they share in the incomes of spouses, although the degree of income dispersion is much less marked than during the prime working years.

While these results might suggest that the equivalence scales implicit in the Australian social security system are too generous towards those with children such scales, as mentioned earlier, are almost identical to the British DHSS scales in their treatment of children, and according to the British Central Statistical Office these scales are not out of step with international practices (CSO, 1990).

In addition, it must also be stressed again that the differences apparent between men and women with different lifetime family characteristics are not only due to their family status. Those who have children are not identical to those who do not have children in all other respects, and the results also reflect these discrepancies.

Figure 9.28: Annual Equivalent Income by Age for Females Ranked by Lifetime Marital and Child Status



9.4 LIFECYCLE INCOME BY LIFETIME EDUCATION STATUS

Males

As the results outlined in Chapters 6 to 8 have already made clear, those with higher educational qualifications achieve higher lifetime incomes and are more likely to belong to deciles with the highest lifetime standards of living. However, the analysis to date has not analysed the relative advantage enjoyed by the better educated at different stages of the lifecycle. While at ages 15 to 19 the average incomes of those who only ever achieve secondary qualifications are higher than the incomes of those who go on to earn degrees, graduates make great gains during their early twenties, so that by age 25 to 29 the average incomes of graduates are already about one-third higher (Figures 9.29 and 9.30). The relative earnings advantage enjoyed by graduates continues to increase; when graduate incomes peak at ages 45 to 49, at about $38,000, they are then receiving about twice as much income as males with secondary qualifications only. In retirement, those who never achieved any tertiary qualifications receive minimal superannuation and are largely dependent on cash transfers. In contrast, graduates receive about twice as much income in retirement as those with secondary qualifications only, with superannuation and investment income contributing the bulk of post-retirement income.

The differing patterns of receipt of cash transfers and payment of income tax are illustrated in Figures 9.31 and 9.32; the income tax profile of those with secondary qualifications is relatively flat, reflecting the lower incomes received during the lifecycle, while the profile for graduates is steeply humped, with income taxes peaking at more than double the amount paid by those with secondary qualifications. In retirement, those with secondary qualifications for the first time become net beneficiaries, receiving more in age pension than they pay in income tax. Those with degrees continue to pay more in income tax than they receive in cash transfers, even in retirement.

Figure 9.29: Average Income Received Each Year by Age by Males With Secondary School Qualifications Only

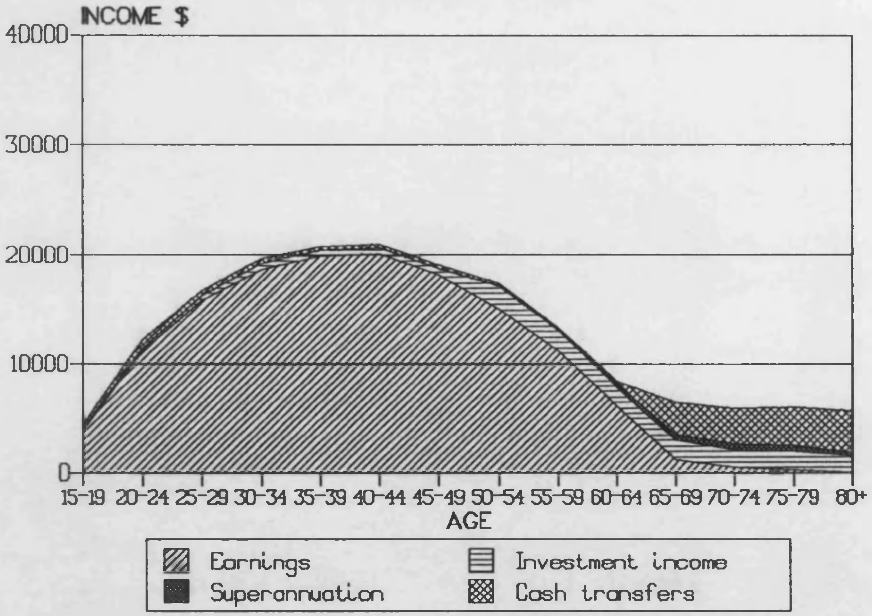


Figure 9.30: Average Income Received Each Year by Age by Males With Degrees

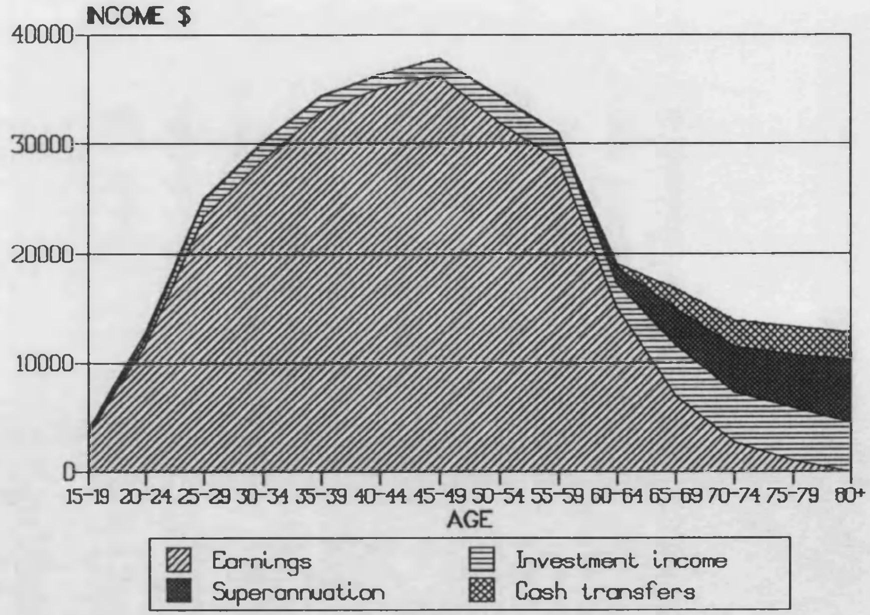


Figure 9.31: Average Income Tax Paid or Cash Transfers Received by Age by Males With Secondary School Qualifications Only

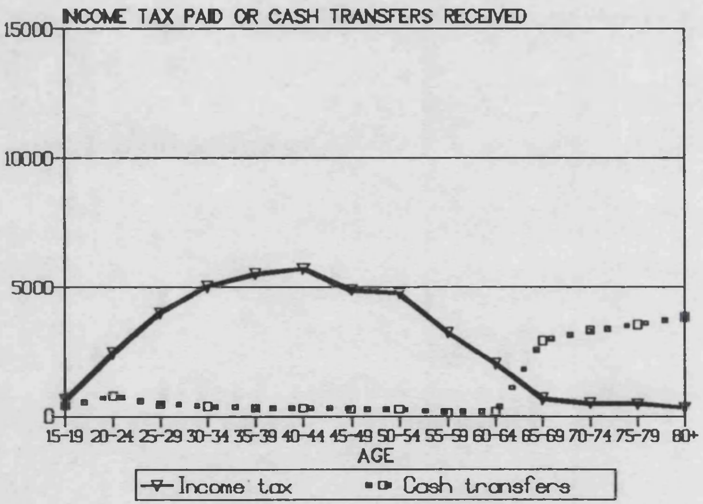
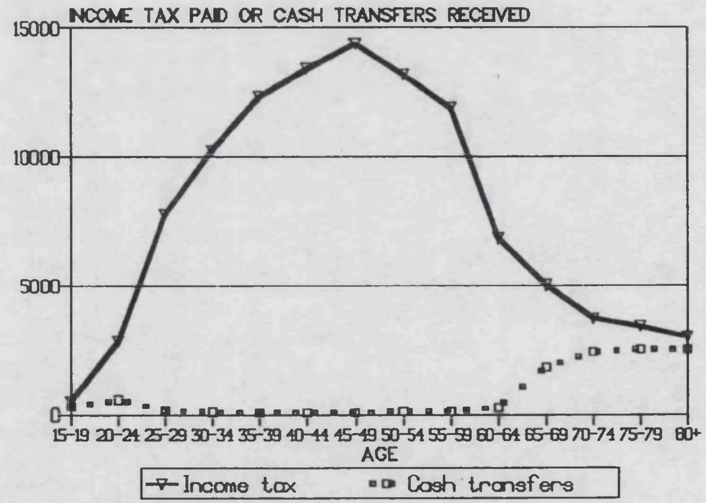


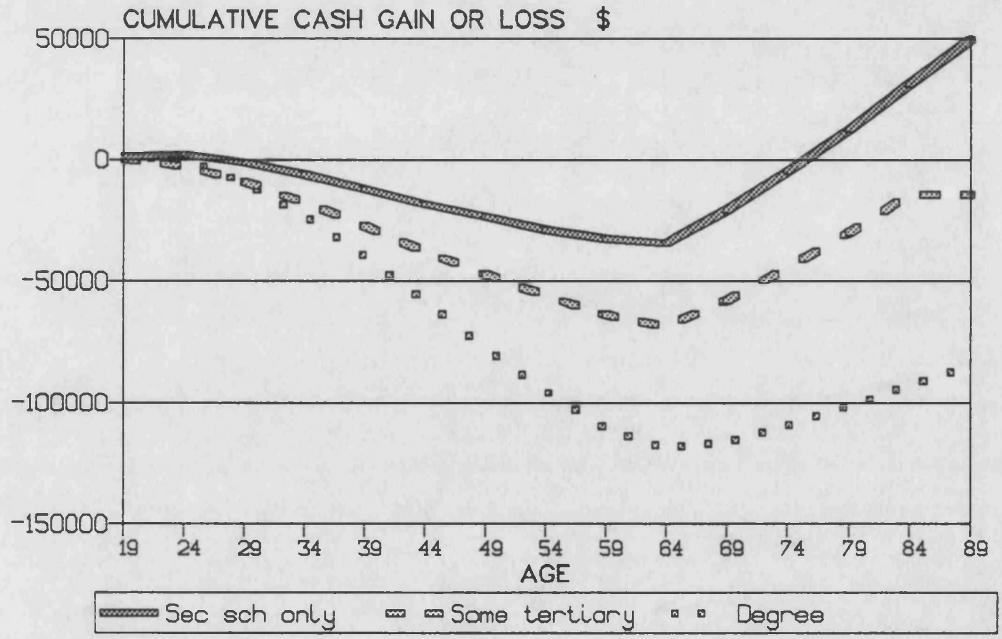
Figure 9.32: Average Income Tax Paid or Cash Transfers Received by Age by Males With Degrees



The direction of redistribution achieved by the tax-transfer system can be more clearly grasped by comparing the cumulative distribution of cash transfers with the income taxes which financed those cash transfers (27.6 per cent of all income tax paid). While there is redistribution from those with tertiary qualifications towards those with secondary qualifications, this redistribution is never sufficient to make any of the three categories of males considered net gainers (Figure 9.33).

Although those with secondary school qualifications do begin to receive substantially more in cash transfers than they pay in adjusted income tax after retirement (reflected in the cumulative net loss line in Figure 9.33 beginning to curve upwards for this group after age 64) when they die at the average age of 73 they are still net losers, having paid out more in adjusted income tax during their

Figure 9.33: Cumulative Gain or Loss From Adjusted Income Tax and Cash Transfers During the Lifecycle for Males by Highest Educational Qualification Achieved

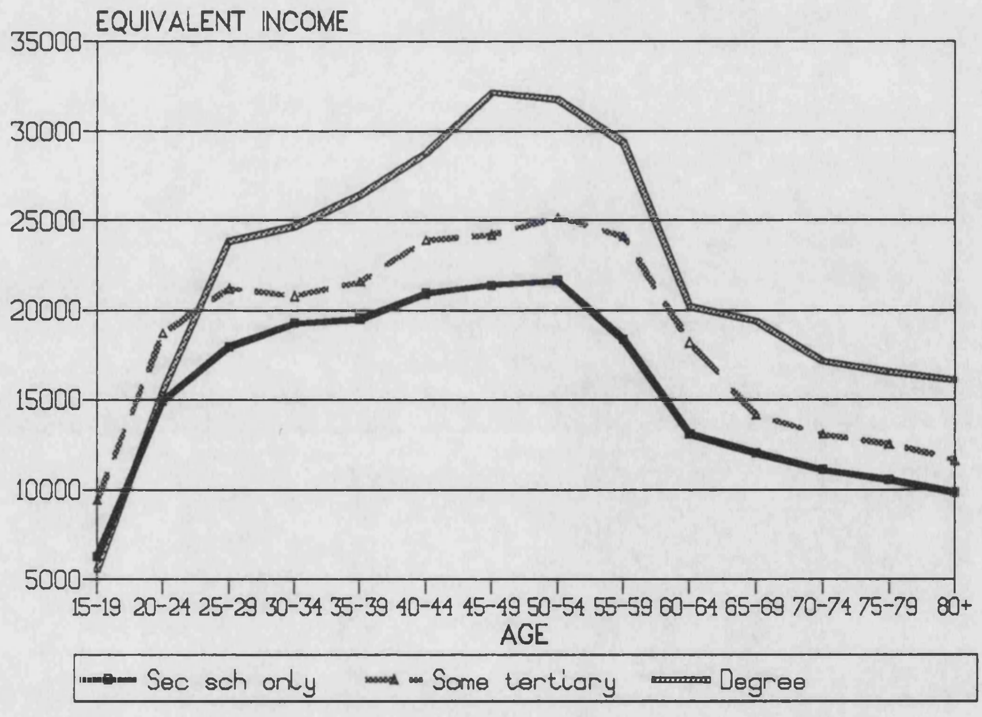


Note: The average age of death is 73.0 yrs for those with secondary qualifications, 73.4 yrs for those with some tertiary qualifications and 75.1 yrs for graduates.

lifetimes than they recoup in cash transfers. Similarly, when graduates die at the average age of 75, their cumulative loss still exceeds $100,000.

Finally, Figure 9.34 traces the standard of living enjoyed by males with different educational achievements, after taking full account of all income taxes paid, cash transfers received, and family composition and size. From age 25 onwards, graduates enjoy substantially higher living standards than other males, with the differences being greatest during the forties and fifties and narrowing somewhat in retirement. Although those with some tertiary qualifications (particularly those who gained trade qualifications during their teens) enjoyed higher equivalent incomes for the first 10 years after labour force entry, they were outpaced during their mid twenties by those with degrees.

Figure 9.34: Annual Equivalent Income by Age For Males by Highest Educational Qualification Achieved



Females

The lifecycle income profiles of women by educational qualification achieved are very different, with women with secondary qualifications only being more likely to drop out of the labour force upon marriage or childbirth. Their income thus first peaks at ages 20 to 24, before slumping during the years of family formation, and subsequently peaking again at ages 40 to 44, when labour force participation rates again rise. Female graduates, on the other hand, maintain much more consistent labour force attachment, and this is reflected in the continuous increases in earnings for the three decades following labour force entry. The impact of family formation is, however, still clearly apparent if the profile of women with degrees is compared to that of men with degrees (Figure 9.30), with the income of female graduates increasing at a slower rate from age 25 onwards, and peaking five years later at ages 50 to 55.

Cash transfers are a significant source of income for women with secondary qualifications only during much of their lifecycle, but attain particular importance during retirement, when they are the major source of income. For female graduates, cash transfers are less significant and comprise less than one-third of post-retirement income (although they are more important for female graduates upon retirement than for male graduates, because the latter receive substantially higher superannuation payments).

The patterns of lifecycle payments of income tax and receipt of cash transfers are again strikingly different, as Figures 9.37 and 9.38 illustrate. While cash transfers during the prime working years are only about $1,000 lower than the income taxes paid each year by women with secondary qualifications, income taxes far exceed cash transfers for female graduates. Once retired, the average cash transfers received each year by women with secondary qualifications are far greater than their annual income tax liabilities, while for women with degrees, although cash transfers do exceed income taxes in retirement, the discrepancy is not very large.

Figure 9.35: Average Income Received Each Year by Age by Females With Secondary School Qualifications Only

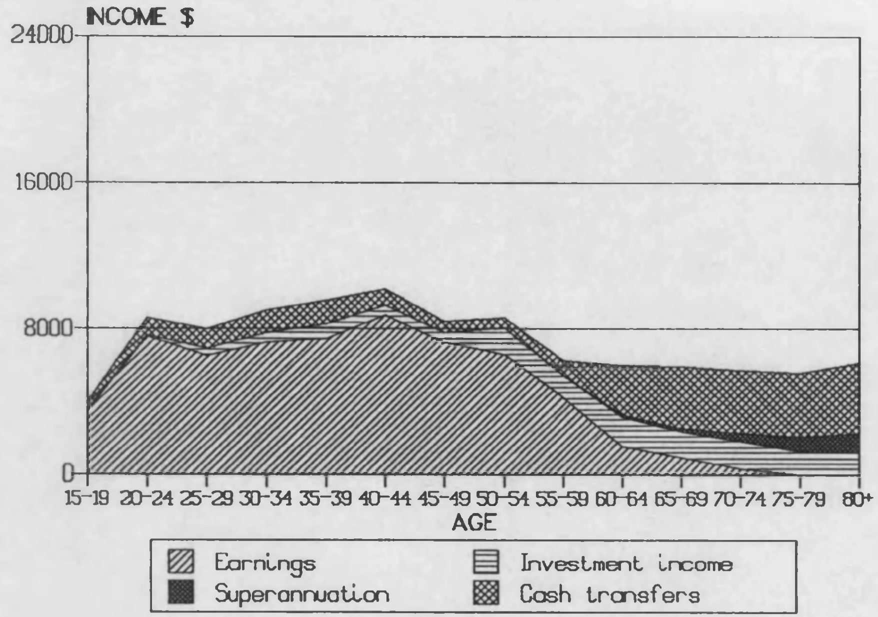


Figure 9.36: Average Income Received Each Year by Age by Females With Degrees

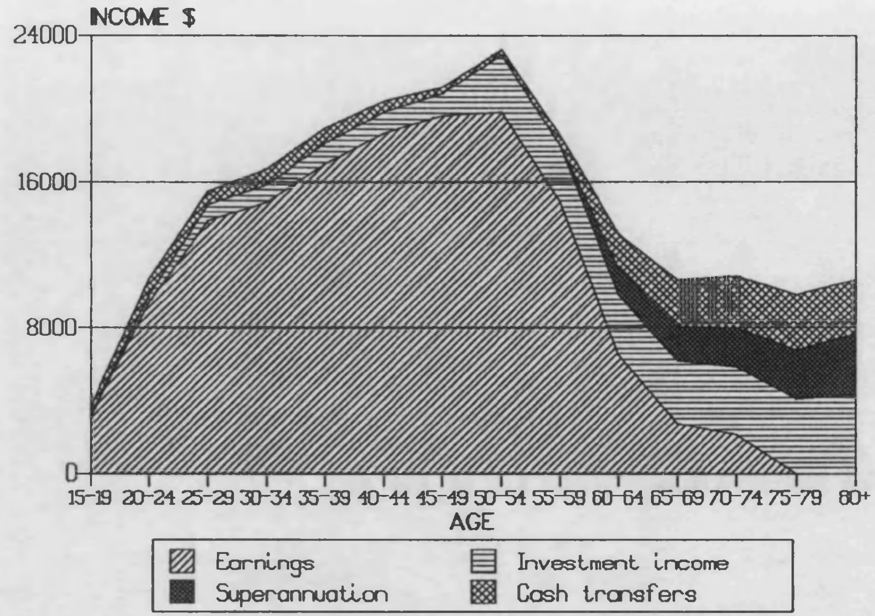


Figure 9.37: Average Income Tax Paid or Cash Transfers Received by Age by Females With Secondary School Qualifications Only

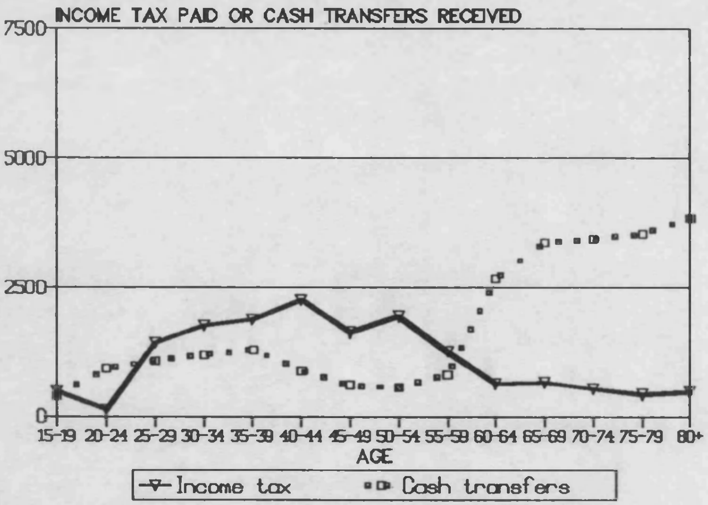
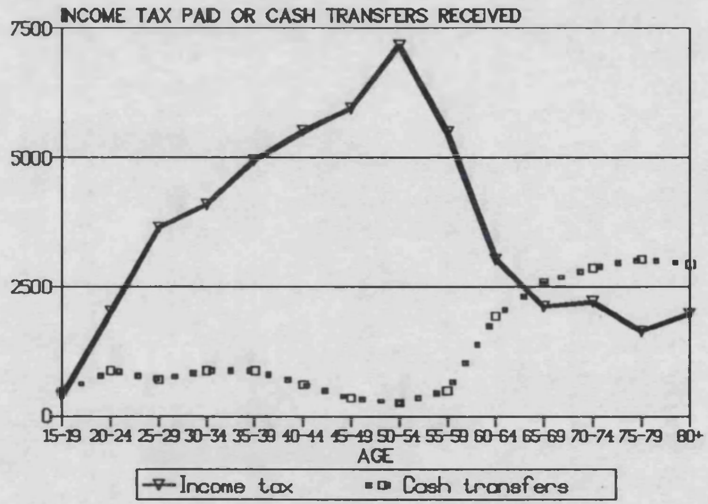


Figure 9.38: Average Income Tax Paid or Cash Transfers Received by Age by Females With Degrees



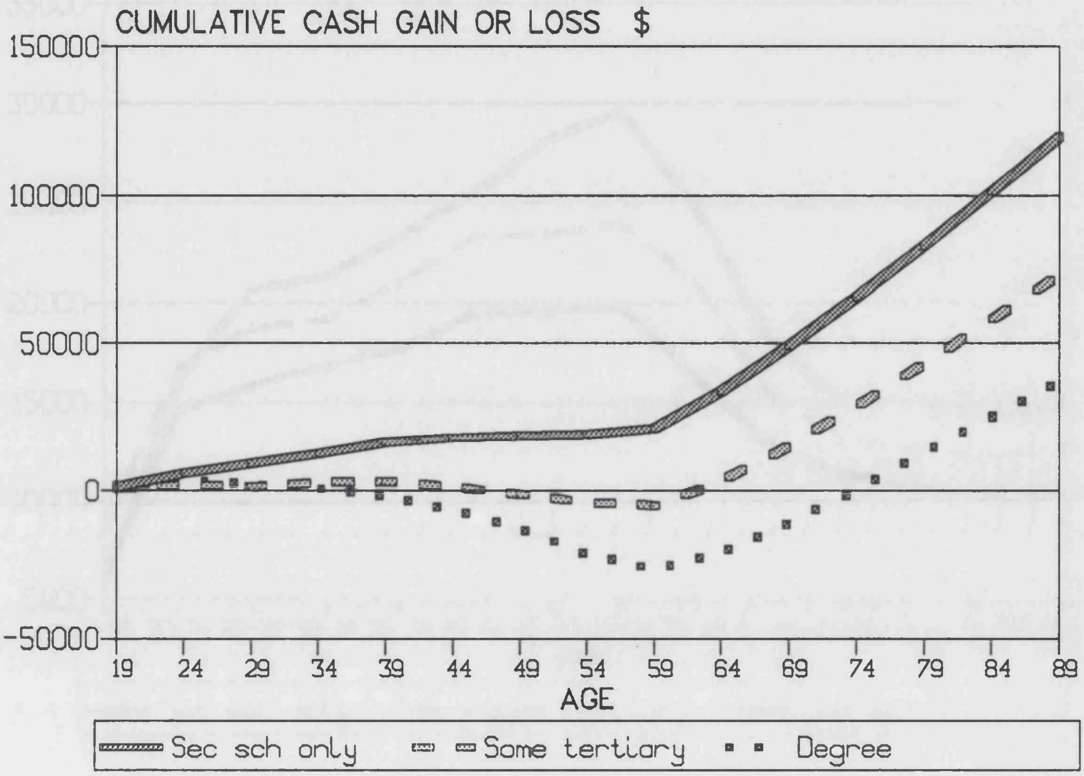
While Figure 9.38 shows clearly that women with degrees pay far more in income tax than they receive in cash transfers during their lifecycle, firm conclusions about the magnitude and direction of redistribution are difficult to draw, because the income taxes paid by female graduates finance a wide range of other services in addition to the provision of cash transfers. It is easier to decide whether such women are net winners or losers if the volume of cash transfers received is compared directly with the income taxes which finance such transfers (ie. 27.6 per cent of total income taxes).

Figure 9.39 plots the cumulative gain or loss made when such cumulative *adjusted* income taxes are subtracted from cumulative cash transfers received, and the conclusions reached are very different. Women with degrees live on average until about age 81, when the net loss which occurred during their working lives has been whittled away by the cash transfers received during retirement, so that such women make an average gain of just under $15,000.

Women with some tertiary qualifications essentially break even during their working lives, with the amount of adjusted income tax paid each year being fairly equal to the value of cash transfers received, so that by age 59 they have made a net contribution of only some $5,000 to the pool of money which finances cash transfers. In retirement, they begin to be net beneficiaries, and by the average age of death at about age 79 they have received around $40,000 more from the 'cash transfers pot' than they have contributed. Women with secondary qualifications alone are net winners during their entire lifecycles and have made a net gain of some $75,000 by the time they die at the average age of 78.

The substantial amount of redistribution which occurs, however, reduces but in no way eliminates the inequality of original income, so that female graduates still enjoy a significantly higher standard of living throughout their lifecycle (Figure 9.40). While the equivalent incomes of women without degrees plateau during their forties and early fifties, those of female graduates continue to show strong growth, so that income differentials are at their height at ages 50 to 55. The equivalent incomes

Figure 9.39: Cumulative Gain or Loss From Adjusted Income Tax and Cash Transfers During the Lifecycle, for Females Ranked by Highest Educational Qualification Achieved

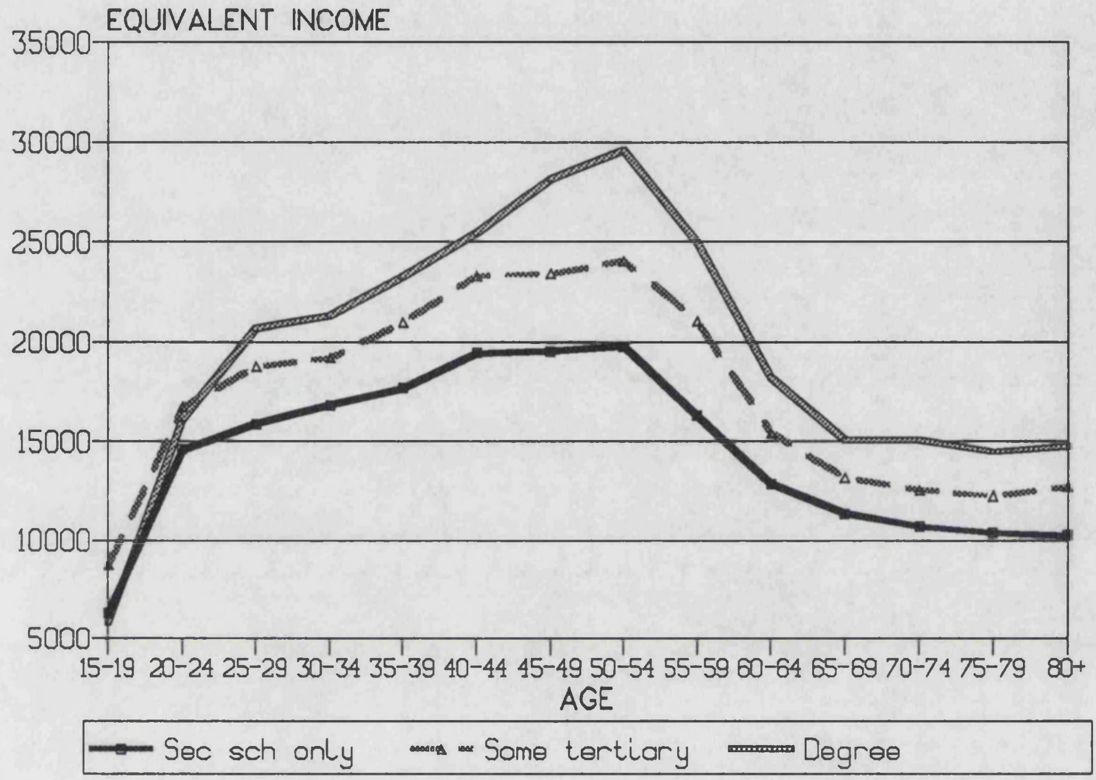


Note: The average age of death is 77.8 yrs for secondary qualifications only, 78.5 yrs for those with some tertiary qualifications and 80.6 yrs for graduates.

of all three groups slump during retirement, although female graduates feel the pinch most strongly as their earned incomes drop sharply, so that the degree of inequality by educational achievement lessens after age 65.

As comparison of Figures 9.34 and 9.40 suggests, males achieve a higher standard of living than females with comparable educational qualifications throughout all of the prime age working years, although living standards in retirement show less discrepancy by sex, with the exception that the equivalent income of male graduates in retirement is a few thousand dollars higher than that of female graduates.

Figure 9.40: Annual Equivalent Income by Age for Females by Highest Educational Qualification Achieved



9.5 CONCLUSION

The tax-transfer system has a profound effect on lifecycle income, redistributing income from the years of work to years of retirement (intra-personal redistribution) and between individuals with different charactersitics (inter-personal redistribution). Aggregate income taxes paid are so much greater than aggregate cash transfers received that they make accurate identification of the magnitude and direction of redistribution very difficult: the easiest way to analyse the type of redistribution occurring is therefore to compare cash transfers received with the income taxes *used to finance those cash transfers* (termed *adjusted* income tax, and amounting to 27.6 per cent of all income tax payments).

When cumulative cash transfers were compared with cumulative adjusted income tax paid, the following groups emerged as net winners, and were thus the beneficiaries of inter-personal redistribution from other taxpayers;

- males with the lowest lifetime standard of living (ie. in the bottom decile of males ranked by annualised lifetime equivalent income);
- all females on average;
- females with the lowest lifetime standard of living (ie. in the bottom decile of women ranked by annualised lifetime equivalent income);
- never married females who did and did not have children and ever married females who had children;

In other words, for all of the above groups, on average all adjusted income tax paid was received back in the form of cash transfers at some other point in the lifecycle.

The following groups were net losers, and thus paid more in adjusted income tax than they received in cash transfers during their lifecycle;

- all males on average;
- females with the highest lifetime standard of living (ie. in the top decile of women ranked by annualised lifetime equivalent income);
- ever married females without children;

Even for these groups the amount of intra-personal redistribution was substantial. For example, for males on average, about 45 per cent of all adjusted income tax paid was recouped at some point in their lifecycle. However, for those with the highest lifetime standards of living, very little of the adjusted income tax they paid contributed to the redistribution of income from one part of their own life to another. For males in the top decile of annualised lifetime equivalent income, around two per cent of their adjusted income tax payments were returned to them in the form of cash transfers, while for females in the top decile the figure was around 4 per cent.

Despite the scale of these transfers, living standards during the lifecycle for those with different characteristics remained highly unequal. Most groups faced precipitous falls in their standard of living upon retirement, perhaps indicating that the state could play a larger role in intra-personal income redistribution. In addition, although living standards for both men and women tended to become more equal after the age of 50 when most children had left home, those with children had very much lower living standards than those without children during the thirty years after age 20. While there is continuing debate about the extent to which the decision to have children is a private choice - and thus about the extent to which the state should intervene to support families with children - it is clear that the child transfers available in 1986 were not sufficient to prevent families with children experiencing much lower living standards than those without children for more than one-third of their lives.

CHAPTER 10: CONCLUSION

The original purpose of this study was to examine lifetime income distribution and redistribution in Australia. In the absence of any comprehensive Australian longitudinal data, it became clear that analysing such issues would require the simulation of lifetime profiles, and a number of methods of creating synthetic lifetime records were investigated. In the event, the techniques of dynamic microsimulation appeared to provide the best method of capturing the constant changes in the circumstances of individuals over time revealed by overseas panel data.

It should, however, be appreciated that the construction of dynamic microsimulation models is a relatively recent development in the social sciences, and that such models remain to be comprehensively tested and validated. Vast amounts of both cross-sectional and longitudinal data are required to build such models, and major problems are created by the difficulty of separating out the age, cohort and period effects embodied in the data used to set the various parameters in the models, and by the improvisation required when available data are inadequate.

Construction of a dynamic cohort model for Australia, where no longitudinal data are available, is an even more challenging task. While comparison of the results of the model with existing Australian cross-sectional data suggested that the model had achieved realistic profiles *at any given age*, there is simply no way of knowing whether the *dynamic* linkages in the model are accurate. For example, while the labour force participation rates by age, sex and education produced by the simulation closely match those found in the 1986 Australian Income Distribution Survey, this does not necessarily mean that the labour force participation patterns of individuals *over time* are correctly captured. As a result, all of the results of the model can only be regarded as indicative rather than definitive.

Apart from the very major problems created by data deficiencies, other restrictions should also be emphasised. First, most of the results only deal with the distribution of money income, and the income base does not include such items as fringe benefits, imputed rent or the imputed value of usage of goods and services provided by the government. Similarly, with the exception of education outlays, only the redistribution of *cash income* by government is assessed, and indirect taxes and most government services are currently excluded from the scope of the model.

Second, a number of important assumptions were made when imputing receipt of cash transfers and payment of income taxes, with such transfers or taxes assumed to be fully incident upon those receiving them or legally liable to pay them, and their burden or benefit assumed to be equivalent to their monetary value. No account has been taken of the underground economy or tax evasion, and the extent of tax avoidance was probably underestimated in the simulation.

Third, the redistributive effect of government was analysed while implicitly assuming that the distribution of pre-tax pre-transfer income would remain the same in the absence of government. This 'zero-government counterfactual' is clearly invalid, but exactly how the distribution of income would change if government disappeared is difficult to quantify.

Fourth, only Federal government income taxes and cash transfers were modelled, and incorporation of taxes levied or benefits paid by state and local governments could appreciably change the results.

Fifth, the results of the model are obviously dependent upon the various parameters built into it. For example, if different assumptions were made about differential mortality rates, dynamic labour force profiles, the degree of earnings mobility and so on, then different results would be produced. While it would be highly desirable to conduct sensitivity analysis in the future, to assess the extent to which the most important conclusions would be affected by changes in such parameters, it has not been possible to include such analysis in the present study.

In addition, equivalent income has been used extensively to rank members of the pseudo-cohort, and use of an equivalence scale which was markedly different to that implicit in the Australian social security system at January 1990 could appreciably change the results.

In conclusion, it must be recognised that a broader definition of income, the inclusion of other Federal services and taxes or other tiers of government, other assumptions about the incidence and valuation of taxes and transfers, a different counterfactual, changes in key parameters, or use of a different equivalence scale could markedly change the conclusions reached about the distribution or redistribution of lifetime income.

Lifetime vs Annual Income Distribution

With these caveats in mind, the simulation produced the following results. First, the distribution of lifetime income, after taking account of differential length of life, was much more equal than the distribution of annual income. Although the precise results depended upon the income measure used, the annualised lifetime disposable income of both men and women was about 40 per cent more equal than annual disposable income, when measured using Gini coefficients.

This indicates that a substantial proportion of the inequality apparent in cross-section analyses of income distribution is simply due to the sampled income units being at different stages of their lifecycles, rather than to inter-personal differences in lifetime income. This impression was also confirmed by an annual-to-lifetime equivalent income transition matrix; when all individuals were ranked by their annual equivalent income, about one-fifth of the individuals remained in the same decile of lifetime equivalent income, while around 45 per cent either remained in the same decile or moved up or down by only one decile. Those with lower annual incomes were more likely to be placed in higher lifetime deciles than those with higher annual incomes were to be placed in lower lifetime deciles, so that income at a single point in time was a more reliable indicator of relative lifetime position for those with high incomes than for those with low incomes. Overall, therefore, the relative positions occupied by individuals captured in surveys at a single point in time appear to provide a reasonable indicator of their relative lifetime position in about half of all cases.

Lifetime vs Annual Tax-Transfer Incidence

Analysis of the redistributive impact of income taxes and cash transfers over the lifetime, suggested that annual tax-transfer incidence studies do markedly overstate the redistributive impact of such programs, but that they are nonetheless still progressive on a lifetime basis in Australia. For example, income taxes amounted to zero per cent of the *annual* gross income of individuals in the bottom decile of annual equivalent income, but reached about 38 per cent of the gross income of those in the top decile of annual equivalent income. Such annual results are similar to those found in other studies of tax incidence at a single point in time, with the Australian Bureau of Statistics finding that in 1984 income taxes amounted to zero per cent of the gross income of households in the bottom decile and about 30 per cent of the gross income of households in the top decile (although these results were for households rather than individuals, and such households were ranked by gross income rather than equivalent income - 1987b:22). The *lifetime* incidence of income taxes found in the model is very different to the annual incidence, rising from 12 per cent of annualised lifetime gross income for individuals in the bottom decile of annualised lifetime equivalent income to 38 per cent of gross income for those in the top decile.

Similar differences in the lifetime and annual incidence of cash transfers were also apparent. While cash transfers amounted to almost 60 per cent of the gross income of individuals in the bottom quintile of *annual* equivalent income, they did not even reach one per cent of the gross income of those in the top decile of annual income. On a *lifetime* basis, cash transfers accounted for 20 per cent of the annualised lifetime gross income received by those in the bottom quintile of equivalent income, declining to under one per cent of the annualised gross income of those individuals in the top decile of annualised lifetime equivalent income.

The difference between the annual and lifetime incidence of taxes and transfers simply demonstrates that many of the high income taxpayers captured in cross-section income surveys must have experienced lower incomes in earlier years or later in life and, similarly, that many of the cash transfer recipients in annual surveys either go on to earn reasonable incomes later in life or enjoyed higher incomes earlier in their lives when they were in the workforce. This is confirmed by comparison of the annual and lifetime concentration coefficients for income taxes and cash transfers. The coefficient for the annualised lifetime distribution of income taxes was almost 30 per cent lower than that for annual income taxes, while the lifetime coefficient for cash transfers was just under 60 per cent of that for annual cash transfers. This indicates that, over the whole lifetime, the benefit of cash transfers and the burden of income taxes is much more equally distributed than annual incidence studies suggest.

Nonetheless, despite this more equal distribution, even when assessed against lifetime income, both income taxes and cash transfers were definitely progressive, and redistributed cash income from those with higher to those with lower lifetime incomes. This indicates that both programs achieve the promotion of vertical equity, which is one of their major goals.

Intra vs Inter-Personal Income Redistribution

Although some have suggested that government programs of income redistribution simply shift income from one part of an individual's lifecycle to another, funding the transfers received while studying or retired from the income taxes collected from the same individual during the prime working years, the above finding indicates that this is not the case. Income taxes finance the provision of so many other services, in addition to cash transfers, that simply comparing total income taxes paid with total cash transfers received masks the extent of intra-personal and inter-personal income redistribution which is being achieved. To circumvent this problem, cash transfers were also compared with only those income taxes which financed them. Some 28 per cent of all income taxes paid in the simulation would exactly finance all cash transfers received, so these *adjusted* income taxes were contrasted with the transfers received by different groups.

The results suggested that about 45 per cent of all the adjusted income taxes paid by males were returned to them in the form of cash transfers at some other point in their lifecycle, while the remaining 55 per cent were devoted to inter-personal redistribution. While this was the average picture for all males, males in the bottom four deciles of annualised lifetime equivalent income recouped all of the adjusted income taxes they paid through cash transfers. The picture was very different for women, for whom, on average, all adjusted income taxes paid were recouped via cash transfers. Once again, however, the average picture disguised major variation amongst women, with the top quintile of women, ranked by annualised lifetime equivalent income, incurring a net loss.

Relative Position of Men and Women

Government income tax and cash transfer programs thus resulted in substantial redistribution of income from men to women. This should not be overstated, as part of the losses made by many husbands were no doubt recouped by their wives through child transfers, and total family income might therefore not have been affected, despite the transfer of resources from husbands to wives. The lifetime redistribution of income from men to women also reflects the relatively disadvantaged position of women, who receive much lower earned incomes during their lifetimes, and thereby pay less income tax than men. In addition, women are more likely to experience sole parenthood than men and thus benefit from transfers to sole parents, and also live longer on average, thereby benefiting from more years of age pension.

Despite this redistribution of resources from men to women, women received much less income during their lifetimes than men, with the average annualised lifetime disposable income of $9050 received by women during each year of adult life amounting to only 68 per cent of the comparable disposable incomes of men. However, this only reflects income *personally received* by men and women. Any comparison of relative living standards requires that account be taken of presumed income sharing within the family unit as, for example, the low earned incomes of many women might not provide an accurate guide to their economic welfare if they were sharing in the income of an employed spouse.

To take account of family circumstances and needs, the *equivalent* disposable income recieved by the family unit was calculated and attributed to each partner within married couples (while, for single people, equivalent income was simply their disposable income divided by the relevant equivalent scale). Once income sharing within married couples and the needs of families were both considered, the annualised lifetime equivalent incomes of women averaged 90 per cent of those of men (with men still enjoying higher lifetime living standards because they received higher average incomes than women during the years they were single).

However, although economists typically assume equal sharing of resources within the family unit, recent empirical research has suggested that such equal sharing does not always occur. Consequently, when a 60:40 income split by married couples in favour of the husband was assumed, the equivalent incomes received by women during each year of adult life amounted to only 71 per cent of those achieved by men. This suggested that assessments of relative welfare might be more sensitive to the assumptions made about income sharing within the family than many economists have traditionally appreciated.

Lifetime Income By Education

Lifetime income varied greatly by education, family status, and unemployment status. Those with higher lifetime incomes tended to be the better educated, those who spent more years in the labour force and more hours employed once in the labour force, and those who married but did not have children.

Male graduates earned 1.7 times as much income on average during each year of adult life as males who only achieved secondary school qualifications; after also also including investment income and superannuation, their annualised lifetime *original* incomes were 1.8 times higher. However, these differences were ameliorated by income taxes and cash transfers, so that their annualised lifetime *disposable* incomes were only 1.5 times greater.

The discrepancies between the lifetime incomes of women by education status were even more marked. The annualised lifetime *earnings* of female graduates were on average 2.2 times greater than those of women who had no tertiary qualifications, while their *original* incomes in each year of adult life were 2.3 times greater. These inequalities were once again reduced by the tax-transfer system, so that the annualised lifetime *disposable* incomes of women with degrees were some 1.8 times higher than those of women with only secondary school qualifications.

These figures thus suggested that the income forgone during years of study was more than recouped by higher earnings later in life. However, particularly for women, higher earnings were the product of many more hours in the labour force, as well as an increased hourly wage rate. For example, women with degrees averaged an extra 605 40-hour weeks in the labour force during their lifetimes, compared to those with only secondary school qualifications.

Most studies of the private rate of return to education do not take such additional work effort into account, and simply examine the total annual earnings of those with and without degrees. However, while the extent to which shorter working hours reflect voluntary or involuntary choice is clearly debatable, standardising for differential patterns of labour force participation indicated that the relative income advantage derived from higher education was reduced once such factors were taken into account. Indeed, the decline in the relative advantage for female graduates was so great that it suggested that studies which did not take differential labour force participation patterns into account could be highly misleading.

Despite this, higher education definitely paid. This was emphasised by the lifetime incidence of education outlays, where outlays on both universities and tertiary cash transfers were proportional across most of the income distribution, rather than being progressive. This suggested that the recent introduction of the Higher Education Contribution Scheme in Australia would help to improve the lifetime progressivity of such outlays.

Lifetime Income By Family Status

While family status had relatively little impact upon the personal earned incomes of men, it had a major effect upon the personal incomes of women, with *women without children* having much higher labour force participation rates, and thus earnings, than those with children. The earned incomes of ever married women with three or more children were particularly low, amounting to only 65 per cent of the annualised lifetime earnings received by ever married women without children.

However, for both men and women, having children resulted in a significantly lower lifetime standard of living (measured in purely monetary terms) while, for women, remaining single also resulted in reduced lifetime welfare. Amongst women, female sole parents who never married experienced the lowest lifetime standard of living, with an annualised equivalent lifetime income which was one-fifth lower than that of ever married women without children. The equivalent incomes of never married women, and those of ever married women who had three or more children, were reasonably similar, amounting to about 87 per cent of the annualised equivalent income of ever married women without children. Those married women who had only one or two children fared much better, with an equivalent income only five per cent lower than their counterparts without children.

Similarly, ever married men who spent more than 20 years in a family with dependent children present had lower lifetime living standards than men in the other four family status groups considered, with an annualised equivalent lifetime income which amounted to only 85 per cent of that of ever married men without children. Those men who never married, or who married but spent between one and fourteen years in a family with dependent children, achieved equivalent incomes which were about 93 per cent of those won by ever married men without children. For both men and women therefore, lifetime income was maximised by marrying but not having children.

These findings were emphasised by examination of welfare during the lifecycle. Both men and women with children experienced lower average equivalent incomes than those without children for the thirty years following the age of 20. Living standards tended to become much more equal after the age of 50, once children had left home. However, the equivalent incomes of never married women were below those of married women after this age, as they did not share in the benefits of the higher incomes earned by husbands. Living standards in retirement were well below those achived during the prime working years, with post-retirement equivalent incomes being similar to those received in the early twenties.

In conclusion, the simulation suggested that the distribution of lifetime income was about 40 per cent more equal than that of annual income, even though the top decile of individuals ranked by annualised lifetime equivalent income still enjoyed disposable incomes which were 3.6 times greater than those of the bottom decile. Cash transfers and income taxes were both less progressive when measured against lifetime income than annual income, but nonetheless redistributed income from those with high to those with low lifetime incomes.

Further education resulted in significantly higher lifetime incomes, even after taking account of differential labour force participation patterns, while having children dramatically reduced lifetime equivalent income. While much of the income redistribution achieved by government cash transfers and income taxes was intra-personal, the pronounced slump in living standards during the years of retirement and family formation and growth suggested that perhaps even more could be done to equalise living standards across the lifecycle.

Future Uses of the Model

While this summarises the results of the first version of the HARDING model, much remains to be done in the future. It would be useful, given the concern with the potential costs of the ageing of the population, to extend the model to include the institutionalised aged, and to simulate aged parents returning to live in the households of their children. Incorporation of indirect taxes, and of other government services apart from education, is also a high priority, so that a more comprehensive picture of the impact of government upon income distribution and redistribution can be derived. In addition, changing key parameters within the model, and examining the effects upon the results, is an important task for the near future.

It would also be interesting to use the model to assess reforms made to the social security and income tax systems since 1986, and to examine the lifetime impact of possible future policy reforms. For example, the Australian government has introduced major changes to the system of child transfers since 1986, and the above analysis indicates that such reforms are likely to have further reduced remaining inequalities in lifetime income, and to have directed resources to those stages of the lifecycle where individuals typically experience lower standards of living.

There is also the possibility in the future of using the same dynamic microsimulation techniques to construct a sophisticated dynamic population model, which would involve projecting a cross-section sample, such as that in the 1986 Australian Income Distribution Survey, forward through time. Australian policy makers contemplating changes to government programs would then have access to static microsimulation models, which gave them detailed estimates of the immediate cost of such changes and of the characteristics of winners and losers; to dynamic cohort models, which provided estimates of the likely impact upon the lifetime income distribution and analysed whether such reforms were well-targeted towards those areas of the lifecycle where individuals experienced the lowest standards of living; and to dynamic population models, which would chart the cost and distributional implications of such changes over the next few decades.

APPENDIX 1: THE 1986 AUSTRALIAN INCOME DISTRIBUTION SURVEY

Many of the parameters in the model were estimated using the 1986 Australian Income Distribution Survey (IDS) micro data tape. In particular, the labour force participation, earnings and other income parameters were estimated from this data source.

The survey covered both rural and urban areas in all States and Territories, and covered both private and special dwellings. Private dwellings are houses, flats, home units, garages, tents and any other structures used as private places of residence at the time of the survey. Special dwellings are hotels, boarding houses, construction camps, caravan parks, etc.

The survey included all persons aged 15 or over except:

(a) certain diplomatic personnel of overseas governments, customarily excluded from census and estimated populations;

(b) overseas residents in Australia;

(c) members of non-Australian defence forces (and their dependants) stationed in Australia;

(d) persons who migrated to Australia after 30 June 1986; and

(e) students in boarding schools and residents of institutions such as hospitals and sanatoria, and inmates of gaols, reformatories, etc.

The survey was based on a multi-stage area sample of private dwellings and non-private dwellings, and covered about one-sixth of one per cent of the population of Australia. The survey was conducted throughout Australia in the period September to December 1986. The information was obtained by trained interviewers in a personal interview conducted with each resident aged 15 or over in the selected dwelling. Respondents were asked to refer to personal records such as taxation assessment or return forms, group certificates, pay slips, etc. to enhance the accuracy of the data. Persons with income from their own business who did not know their annual income were asked if the interviewers could call back when their records were available. Call-backs were made in February to March 1987.

The estimates provided in the IDS tape are subject to two types of error:

1. *Sampling error*

This is the difference which would be expected between the estimate and the corresponding figure that would have been obtained from a collection based on the whole population using the same questionnaires and procedures.

2. *Non-sampling error*

These errors can occur whether the estimates are derived from a sample or from a complete enumeration, and are usually referred to as non-sampling errors. Three major sources of non-sampling error are:

(a) inability to obtain comprehensive data from all persons included in the sample. These errors arise because of differences which exist between the characteristics of respondents and non-respondents.

(b) errors in reporting on the part of both respondents and interviewers. These reporting errors may arise through inappropriate wording of questions, misunderstanding of what data are required, inability or unwillingness to provide accurate information and mistakes in answers to questions; and

(c) errors arising during processing of the survey data. These processing errors may arise through mistakes and data recording.

Definitions of Variables

The following variable definitions were used in the 1986 IDS, and therefore also used in the model.

Dependent child. Person aged under 15 years, or aged 15 to 20 years and a full-time student, who has a parent/guardian in the income unit and is neither a spouse nor parent of anyone in the income unit.

Earned income. Gross income from wages or salary, and from own business, trade or profession.

Employed person. Person aged 15 years or more, who in his or her main job:

(a) Worked for one hour or more for pay, profit, commission or payment in kind in a job or business, or on a farm (including employees, employers and self-employed persons); or

(b) worked for fifteen hours or more in a family business or on a farm; or

(c) was an employee who had a job but was not at work and was on paid leave; on leave without pay for less than four weeks prior to the placement date; stood down without pay because of bad weather or plant breakdown at their place of employment for less than four weeks prior to the placement date; on strike or locked out; on workers' compensation and expected to be returning to their job; or receiving wages or salary while undertaking full-time study; or

(d) was an employer or self-employed person who had a job, business or farm, but was not at work.

Full-time workers. Persons were classified as full-time workers on the basis of the kind of work in which they were mostly engaged during 1985-86, full-time work being defined as work occupying 35 hours or more per week.

Full-year, full-time workers are those who had worked in Australia for at least 48 weeks during the year 1985-86 and had been engaged mostly in full-time work. A person who had worked for 25 weeks full-time and 23 weeks part-time would have been classified as a full-year full-time worker; however, it should be noted that most persons who work for a full year engage in either full-time or part-time work, but not in both.

Full-year, part-time workers are those who had worked in Australia for at least 48 weeks during the year 1985-86 and had been engaged mostly in part-time work.

Gross weekly income was defined as the sum of amounts usually received per week at the time of interview. It includes moneys received from wages or salary, government pensions and other regular payments such as superannuation, maintenance, etc. It also includes derived weekly equivalent amounts of income received usually from own business, partnerships, interest, rent, dividends, etc. during 1985-86.

Income Unit. A group of people who live together and form a single spending unit. In the IDS, income units comprise the following: (i) married couple income units; (ii) one-parent income units and (iii) one-person income units.

Interest, rent, dividends, etc. includes gross income from interest on savings, bonds, debentures, etc., dividends from stocks and shares, net income from rental of a house or other property and net royalties. Current income from these sources was estimated by deriving a weekly equivalent of amounts received from these sources in 1985-86.

Labour force. Persons were classified as being in the labour force if they were employed or unemployed.

Married couple income units consist of husband and wife and dependent children (if any) as defined. De facto relationships are included.

One-parent income units consist of a parent and at least one dependent child.

One-person income units consist of persons who are not included in married couple or one-parent income units. Non-dependent children living with their parents are classed as one-person income units.

Other private income comprises income from 'superannuation', 'interest, rent and dividends' and 'other sources'.

Other sources refers to gross income from other than wages or salary, own business, government pensions and benefits, superannuation or interest, rent or dividends. It comprises gross income from items such as private educational scholarships, maintenance or alimony, a trust or will, and an annuity. Income paid at regular intervals and received by a beneficiary under a will, settlement, deed, gift or instrument or trust was included. However, a lump sum payment from any of these sources was not regarded as income.

Own business, trade or profession (including income from a share in a partnership). In these cases, income was defined to be net of business expenses. If income had not been received in 1985-86 or a loss had been made, income from these sources was recorded as nil. Current income from these sources was estimated by deriving a weekly equivalent of amounts received from these sources in 1985-86.

Part-time workers. Persons classified as part-time workers on the basis of the kind of work in which they were mostly engaged during 1985-86, part-time work being defined as work occupying less than 35 hours a week.

Part-year, full-time workers are those who had worked in Australia for less than 48 weeks (during the year 1985-86 and had been engaged mostly in full-time work. A person who had worked for 24 weeks full-time and for 23 weeks part-time would have been classified as a part-year, full-time worker; however, it should be noted that most persons who work for less than a year engage in either full-time or part-time work but not in both.

Part-year, part-time workers are those who had worked in Australia for less than 48 weeks during the year 1985-86 and had been engaged mostly in part-time work.

Superannuation comprises gross income from regular payments made to a person or his survivors by a former employer, either directly or through a superannuation fund, insurance company, etc. Any lump sum payment received by a person on his retirement was excluded.

Unemployed persons are those aged fifteen years and over who were not employed during the survey week, and

(i) had actively looked for full-time or part-time work at any time in the four weeks up to the end of the survey week and;
   - were available for work in the survey week, or would have been available except for temporary illness (i.e. lasting for less than four weeks to the end of the survey week); or
   - were waiting to start a new job within four weeks from the end of the survey week and would have started in the survey week if the job had been available.

(ii) were waiting to be called back to a full-time or part-time job from which they had been stood down without pay for less than four weeks up to the end of the survey week (including the whole of that week) for reasons other than bad weather or plant breakdown.

Wages or Salary was defined as the gross income from all wage or salary jobs and limited liability companies before the deduction of tax. The value of items such as payments in kind, employer contributions to board or rent, gratuities and tips, etc. were not recorded as income.

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