1996

Pensions, savings and economic growth

Conrad David Nell
University of Wollongong

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PENSIONS,

SAVINGS

AND

ECONOMIC GROWTH
A thesis submitted in fulfilment of the requirements for the award of the degree

MASTER OF COMMERCE (HONOURS)

From

THE UNIVERSITY OF WOLLONGONG

By

Conrad David Nell

Bachelor of Economics (UNSW)

Master of Commerce (UW)

1996
"To-morrow, and to-morrow, and to-morrow,
Creeps in this petty pace from day to day
To the last syllable of recorded time,
And all our yesterdays have lighted fools
The way to dusty death."

William Shakespeare
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author's Certification</td>
<td>v</td>
</tr>
<tr>
<td>List of Tables</td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>vii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>viii</td>
</tr>
<tr>
<td>Abstract</td>
<td>ix</td>
</tr>
<tr>
<td>1. AN INTRODUCTION TO AGED PENSIONS</td>
<td>1</td>
</tr>
<tr>
<td>2. SAVINGS-CONSUMPTION THEORIES</td>
<td>17</td>
</tr>
<tr>
<td>3. A BROADER PERSPECTIVE</td>
<td>43</td>
</tr>
<tr>
<td>4. CONSTRUCTING A MODEL</td>
<td>56</td>
</tr>
<tr>
<td>5. ESTIMATION OF MODEL</td>
<td>67</td>
</tr>
<tr>
<td>6. CONCLUSION</td>
<td>88</td>
</tr>
<tr>
<td>Appendix</td>
<td>93</td>
</tr>
<tr>
<td>Bibliography</td>
<td>94</td>
</tr>
</tbody>
</table>
AUTHOR’S CERTIFICATION

I certify that the substance of this thesis has not already been submitted for any degree
and is not being submitted currently for any other degree.
I also certify that any help received in preparing this thesis and all sources used have
been acknowledged.

Conrad David Nell
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Augmented Dickey-Fuller Unit Root Tests</td>
<td>70</td>
</tr>
<tr>
<td>1.2</td>
<td>Unit Root Testing of Log-Values</td>
<td>72</td>
</tr>
<tr>
<td>2.1</td>
<td>Augmented Dickey-Fuller Tests for Pairwise Co-integration</td>
<td>74</td>
</tr>
<tr>
<td>2.2</td>
<td>Augmented Dickey-Fuller Tests for Pairwise Co-integration: Reverse Equations</td>
<td>75</td>
</tr>
<tr>
<td>3.1</td>
<td>Partial Correlation Coefficients of Proportionate Growth Regressors and Instruments</td>
<td>78</td>
</tr>
<tr>
<td>3.2</td>
<td>Regression of Savings in Proportionate Growth - Estimated Jointly</td>
<td>79</td>
</tr>
<tr>
<td>3.3</td>
<td>Regression of Savings in Proportionate Growth - Estimated Individually</td>
<td>80</td>
</tr>
<tr>
<td>3.4</td>
<td>Chow Tests for Structural Stability on the Proportionate Growth Savings Regression</td>
<td>83</td>
</tr>
<tr>
<td>4</td>
<td>Granger Causality Tests</td>
<td>85</td>
</tr>
</tbody>
</table>
### FIGURES

<table>
<thead>
<tr>
<th>Fig.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Household Savings and Pensions</td>
<td>15</td>
</tr>
<tr>
<td>1.2</td>
<td>Australian Savings and Investment</td>
<td>15</td>
</tr>
<tr>
<td>1.3</td>
<td>Pension Recipients and Over 65's as a Percentage of Total Population</td>
<td>16</td>
</tr>
<tr>
<td>1.4</td>
<td>Growth of Pensions Relative to Total Government Transfers</td>
<td>16</td>
</tr>
</tbody>
</table>
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ABSTRACT

This paper explores the relationship between the aged pension form of social transfer payments and savings in a growth context. This still predominant form of public provision for retirement has long been postulated to have a deleterious effect on savings growth. The initial thrust of the paper will be to effectively collate for the first time, the numerous diverse strands of literature which purport to investigate this subject. This broad survey encompasses both theoretical and empirical issues, and is not restricted to demand-side analysis alone.

A significant body of research contests Feldstein's claim that increases in government transfers act as a depressant of savings growth. Moreover, an evaluation is carried out on a variety of alternative theoretical solutions to the issue, including endogenous growth, income distribution and dynamic models.

After canvassing this vast array of relevant literature and issues, a version of the widely utilised life-cycle model is ultimately developed. It was through the estimation results of an extended version of this model that Feldstein originally advanced the highly influential proposition that aged pensions may impact adversely an economy's household savings via an asset-substitution effect.

An empirical outcome is provided here, which yields a compelling answer to an issue which has long remained theoretically indeterminate. When tested using Australian data and unit root testing and co-integration econometric procedures, a proportionate growth version of model is revealed to be the preferred specification for estimation purposes. The conclusion from this analysis is clear: aged pensions have a statistically insignificant influence upon savings growth. Moreover, this result appears robust under a variety of empirical tests.

Thus the principle policy conclusion to be drawn from the paper, is that the government should not concern itself with savings growth effects when assessing its provision of aged
pensions. In so far as this paper highlights both theoretical and empirical weaknesses of the original Feldstein conclusion that pensions reduce savings growth, there remains scope for further research, perhaps through examining other economies.
1. AN INTRODUCTION TO AGED PENSIONS

The recent shift towards non-government financed provision for old age, highlights one economic aspect of aged pensions - they are costly. Yet as the economy gears itself for this transition, important questions remain unanswered about the complete set of economic consequences of the existing pensions scheme. Moreover, because the transition to superannuation is likely to be both gradual and incomplete, any such knowledge would certainly be of value for many years to come. It is from this perspective that this paper will explore theoretical and empirical issues relevant to creating a better understanding of the relationship between aged pensions growth and savings growth.

Despite a growing body of literature on pension effects, there still remains widespread disagreement regarding both the magnitude and direction of the savings growth implications of pensions. Since the publication of Feldstein's landmark 1974 paper, the notion that aged pensions have a deleterious effect on savings growth, has been powerfully seeded into the economic psyche. Adopting a life-cycle model, Feldstein first advanced the proposition that aged pensions may adversely impact upon an economy's savings rate.

Of the range of transfer payments currently distributed by governments, there is reason to believe that the age-related transfer of pensions, have the greatest effect on the long term growth of the economy through the savings mechanism. This is largely because pensions are the only transfers that are likely to have life cycle impacts. Unemployment benefits are the predominant form of non age-related transfers. They serve a vital role as automatic stabilisers of the business cycle, but they are short term phenomena for a majority of recipients and hence their effect upon long run consumption-savings decisions is presumably minimal. There is a minimal likelihood of intertemporal reallocations of consumption resulting from these transfers, precluding them from altering national savings.

Fitzgerald's (1993) influential inquiry into national savings recommended that it be of urgent priority to raise the savings rate by several per cent of GDP. He argued that savings is of
critical economic import for two main reasons. Firstly, it provides a major source of funds required for investment, which in turn has output and job expanding potential. The second and related point, is that a failure to increase savings will exacerbate recourse to foreign savings, which will lead to a further build up of the foreign debt. This provides an additional channel through which the economy's rate of growth will ultimately be effected. Fitzgerald did not seek solace in the explanation that the historically low rate of national savings was primarily caused by the recent recession. He claimed that the origins of the problem were structural, rather than cyclical in nature.

However, it possible that the increasing prevalence of the long term unemployed across the globe may precipitate a re-examination of the present theory. The Post-Keynesian school for instance, has long maintained that further investigation into the income redistribution effects of all transfer payments, would provide the most valuable potential insights into our understanding of economic growth.

The private rate of saving is insufficient to provide adequate retirement incomes for many Australians under the current definitions of adequacy and for the average duration of retirement. Hence the justification for some degree of public transfer provision is apparent. However, it is misleading to suggest that the only alternative to pension payments is higher levels of private savings. In the past, pensions have substituted for increased labour force participation and for dependency on family transfers or voluntary charities. A more recent trend - and one that is strongly encouraged by the Australian government - is towards a greater degree of self-sufficiency in the financial provision for old age, via superannuation schemes.

It is the relationship between pensions and private savings which has traditionally formed the basis for much analysis of the economic effects of welfare policy. According to the highly popular life-cycle hypothesis (LCH), private savings are primarily driven by the need to provide for oneself during retirement. The central message of life-cycle theory is that the lifetime pattern of consumption is independent of the lifetime pattern of earnings. However,
Blinder (1976, p.87) cautions against taking this interpretation too literally in a world where the consumption-leisure choice is uncertain over time, and where the ability to borrow against future earnings is severely restricted.

Figure 1.1 provides visual evidence that such concerns may be founded. The household savings ratio - measured as a proportion of GDP - exhibits greater variability than the aged pension share of GDP. The late upward movement that is detectable within the latter actually occurs as the savings ratio is in decline. Whilst such short term trends may not be so important if social security is measured as a long term wealth variable, they are quite significant in another case. If the major impact of social security is perceived to be its immediate intertemporal effect on consumer behaviour, then this graphical analysis illustrates that this effect is likely to be small, if at all existent.

The theoretical ambiguity of pension effects is highlighted by the decades old debate regarding the appropriate specification of the aggregate consumption function. With the advent of life-cycle theory, the consumption function has become the preferred means of testing for the impact of social security on savings - since consumption is the reverse action of saving. In practice, aggregate consumption functions applied to time series modelling are outwardly quite similar, despite the often diverse range of theoretical arguments used to support them. Lagged and current values of disposable income and wealth, and even lagged consumption - which may be used to capture habit persistence effects - have become the standard variables implemented in regression analysis, with a variety of government outlays and demographic variables being added largely according to taste. Economists as diverse as Modigliani, Friedman, Feldstein and Barro have adopted this methodology in their efforts to quantify the impact of aged pension transfer payments on national savings and hence long term growth. But the typically ad hoc nature of many consumption function specifications has rendered definitive conclusions in the past, untenable. The simple reality is that major policy implications may be tailored according to the value judgements of the modeller.
This impasse highlights the fundamental difficulty which has plagued economists in this field for decades. On the one hand, the richness and diversity of the underlying theoretical structure here, provides the scope for much intensive analysis. However, in spite of the diverse range of arguments implemented to describe life-cycle savings behaviour, the derivation from first principles usually leads to highly similar mathematical versions of the consumption function. The existence of an unobserved variable - expected life-time income - on the other hand, has led to the creation of a variety of econometric specifications that differ according to the proxies used. Thus whilst the econometric aspects of consumption modelling may be tenuous, it is the breadth of information contained in the theoretical debate that has continued to attract the attention of economists.

It is perhaps pertinent to detail this introduction with some of the historical and statistical features that underlie the system of aged pensions in Australia today. The Australian Department of Social Security (1991, p.140) defines the primary objective of its aged pension program as being the assurance "that people who have reached retirement age have adequate levels of income for themselves and their dependants". For economists, this goal may be interpreted as minimising the poverty rate amongst the retired elderly in the community. The logistics of the present national system of old age pensions which have been designed to achieve this objective, are fairly simple. The pensions are flat amounts which differ only according to the marital status of the recipients. They are indexed each March and September to ensure that pensions maintain their value in relation to prices, as measured by the Consumer Price Index.

The payment of pensions may be reduced or withdrawn entirely, according to the outcome of an income or assets test. From their inception until the Whitlam era, aged pension applicants were subject to stringent means testing of their incomes, which severely curtailed the ability of the government to cater for many needy, potential, recipients. The means test was substantially liberalised in 1972, and the pension virtually became a universal benefit. In recent times however, the means (or income) test has been tightened once more, and it is now supplemented by an assets test as well. When a person's assets are below the allowable limit,
only the income test applies. However, where assets exceed this limit, both the income and assets tests are applied, and the pension rate is paid according to the test producing the lower rate. The regulations stipulating the conditions under which the Department of Social Security is to administer pension payments, state that "the income test operates by reducing the pension by one-half of the amount by which the pensioner's income exceeds a specified limit. Under the assets test .... the weekly pension rate is reduced by $2 for each $1000 that the value of the assets exceeds an allowable assets limit." However, it is important to note that pensioner's homes are excluded from the assets test.

Although social security transfers are justified on social grounds, they have endured probably the most intense political scrutiny of the whole range of government spending programs in Australia. When the aged pension was first introduced into Australia in 1908, it coincided with a change in world economic philosophy. Previously, economists had believed that by maximising the sole objective of economic growth, the existence of poverty in traditional categories of poor people such as retired workers would automatically be eliminated. The so-called "charity" model of social policy which governments adopted, emphasised intervention only when the support systems of the free market and the family had failed. Thus the role of the state was limited to those cases when the most basic human needs could not be met.

However, the Great Depression severely affected the living standards of not only the working class, but also the middle class. Doubts arose concerning the ability of pure capitalist growth policies to achieve equity objectives. Thus when the welfare state was introduced - a central feature of which comprised a payment scheme for retired workers - it was heralded as representing the maturation of a modern industrial society. The free market was no longer relied upon as the sole mechanism to allocate goods and services throughout the economy. Indeed, it was now recognised that economic growth in itself did not, and could not, eliminate poverty: it merely altered income distributions somewhat and left non-labour force participants dependent upon others.
Whilst the welfare state model was hailed at its inception as the solution to social inequalities, the passing of time has indicated that the welfare state has not caused the intended fundamental changes in the structure of our society. Some economists argue that the welfare state only serves to reinforce the imbalance of wealth, power and incomes in Australia, and that it institutionalises poverty by failing to address its true causes (eg. Graycar 1980). The more hardened of these observers have highlighted an inherent contradiction in welfare state policies: despite its seemingly progressive objectives, the true purpose of the welfare state is actually to shore up the corporate state, not to transform it.

There exists another school of thought which opposes the whole notion of welfare payments - but for a completely different set of reasons. This latter group desires a return to the days of minimal state intervention in the market. Prominent amongst these economists is Porter (Hendrie and Porter 1987, p.4), who claims that the high tax burden that must necessarily accompany social security payments, creates unfavourable incentives which reduce the size of the economic 'pie', thus leaving a smaller quantity of goods and services to be shared around between everyone. His solution is to drastically reduce social security transfers of all forms and to tighten eligibility criteria. James (cited in Jones 1983, p.232) has similar views. He questions the state's near monopoly on social welfare outlays and calls for a greater appreciation of both existing and potential new forms of non-state welfare provision. Critics of this view contend that this implied return to the charity model is a regressive rather than a progressive development.

Although there remains much dispute about the equity-efficiency tradeoff of financing aged pension programs, this only serves to mask the fact that the effects of these transfers - even after abstracting from financing considerations - vastly exceed that of their intended function. Besides redistributing income, it is generally believed that pensions influence capital accumulation through their effect on aggregate savings. Moreover, there is compelling evidence from America that aged pensions are a major determinant of the drastic decline in the labour force participation rate there. Hurd (1990, p.605) suggests the reason to believe that
social security has been the most important determinant of this decline is due in part, to the absence of adequate alternative explanations.

Of the Australian researchers, Manning (1986) has most strongly queried the policy relevance of analysing private savings. He suggests that in the 'real world' business retained surpluses are actually the major source of investment funds. Whilst private saving is the major source of housing finance and is important in the finance of small business, Manning argues that it is less significant to the large corporations which represent a large proportion of the demand for investment funds. He claims that because much private savings is channelled through financial intermediaries with conservative investment policies, they act more as a supplement, rather than the principle component of, business finance.

Whilst this opinion gained many adherents at the time, Manning clearly did not anticipate the carefree attitude of the banking sector in the mid 80's. 'Conservative' is hardly the appropriate word to describe the banking policy of that decade - although it has become an increasingly apt description in more recent times. Moreover, Manning neglects to consider the sizeable flow of private savings funds which are directly invested in large companies through the share market. Whilst shareholder's funds are not usually the largest source of funds of most large companies, they are a sizeable component nonetheless.

Whilst the theoretical implications of the pensions-savings growth link are complex and interesting, it is perhaps useful to review the operational characteristics of pension programs in Australia today. Firstly, the aged pension scheme is designed to aid a certain subset of the population. Specifically, it targets those people who have reached retirement age, which is 65 years of age for men and currently 60 to 65 years of age for women. (The retirement age for women is progressively being increased by 6 months annually from the previous limit of 60).

In general, it is legally required that pension recipients have continuously lived in Australia for at least ten years at any one time. Alternately, any individual who does not meet this requirement, may still receive a pension if they have resided in Australia in broken periods that total ten years, five years of which must be continuous. As of June 1992, the Department of
Social Security was responsible for the provision of financial security for 1,446,200 suitably qualified people, who constituted more than 8% of the total Australian population. A further 30,900 people received 'wife pensions', which are paid to the wives of aged pensioners. In addition, 'carer pensions' were allocated to 5,600 people to enable them to look after severely disabled aged pensioners on a full time basis. An examination of the separate economic consequences of these two minor categories of 'pension recipients', is far beyond the scope of the present analysis.

Because women live longer on average than men, it is not surprising to note that there are more than twice as many female pensioners as there are male pensioners. Together, these recipients were responsible for a $10 billion outlay by the federal government for the 1991-92 financial year.

Benefits for the aged have perhaps become the central issue of the modern welfare state. The increase in longevity of human life and the corresponding reduction in retirement age, together suggest that most of the aged can now expect to be supported by government pensions for an average of about twenty years. Reductions in the mortality rate are particularly significant. For example only 48.7 per cent of the male population reached the age of 65 in 1901-1910; by 1975/76 this figure had grown to 70.8 per cent. In Australia, these trends are exacerbated by the expectation that the proportion of retirees will increase sharply in the future, in line with the ageing of the post war 'baby boomers'. As a result, the number of eligible pension recipients is likely to increase substantially. Indeed, the implications revealed by this study will possess increasing importance as the ratio of those people of pensionable age to those of working age, increases over time. Of course, ageing populations are actually a world wide concern for practically all the governments of modern industrialised economies. With substantial existing commitments to the aged combined with exceptionally low birth rates, many of these countries face a far worse predicament in the future than does Australia.

Figures 1.3 and 1.4 illustrate two of the long term trends of the Australian pension scheme. In the former, the proportion of over 65's receiving aged pensions steadily rose with easier
eligibility criteria, but reverted as the government tightened its criteria in the mid 1980's and encouraged private provision for old age. Figure 1.4 demonstrates that pensions have gradually diminished as a proportion of total government transfer outlays over time. This result is most likely due to the sharp rise in the base level of unemployed, with each successive recession.

Whilst these seemingly inevitable demographic trends are sufficient to agitate the majority of economic observers, Jones (1983 p.108) has issued a steadying word of caution. He cited statistics which revealed that the aged in 1959 represented 8.5% of the total population. By 1979 this ratio had risen to only 9.5%. Consequently, Jones did not support the notion that the much heralded 'ageing crisis' had eventuated by 1980. Moreover, his projections predicted a population structure that will certainly age, but far more gradually than many people would expect. Whilst the aged ratio will eventually reach about 12.7% in 2020, this figure will still be substantially lower than most countries of a comparable level of economic development. Jones actually views the rapid increase in the cash value of pensions during the Whitlam years - from an admittedly low starting point - as constituting far greater explanatory power in the expansion of the welfare state to the present, than demographic changes.

Nevertheless, recent government policy has strongly encouraged a shift towards privately funded income security for the elderly. Through a continuing process of revised incentives and regulations, the government has increased the contributions employers and employees are legally obligated to pay for the retirement savings of the latter. The primary motive for these changes concerns a commonly held perception that the real cost of the pension program is expected to increase drastically in the near future, in line with the demographic changes in the Australian population outlined above.

However, a major problem with the encouragement of private superannuation is that it does not adequately cater for either the growing pool of long term unemployed in this country, nor for the equally rapidly expanding part time labour force. In the long term, people in these categories will remain reliant on government transfers for old age income security.
There remains little doubt that aged pensions are highly effective mechanisms in terms of their stated objective of redistributing incomes. Podder and Kakwani (cited in Jones 1983, p. 147) established that transfer payments had a far greater equalising impact on income distribution than did the income tax system from 1966-78. A more recent study by Collins and Drane (ibid., p. 184) reveals that the 21% of the population in the lowest income households receive between 57.5 and 60% of all Commonwealth social welfare benefits. Moreover, they discovered that old age pensions were more concentrated towards low income households than all other forms of social welfare payments. The saving growth consequence directly arising from this massive redistribution of incomes, is an aspect of the pensions debate which has been largely neglected of late. A comprehensive analysis of aged pension effects would require explicit consideration of the income redistribution implications - but this issue will have to be reserved for others, for the time being.

As mentioned earlier, the primary objective of all social security programs is to minimise the rate of poverty amongst the recipient categories. The setting of poverty lines above which people are presumed to live in tolerable comfort is a highly arbitrary and developing art which is often used to measure the success of social security programs. The Department of Social Security interprets its objective with regard to the financial well-being of the aged as being the attainment of a target rate of 25% of Average Weekly Earnings for the standard single pension. This rate has been consistently achieved since the June quarter of 1990. Whether or not this target rate represents a socially desirable level of assistance, is an argument which lies outside the domain of this paper.

The important point here is that if the standard pension amounts to only a minor fraction of the average wage, then each of the Feldstein (1974) wealth effects will be less than what they would be if there existed, say, a one-to-one correspondence between the two variables, ceteris paribus. That is, workers will be less likely to erode their personal savings in anticipation of government payments, the lower the pension rate. Hence the size of the average pension
payment will have implications for the strength of the social security variable in any regression analysis based upon Feldstein's extended life-cycle model.

Whilst the economic significance to the government of the aged pension program is indisputable, the importance of the program to its recipients is no less substantial. The 1988-89 Household Expenditure Survey reveals that for those households whose principal source of income was the aged pension, it represented an average 81.4% of their total income, the remainder being made up of various other government benefits and private income sources. Hence it is clear that any revision of government pension payments is likely to have far-reaching consequences for the consumption-savings decisions of both present and potential pension recipients.

The unique feature of social security transfers that separates its economic implications from those of other government programs, is that the government makes virtually no claim on resources from the private sector - it merely transfers purchasing power within that sector. Thus from an efficiency point of view, the physical disbursement of aged pensions is relatively insignificant. The taxes used to finance welfare schemes are immediately redistributed, with only a relatively minor transaction cost involved. In fact, the administrative costs of this massive transfer program - representing the government's claim on private resources - amounts to less than 4% of total social security outlays.

It is thus reasonable to assert that the government's transfer programs do not influence the overall autonomy with which the private sector makes its consumption and production choices. Rather, as Castle (1987) has pointed out, the government merely changes the composition of those individuals within the private sector who make those choices. Social security recipients gain greater participation in economic decision making, at the expense of taxpayers. Restated for our purposes, it is clear that the major economic implications of pensions are likely to be discovered by examining the manifold consequences of shifting financial resources from one sector of the population to another, rather than by pursuing the implications of minor administrative costs.
Recent trends in household savings statistics are also worthy of investigation. This figure - which measures the ratio of household savings to disposable income - moved along a consistent downward trend from 15.0% in 1975, to a low of 5.5% in 1988 (although it has since recovered by a few percentage points). On the basis of international evidence that household and business savings tend to offset each other, Edey and Britten-Jones (1990 p.3) contend that an inflation-adjusted measure of gross private sector savings is a less arbitrary measure of savings behaviour. An examination of this preferred time series reveals no trend deterioration in savings. In fact, it has fluctuated in a fairly narrow band around 15% for the past three decades.

The investigation to follow will focus on the overall consequence of aged pensions on savings within a life-cycle savings growth framework. The reasoning behind this decision is quite logical. The majority of research to date into the effects of pensions on savings, has been carried out by American economists using American data, within the LCH context. Although Australian studies on the subject do exist, they are too scarce for any definitive conclusions to be drawn as yet. Hence there is a definite need for an analysis using Australian data. The bulk of recent Australian research, such as that produced by Johnson (1983), McKibbin and Richards (1988) and MacDonald and Kearney (1990), has tended to focus on analysing the empirical validity of the fundamental assumptions underlying the major alternative to the LCH: the permanent income hypothesis.

However, the present study will directly apply the theoretical structure of the LCH to our stated objective - the nature of the relationship between aged pensions and aggregate savings. The basic asset-substitution effect underpinning the LCH will be examined, and so too will Feldstein's incorporation of the labour participation rate effect. Some further specific refinements to our approach will be forthcoming throughout the paper, depending on the results obtained in the extensive surveys of the literature.
In addition, subsequent observations will indicate that even within the well documented studies of pensions and savings growth with American data, the answer to the question of ‘do pensions influence savings growth?’ remains hotly disputed even today, on both theoretical and empirical grounds.

Yet this paper shall not restrict itself to the aggregate demand side of the picture alone. An investigation of the likely effects of pensions on the aggregate supply side of the picture, will also be undertaken in the light of recent developments within the endogenous growth literature. This field represents a potential new means by which the growth consequences of pensions may be investigated. Collectively, the components of government consumption have formed one of the most widely modelled variables in these models. However, until now, transfer payments - including pensions - have only been subjected to fleeting investigation.

More generally, whilst the study of life-cycle theory and economic growth models have traditionally been separated, it is hoped that progress towards a partial reconciliation of these two vital research fields in this study, will pave the way for future research. In addition, an evaluation shall be undertaken of the relative merits of partial equilibrium versus dynamic approaches to modelling. In particular, an LCH growth model shall be econometrically estimated and tested.

An important neoclassical postulate is that of the equivalence of aggregate savings and investment flows in the ex-post sense. In Figure 1.2, aggregate savings and investment are seen to differ markedly. The difference between the two is overseas borrowing, which in turn is a function of additional factors such as exchange rate movements.

In this paper we shall not attempt to model these open economy aspects. A partial equilibrium analysis shall be developed in later Chapters in order that the fundamental closed economy causalities may be assessed. To that end, this study shall consider the relationship connection between pensions and savings growth in Feldstein’s adaptation of the LCH paradigm. The scope of this paper is sufficiently broad to ensure a sufficiently substantial scope in focussing
upon the closed economy interactions between pensions and savings in the context of an economic growth framework. That is to say: emphasis shall be placed upon the examination of pensions and savings as measured in growth terms. Specifically, the subsequent empirical investigation shall be pursued in proportionate growth terms (of the type $X_t - (X_{t-1})/X_{t-1}$). The current econometric practice of unit root testing has demonstrated the common error of lending credence to empirical tests derived from variables expressed in levels.

In addition, it has been noted that the playing field in economics has been altered substantially since the advent of unit root and co-integration testing as near standard procedures since the publications by Dickey and Fuller (1979) and especially Engle and Granger (1987). Briefly, this is because these papers have demonstrated that regressions performed upon variables expressed in levels, are susceptible to violation of one or more of the classical assumptions of ordinary least squares regression. A survey of the pensions-growth literature reveals that these techniques have only been applied sparingly, and hence a key advancement of the present paper will be to assiduously incorporate such methods into the empirical analysis.

Thus the primary objective of this paper is to thoroughly canvass and then apply the most appropriate theoretical model to the question of ascertaining whether or not pensions influence savings growth in Australia. In Chapter 2, a broad review of the relevant theoretical literature on life-cycle theory shall be undertaken. Owing to the large and diverse quality of theories which have been promulgated, a special effort shall be made to evaluate all known approaches to the task at hand. In Chapter 3, some of the alternative models for assessing the potential linkages between pensions and savings shall be examined, including endogenous growth models and income distribution effects. In Chapter 4, the desired model shall be derived. This model will then be rigorously tested for a relationship between pensions and savings in Chapter 5. In the conclusion, the outcome will be assessed, and recommendations will be provided for further work in this field. This process will enable a response to the principle policy conclusion for the government to be made: how should economic growth considerations influence the formulation of aged pensions policy?
FIG. 1.1 HOUSEHOLD SAVINGS AND PENSIONS

Source: Constructed from Reserve Bank Occasional Paper No. 8 and Department of Social Security Annual Reports

FIG. 1.2 AUSTRALIAN SAVINGS AND INVESTMENT

Source: Constructed from Reserve Bank Occasional Paper No. 8. All figures in 1980-81 constant prices.
FIG. 1.3 PENSION RECIPIENTS AND OVER 65'S AS A PERCENTAGE OF TOTAL POPULATION

Source: Constructed from Reserve Bank Occasional Paper No. 8 and Department of Social Security Annual Reports

FIG. 1.4 GROWTH OF PENSIONS RELATIVE TO TOTAL GOVERNMENT TRANSFERS

Source: Constructed from Reserve Bank Occasional Paper No. 8 and Department of Social Security Annual Reports
Despite various modifications and challenges, it is within the general framework of the well-known life-cycle hypothesis that most analyses of aged pensions have taken place. This model incorporates several plausible determinants of long run savings behaviour, and thus provides the most suitable framework within which to discuss the economic effects of pensions. The major purpose of this Chapter will be to assess the traditional LCH in its various manifestations, and to canvass several of the surprisingly broad range of critiques which have been levelled at it over the years. An adaptation of an LCH model will ultimately be derived for estimation purposes in Chapter 4. Whilst it may not be possible to accommodate all of the critiques into the final model, they may nevertheless provide a useful framework within which to view the final empirical results. By examining the immense and diverse array of literature on the LCH, we shall be placed to broaden our investigation in the following Chapter, where endogenous growth models - amongst other ideas - shall be carefully evaluated.

Whilst the traditional life-cycle model predicts an unambiguous reduction in savings as a response to the introduction or increase in benefit levels of an aged pensions system via a asset substitution effect, more recent studies have stressed a variety of channels through which this effect may be offset. The literature features a vast array of work which disputes - either partially or completely - the notion that a pay-as-you-go pension system will depress household savings and hence national savings.

The LCH was originally developed by Harrod (1948), Modigliani and Brumberg (1954) and Ando and Modigliani (1963), and was designed to permit a broader understanding of aggregate savings behaviour than the simple Keynesian consumption function permitted. The LCH represented one of a number of attempts to reconcile the long run constancy of the savings ratio, with the observed increase in savings out of income in cross-sectional analysis.

However, the LCH was a substantial advance for other reasons too. Feldstein states that "the life-cycle model is the central idea in the modern theory of saving, because it provides the
crucial link between the microeconomics of rational household behaviour and the macroeconomics of the rate of saving" (Feldstein 1976, p.77). The derivation of the theory from individual utility maximisation behaviour was highly desirable, in that it gave savings theory an unprecedentedly explicit theoretical foundation.

The basic life-cycle model proposes that since social security pension programs operate on a pay-as-you-go basis, they effectively constitute a resource transfer from current workers to current retirees. Because the reduction in private savings will not be offset by an increase in public savings under this system, the impact of pensions on savings will be negative. Since pension transfers effectively entail the transfer of funds from the high saving young members of the community to the low saving elderly, the aggregate effect should be that of a diminution in size of the national savings pool.

Moreover, this result will be maintained if the analysis is expanded to include tax considerations - as long as 'preretired' workers estimate the present value of benefits to be larger than the present value of taxes required to finance them. Individuals will thus increase their consumption (and reduced their savings) accordingly (Danzinger et. al., 1981, p. 980).

In contrast, the Keynesian hypothesis was founded on the basis of fairly obscure reasoning and had minimal recourse to microeconomic theory. Specifically, it was premised upon the 'psychological observation' that the short run marginal propensity to consume (MPC) was greater than zero but less than the average propensity to consume (APC). In addition, Keynes proposed that the propensity to consume from long run increases in income, would diminish with increases in income. In other words, savings was postulated to take up an increasing proportion of any long run growth in incomes, at the expense of consumption. The original long run consumption function was thus defined to have a positive intercept and a positive but declining slope.

The main focus of the LCH is that individual's save during their working years in order to smooth out the fluctuations they expect during their life-time consumption, because they are
assumed to behave in a utility maximising fashion. In this way, they are able to maintain their living standards at a constant level - as measured by consumption expenditure - both before entering the workforce, and, in particular, after retirement from the workforce. A critical departure of the LCH from the absolute income hypothesis, was that the availability of credit in modern economies meant that consumption need no longer be restricted by current receipts (Johnson 1971, p. 38). Instead, individual consumption was now perceived to remain constant over time, irrespective of the time profile of income, since people could now borrow and lend at the same rate of interest.

Thus the new theory represented an important break with Keynesian tradition, in that it questioned the presumed relationship between short run consumption and same period income, now that consumption was perceived to be determined by longer run life-cycle considerations. Put simply, the LCH implied that rational people will base their consumption decisions on expected life-time income instead of current income. This theory is consistent with the empirical finding that temporary fluctuations in income have little impact on either expected life-time income or current consumption. Modigliani and Brumberg (1954) concluded that the marginal propensity to save was thus independent of current income and instead depended upon short run changes in income; savings was merely the adjustment factor required to maintain consumption at a constant level.

Significantly, the new determinants of savings under this framework cast considerable doubt upon the aggregate savings reduction effect of income redistribution measures. The LCH disputed the Keynesian belief that a larger wage share of output in the economy would lead to a desirable expansion in aggregate demand and hence to higher aggregate investment through the accelerator principle. This represented somewhat of a return to the classical notion that savings was the major determinant of investment. As such, an unequal distribution of income was once more regarded as a desirable precursor to economic growth.

Kuznet's data on overlapping decade averages of consumption, revealed that the long run APC is constant and equal to the long run MPC, (implying that the national savings ratio was
constant). Equivalently, it may be stated that the long run elasticity of consumption with respect to income in such a case, is unity. Accordingly, the long run consumption function was now hypothesised to pass through the origin of consumption-income space and maintained a constant and positive slope. This empirical discovery relieved fears that the original non-linear Keynesian consumption function which predicted declining consumption (and increasing savings) over time, necessarily implied chronic deficiencies in effective demand for growing economies (Johnson 1971, p. 27).

The experience of most Western economies in the early 1970's provided a substantial departure from the unit income elasticity theory. High inflation rates precipitated equally high savings rates, and the APC drastically declined in many countries. Whilst the empirical effect of inflation - the rate of change of prices - has been repeatedly confirmed, the theoretical debate remains far from settled. Deaton (1977 p.899) has argued that "consumers have no possible means of distinguishing relative price changes from absolute price changes", and hence consumption falls during inflationary periods because of a mass illusion that all goods are relatively more expensive at the same time. Moreover, the savings ratio will continue to rise whenever consumer expectations lag behind the reality of further price changes. On the other hand, there exists the more simple belief that higher savings represent a conscious desire to restore the real value of money-denominated wealth assets. Either way, the inflation rate variable has proven to be an empirically valuable addition to pure life-cycle explanations of savings behaviour. Furthermore, there is some evidence that the level of prices may have a negative impact on savings, due to the money illusion effect associated with higher nominal prices (Surrey 1989, p. 160).

In addition, Davis (1984) perceives the specification of mechanisms that permit prices to influence consumption, as comprising the most significant recent advance in the refinement of the consumption function. Whilst the LCH and Permanent Income Hypotheses (PIH) had traditionally focused upon variables such as current and lagged income and wealth, these relationships empirically broke down with the advent of inflation in the early 1970's. For example, Townend (1988) responded by including a net real liquid assets variable in his
consumption equation. The rationale here is that this type of asset constitutes a vital component of the resources available for an individual's consumption in the long run. Moreover, it is possible that consumers seek to maintain a constant proportion of their stock of liquid assets, relative to their incomes.

These price considerations raised doubts about the unit elasticity with respect to lifetime resources, which had become a feature of LCH models. Ironically, Keynes hypothesis of a long run income-elasticity of aggregate consumption being less than one, seemed increasingly relevant once more. The tendency for consumption to rise by less than in proportion to income appeared to have regained its former status as an important feature of long term economic behaviour. Furthermore, there is some empirical evidence that there is another short term determinant of aggregate savings: real interest rates are often hypothesised to encouraging savings at the expense of consumption. Most modern analyses of consumption-savings behaviour now make some reference to inflation and interest rates in addition to standard life-cycle permanent-income hypothesis (LC-PIH) theory.

It was later discovered that the APC was sensitive to business cycle fluctuations and hence oscillated around its long run equilibrium value in the short term. The LC-PIH model suggests that the slope of the short run consumption function will differ from its long run position. This is because, to the extent that changes in current income are transitory, they will induce a movement along the short run consumption function, whilst only permanent changes in expected future labour income - or wealth - will shift the position of the long run consumption function. Surrey (1989, p.150), however, has strongly argued that accumulated wealth represents an alternative to, rather than a determinant of, increased consumption. Consequently, he argues that it should be omitted from any consumption model.

The traditional LCH postulates that social security programs will substantially depress private savings, by substituting for them as sources of post-retirement consumption. Furthermore, since social security programs are typically unfunded - in the sense that funds are not accumulated to meet future benefit obligations (as is the case for private pensions) - the
hypothesised reduction in private savings will translate into a reduction in the national savings rate (Feldstein 1981, p 2).

Under the LCH, savings behaviour is an outcome of the intertemporal optimisation of households. The individual's utility function is maximised subject to the lifetime budget constraint equal to the present value of future income plus current income. Assuming that consumers have identical preferences, the dynamic consumption path may be derived from the first order conditions obtained from the maximisation of the following infinite horizon utility function:

$$ U_t = \int_t^\infty e^{-\rho(\tau-t)} \log C(\tau) \, d\tau, $$

where $\rho$ represents the subjective rate of discount, $C(\tau)$ is consumption at time $\tau$, and a logarithmic utility function is imposed for convenience, with the additional implication that the elasticity of consumption is unity (Grossman and Helpman 1992, p. 27).

There are a number of issues raised in the literature that question several of the founding premises of the LCH, however. Firstly, life-cycle interpretations rely on the assumption that a single representative agent is reasonably indicative of the behaviour of the broad spectrum of consumers. This simplification becomes questionable when it is considered that there are many individuals who earn income erratically during the course of their lives. Whilst some economists would have us believe that deviations from full employment are merely of a short run nature, recent experience does not bear this out. In other words, not everyone maintains a consistent labour income over their complete working lives. Moreover, the historical gulf between male and female rates of labour force participation, further restricts the generality of the theory. Even today there are far fewer full time female workers than there are full time male workers. Hence aggregation typically ignores the diversity of individuals in terms of their labour force status.
Secondly, despite the overwhelming acceptance of the LCH in preference to Keynesian views on consumption-savings decisions, empirical estimates of fiscal multipliers often reveal effects significantly larger impacts than the LCH would predict. Boskin (1988), for example claims that tax cut effects, though generally a third the size of Keynesian predictions, are still substantially larger than the neutrality predicted by Ricardian equivalence, or the minor effects predicted by the life-cycle and permanent income hypotheses. There exists considerable empirical evidence emphasising a significant role for current disposable income in explaining consumer behaviour. In attempting to reconcile the pioneering work of Sargent and Hall (1978), Flavin (1981) discovered an unexpectedly strong response of consumption to current income. She concludes that the evidence is sufficient to threaten the very credibility of the permanent income hypothesis adopted in her analysis. Hayashi (1985a) reports similar results. Hence, there remains considerable doubt as to whether individuals actually do base their savings-consumption decisions on life-cycle income, or whether they make choices contingent upon a shorter time horizon, as Keynes hypothesised.

A third school of thought believes that it is aggregate savings - not aggregate consumption - that remains stable over time. This argument is usually referred to as Denison's Law. According to this viewpoint, fiscal policy is unable to influence aggregate demand under the assumption of full employment. David and Scadding (1974) have argued for a re-examination of Denison's Law and its associated concept of the Gross Private Savings Rate (GPSR), which was defined to include consumer durable expenditures and imputed returns on durables. This law observed that "the year-to-year variability in the GPSR was very small and ... there was no trend in the rate" (p. 227).

The theoretical framework used to investigate this law incorporates a notion of 'ultra-rationality', whereby households subsume corporate and government, spending and savings decisions. The LCH postulate of rational people planning their incomes to spend over a lifetime, is taken one step further. The centrepiece of this proposal was that corporate and household savings should be regarded as near perfect substitutes, and should thus be entered together in the definition of GPSR. The stability of this combined figure was cited as evidence
that savings, and not consumption, was a constant function of GDP. That is, changes in the average tax rate are exactly offset by changes in the average propensity to consume in the opposite direction - leaving savings unchanged.

David and Scadding similarly cited their principle of ultrarationality to explain how government spending displaces private investment via *ex ante* crowding out, since households regard these two forms of expenditure as interchangeable. Unlike the LCH (and in even more striking contrast to the Evans (1983) critique described below), the implications of this theory were that fiscal policy would not influence aggregate expenditure or the investment-consumption ratio, assuming full employment. Furthermore, long run growth would remain the same: only the mix of activity between the private sector and the public sector would be altered. Hence they concluded that fiscal policy was just as neutral as monetary policy with respect to long run growth - providing further evidence that the supply constraint of the neoclassical growth model was binding.

Kormendi (1983) adopted a similar approach which he labelled 'consolidation' to combine the consumption and investment activities of the private and public sectors. He then found empirical support for a consumption function which featured a government spending variable instead of a tax variable, where consumption was defined to be the sum of private and public consumption. He claimed that the Ricardian Equivalence theorem does operate in reality - consumption is reduced by government spending, not by taxes, since consumers internalise the government budget constraint. However, Feldstein and Elmendorf (1990) powerfully refuted these claims: they highlighted the fact that the results were contingent upon the inclusion of data from the war years, and that the estimation technique of first differences was inappropriate. He thus rejected the consolidated approach in favour of the standard model, which states that government spending as captured by the debt variable, is a form of wealth which positively influences consumption (and reduces savings).

Jappelli and Pagano (1989) provide impressive evidence that liquidity constraints cause the LCH to fail in empirical tests. They observe that "low levels of consumer debt were observed
in countries where excess sensitivity of consumption is high". Hence, a key theoretical underpinning of the LC-PIH model is called into question: that of perfect credit markets. That is, if consumers cannot borrow and lend at the same interest rate in order to carry out an optimal consumption plan, then desired consumption has probably been constrained at some stage by current resources. The possibility that these findings only occur because of different desires to borrow by households across countries, is rejected. By examining cross-sectional data, Hayashi (1985b) reaches similar conclusions. He demonstrates that the gap between actual and desired consumption is greatest amongst young households - the group that would typically expect to face the most severe liquidity constraints. An important implication of this result is that the response of consumption to transitory changes in disposable income brought about by taxes or transfers, will be greater than that predicted by the LC-PIH.

Another critique of the LCH predates it - Marshall (cited in Kurihara, 1954 p. 168) postulated that the main reason governing savings behaviour was rather less introverted. He claimed that workers seldom spent "more than the income that comes in from their savings, preferring to leave their stored-up wealth intact for their families." Despite this argument, few utility functions today take account of the well-being of other people.

In 1957, Friedman formulated an alternative theory of savings in his permanent income hypothesis, which views consumption as a fixed proportion of so-called permanent income, rendering it insusceptible to transitory changes in income. Permanent income reflects income derived both from non-human and human wealth sources. Measured income equals permanent income plus a random income component. Like the LCH, the basic idea here is that consumers maximise utility by smoothing consumption over time and both models are frequently featured in the literature. The PIH retains many outward features of the LCH: each postulates consumption to be essentially stable, whilst the difference in planning horizons - life-time versus about three years - is not that significant in the final analysis. However, the explanatory income variable here is a flow rather than a stock term. Yet the theoretical foundations of both models are otherwise identical. The PIH predicts even smaller fiscal policy effects than the life-cycle model. Moreover, the applied empirical formulations of the models are quite distinct.
The LCH expresses consumption as a function of current labour income and net worth, whilst the PIH expresses consumption in terms of current income and lagged consumption, and is therefore more readily amenable to the data. This formulation is, nonetheless, empirically indistinguishable from the much vaguer hypothesis that consumption depends on current income and a measure of habit persistence.

Friedman was careful to clarify the difference between consumption and consumer expenditures. Consumption refers to the use of consumption goods - which is not necessarily the same as expenditure on consumer goods. Consumption and consumption expenditure are only equivalent in the case of consumer non-durables. When consumer durables are purchased, the flow of consumption benefits continues long after the initial consumption expenditure has been made. It is for this reason that many economists treat consumer durable purchases as part of the definition of savings, because they represent a future reduction in consumption expenditures. Friedman also postulated that the long run marginal propensity to consume would depend on such factors as the interest rate, wealth, personal preferences and age, but that it would be independent of the level of permanent income.

As the central concept of permanent income is unobservable, it is usually assumed that consumers estimate their permanent income through an adaptive expectations process. The conventional practice in the literature has been to proxy permanent income with a fixed distributed lag of current and past disposable income, in a manner reminiscent of the adaptive expectations assumption. However, Lucas (1976) has criticised the notion that intelligent economic agents form expectations about future variables based upon past data. He asserted that the causality between current income and consumption does not lend itself to the mechanical interpretation posited by the standard consumption function. This is because the consumption response of households to a change in current income will depend on the extent to which households perceive that change to be temporary or permanent.

Sargent (1979) was the first to implement forward-looking expectations into the permanent income hypothesis, in the form of rational expectations. However, the consumption function
associated with his definition of permanent income as the present discounted value of current and future disposable income, cannot be derived from the household's intertemporal optimisation problem. This is because future disposable income includes returns from savings, and these should not alter current consumption decisions.

Hall (1978) avoided an explicit definition of permanent income, but developed a version of the permanent income hypothesis with rational expectations, derived from the microeconomic foundations of consumption smoothing behaviour. It is interesting to note that Edey and Britten-Jones' (1990) simple graphical analysis reveals consumption smoothing behaviour to be quite significant over short periods of two to three years, but less so over periods such as decades or life-times. But until more concrete evidence is accumulated against the fundamental assertion of consumption smoothing, we shall have to accept it as it stands.

A testable implication of his intertemporal optimising model is that the timing of consumption expenditures is independent of the timing of income receipts, and hence Hall attempts to overcome the critique of Lucas (1976). His own empirical findings verify that disposable income is statistically insignificant in the regression of consumption on its own lagged value and lagged disposable income. As stated earlier, several studies have since found a significant, though less than one-for-one, effect of current income on current consumption.

A similar study by Johnson (1983) using Australian data, revealed that no lagged measures of current income could improve the explanation of current consumption by lagged consumption. However, the coefficient on the lagged change in unemployment was a significant determinant even at the 1% level of significance, thus contradicting the pure rational expectations LCH. In an even more powerful refutation of Hall's approach, several empirical tests of his model have failed to find a significant effect of the real interest rate on consumption.

Flavin (1981) continued in this vein and explicitly defined permanent income to be a proportion of the sum of nonhuman wealth and human wealth. The former is equivalent to physical asset holdings, whilst the latter represents the present discounted value of current and
future labour income. Flavin’s empirical findings suggested that consumption was more sensitive to disposable income than predicted by Hall’s ‘martingale’ equation which holds if the utility function is close to quadratic or if the change in marginal utility from one period to the next is small. Hayashi (1985a) also tests a version of the rational expectations permanent income hypothesis. Using the desirable definition of consumption which includes the flow of services from durable goods, his empirical results lend support to the notion that the majority of consumers abide by the PIH.

When permanent and measured income are equal, consumers will consume that portion of their incomes predicted by the marginal propensity to consume - which is the same as the average propensity to consume in the long run. But if consumers experience a transitory change in their income, they will modify their consumption by only a small proportion of the change in income. It is only when the change in income is perceived to be permanent that long run consumption is altered by the larger coefficient suggested by the marginal propensity to consume. Despite the problems inherent in distinguishing between measured, permanent and transitory income, economists have usually assumed that the average value of transitory income is zero, thus permitting measured income to proxy permanent income.

MacDonald and Kearney (1990) test the restrictions implied by the Rational Expectations Permanent Income (REPI) model by modelling consumption and income as a bivariate autoregressive process and imposing the cross-equation restrictions implied by the theory. Their application of the co-integration methodology ensured that the variables in their multivariate system were stationary. Although a co-integrating relationship between consumption and disposable income was unearthed, the restrictions implied by the REPI model were consistently rejected. This approach to testing the relevance of the permanent income hypothesis was originally attempted by Flavin (1981) with American data, but Mankiw and Shapiro (1985b) have argued that the t-statistics will be inappropriate if consumption and income follow random walks. Ermini (1993), using Australian data, confirmed that the best model for predicting both future consumption and incomes was the random walk specification.
Another serious problem with the LCH is that the central concept - that of life-cycle income - is unobservable. Modigliani and Brumberg's (1954) solution of using current labour income as an estimator of future labour income, is debatable because there is no proof that people actually do estimate their life-time income in such a manner. Despite these caveats however, the LCH remains the most widely adapted theory of aggregate savings behaviour. In an imperfect world of imperfect information, the economic profession has chosen to employ the LCH as the best available theory of reality. Consequently, a modification of the LCH shall be adopted in the analysis to follow.

The macroeconomic consequences of social security transfers received their most critical attention with the publication of Feldstein's (1974) landmark paper, which extended the basic life-cycle model to include labour market considerations. Because pension payments are age-related and hence more likely to influence the longer run determinants of savings behaviour than other government payments such as unemployment benefits, Feldstein focussed on pension programs alone, and set an important precedent for the work that was to follow. His major assumption was that the retirement decision was jointly made with the savings decision and hence any exogenous variable which altered the former, would also influence the latter.

Feldstein thus isolated a 'retirement effect' which operated in addition to the traditional 'asset effect' outlined previously. He suggested that social security could positively impact upon savings, by encouraging people to retire earlier and hence necessitate greater savings to match the longer retirement period. This labour supply effect has ramifications for the national savings rate, because workers who choose to leave the labour market in response to the expectation of social security provisions, will require higher accumulated savings to cover this extended retirement period. The Net Social Security Wealth variable Feldstein constructed to capture these two competing effects, was defined to be equal to the present value of anticipated retirement benefits, minus the present value of anticipated social security taxes.

The simultaneous equation model Feldstein applied to test his theory on an international cross-section of data, allowed for the choice of retirement period to be determined endogenously.
On balance, the econometric results revealed the greater strength of the asset-substitution effect over the retirement effect. Feldstein concluded that social security payments had reduced aggregate savings in the United States by 38% since World War Two, with a corresponding decrease in GDP estimated to be about 15%. Feldstein also noted that the overall regression results will underestimate the negative savings effect on those people whose retirement behaviour is fixed. Thus the major policy implication drawn from Feldstein's study was that higher social security spending would reduce long term economic growth - especially during periods of full employment.

Although both capital accumulation effects and labour supply effects each have implications for savings growth, the first of these - Feldstein's 'asset substitution' effect - is still believed to constitute the largest and most direct impact on aggregate savings. In contrast, the 'induced retirement' effect - which operates in the opposite direction - is perceived to be too small to offset the original depressing impact on savings. Of equal importance, the effect of pensions on savings may not be monotonic: it may vary with the age of the pension system. In Feldstein's (1981, p.6) own words, "the induced retirement effect might (initially) dominate but then, as the probability of retirement reaches a natural maximum, further increases in retirement benefits depress private saving."

Unfortunately it was not until eight years later that Leimer and Lesnoy (1982) discovered a crucial computer programming error in the calculation of Feldstein's social security wealth variable, which severely altered the nature of these results. The error was responsible for a cumulatively growing estimate of the value of the social security wealth variable for one category of pension recipients: surviving widows. After replicating Feldstein's experiment without the calculation error, Leimer and Lesnoy obtained mixed results with regard to the impact of social security on savings. For the total sample period from 1930-74, the net social security wealth variable coefficient plummeted from 0.037 to 0.009, and it became statistically insignificant. For the postwar period of 1947-1974, the coefficient remained significant, but changed sign. At first impression, this suggests that the retirement effect now exceeds the asset-substitution effect. However, the absolute values of the revised coefficients implied the
absurd notion that American personal savings would have been negative in the absence of social security. Leimer and Lesnoy concluded that it was unclear as to what individuals perceived their social security wealth to be. In other words, they lent support to the perception that the life-cycle model provides an inadequate explanation of individual saving behaviour. Nevertheless, Feldstein had succeeded in arousing interest in the field of social security consequences.

An early point of contention was caused by Barro and MacDonald's (1979) re-interpretation of the Ricardian Equivalence Theorem. This theorem was founded on the premise that public transfer payments were equally offset by the _private_ intergenerational transfers that would otherwise have occurred. As a result, public transfers actually had a zero impact upon the savings-consumption decisions of individuals and therefore were unable to influence either business cycles or long term growth. Although it was clear that this proposition relied upon highly debatable simplifying assumptions - including an implausible estimate of altruism and the existence of perfect capital markets - a 'bequest motive' nevertheless began to appear in modified versions of the LCH, and it was in this setting that much of the social welfare debate evolved over the ensuing years.

Kotlikoff and Summers (1981) proposed that since the present value of savings accounted for a small fraction of the capital stock held by households, the remaining majority must have been inherited. They thus fundamentally questioned the ability of the LCH to predict the total level of aggregate savings in an economy. They estimated the average excess of after-tax earnings plus government transfers over consumption, experienced by members of an age cohort during their adult years. The differences were then accumulated up to 1974 using historical nominal interest rates. The total over all age cohorts of these accumulated life-cycle assets was finally compared with the 1974 value of total private net worth. Examining the patterns of longitudinal earnings and consumption profiles, the authors were unable to detect the evidence sufficient to support the LCH. Whilst the earnings profiles exceeded the consumption profiles over most the life-cycle for males, this trend was essentially offset by the female excess of consumption over earnings.
Kotlikoff and Summers hypothesised that private intergenerational transfers - especially by the wealthy - must thus account for the bulk of aggregate savings and hence capital accumulation in the American economy. These transfers may take the form of direct monetary gifts, or may be more subtly expressed as cheap loans from parents to purchase a house, or the subsidisation of children's tertiary education. The subsequent estimations further reinforce that life-cycle savings cannot explain capital accumulation in an accounting sense: intergenerational transfers appeared to explain the major component of wealth accumulation. The conclusion reached was that savings models stressing the homogeneity of agents and the importance of the demographic structure should yield to models emphasising intergenerational transfers. However, Kotlikoff and Summers acknowledged that their analysis is only a partial equilibrium one: a general equilibrium analysis would require taking account of the responsiveness of the level and shapes of earnings, consumption and life-time transfer profiles, to changes in capital accumulation.

However, Hurd (1987) has elaborated several convincing objections against augmenting the LCH with a bequest motive. He argued that the existence of bequests does not necessarily imply the existence of a bequest motive, because nearly everyone leaves bequests due to their uncertainty of date of death. The possibility that the wealth of the elderly increases after retirement thus does not contradict the LCH, because the age by which an optimising consumer should hold zero wealth is not known. He argues that most intergenerational transfers occur earlier in life under the guise of human capital bequests, rather than as 'accidental' financial bequests later in life. In a subsequent paper Hurd (1990, p.608) demonstrated how the LCH instantaneous utility function could easily be modified to include a variable capturing this uncertainty of date of death - a preferable specification to a bequest motive variable.

Lord and Rangazas (1991) discovered that the human capital bequests distributed during the middle of the life cycle are more significant than any financial bequests distributed at the end of the life cycle. Moreover, they argued against augmenting the LCH with a bequest motive.
based upon their microdata simulations. In particular, they claim that indirect wealth effects will operate to offset any change in savings brought about by excluding either human capital or financial bequests from the theoretical LCH model.

Feldstein (1981, p.10) has highlighted another mechanism by which private behaviour may offset the depressing effect of social security on savings: publicly provided pensions may substitute to some extent for private pensions. However, he argues that the latter will not completely nullify the effect of the former on savings, because private pensions are fundamentally different to their publicly provided counterparts. Specifically - to the extent that private pensions are unfunded - the likely response from shareholders will be to reduce the equity of the companies involved. This in turn may induce an increase in savings by the companies, as they seek to restore their wealth. Consequently, Feldstein claims that the substitution of public for private pensions, in reality, is unlikely to prevent the expected reduction in national saving.

The unique attributes of expected social security 'wealth' may also inhibit the negative response of savings to social security. The illiquidity of this wealth, its contingency upon being provided for by future government legislation, and its actuarial inequity (it alters lifetime budget constraints), are several of the characteristics which may prevent social security benefits from causing an equivalent reduction in private wealth accumulation (Feldstein 1981, p. 11).

Indeed, thirty years ago there was actually some evidence of a positive effect of pensions on savings in America. Cagan (1965) and Katona (1965) separately obtained survey results indicating that people covered by private pensions saved more than those who were not covered. Cagan proposed that this was because of a 'recognition effect' which continually reminded the individual of the need to provide for old age, once they participated in a pension plan. That is, the individual's perception of their utility function changed ex ante, during their working years. Katona's 'goal gradient' hypothesis is an even more radical departure from conventional thinking. This theory states that the effort to save is intensified, the closer the
individual is to achieving their goal. More formally, this implies that individual preferences are a function of the opportunity set or of the original position (Feldstein 1981, p. 5).

The cross-sectional evidence in the literature that finds that the elderly save more with age, is also explicable within the LCH framework. Hurd (1987) suggests that this is merely because the wealthy live longer than the poor, and, ceteris paribus, the wealth holdings of the old will thus exceed the wealth holdings of the young. Furthermore, he also finds that the savings of the elderly with children, is no greater than that of the savings of the elderly without children. However, his survey of empirical findings yielded conflicting evidence on the economic behaviour of the elderly.

In the United States, the social security system functions autonomously from the rest of the government’s budgetary programs. Payments to the retired are funded by contributions made during the working lives of individuals, in the form of social security taxes levied for that express purpose. The independence with which the aged pension system operates, contrasts with the Australian experience, where pensions operate under the broad arm of budgetary policy. This facet makes it difficult to separate the impact of any net income effects which may accrue within the system. In the American case, these will occur if there is a disparity between the population growth rate and the real interest rate over time, such that social security benefits differ from social security taxes for recipients. Nevertheless, by concentrating on the intertemporal aspects of the outlays side of the program, the potentially most significant policy considerations may be derived - since in the aggregate, these net income effects will roughly cancel each other out.

It is the lack of a fully-funded pension system in practice, that has led many economists to believe that the intergenerational transfers required to finance the system are responsible for translating any reduction in household savings, into a reduction in national savings. By definition, under a self-financing, fully-funded system, aged pension schemes would not influence the national savings ratio. But an additional complicating factor applies to the Australian context. There are likely to be income effects as well, to the extent that the present
value of benefits received by pensioners differs from the present value of life-time taxes expended on pensions payments.

In both Australia and America, the aged pension system causes two main types of resource transfers to occur: intergenerational and intertemporal. With regard to the first of these, recipients of pensions are theoretically supposed to receive benefits which are an interest adjusted update of their prior tax contributions to the system. However, the fact that the link between taxes and benefits remains weak, suggests that the elderly have been receiving benefits substantially in excess of their contributions. These intergenerational transfers operate such that each individual receives more from the current working generation than they themselves contributed to the preceding generation. Within a single generation, dependent and surviving widow and widower benefits lead to resource transfers from single to married households, and from two-earner to single earner households.

Intertemporal transfers occur simply because financial resources are reduced when young people contribute to the social security system, and are followed by an increase in resources when they become recipients of pensions. Taken as a whole, transfer payments represent a redistribution of factor incomes from those making a contribution to the production process, to those who are unable to earn such a factor income for whatever reason - be it age, invalidity or unemployment. In the case of aged pensions, this process may be viewed as an intergenerational transfer from the working aged to the retired elderly.

Thus one possible avenue of investigation into the savings consequences of pensions is through quantifying the impact of redistributing income from high marginal savers to low marginal savers. However, the literature has tended to focus upon the intertemporal aspects of the pay-as-you-go pension system. That is, the focus has mainly centred on examining the consequences of the representative economic agent's efforts to maintain a constant level of consumption, via adjustment to his/her savings patterns.
There are two ways to fund a pension system. Thus far we have assumed an unfunded pay-as-you-go system, because this choice best accords with the Australian reality. The alternative choice is the fully-funded system.

Blanchard and Fischer (1989, p. 110) have summarised the likely impact of each approach in the context of a dynamic overlapping generations model. In a fully-funded system, the contributions of the young are invested and returned to them at the accumulated rate of interest when they are old. Here, the social security system provides a rate of return equal to that on private savings and the consumer simply offsets through private savings, whatever the social security system saves on their behalf. The net impact on total savings is thus zero. In an unfunded pay-as-you-go system with no bequests, transfers are directly made from the young to the old, so that the return on contributions is theoretically equal to the rate of population growth. Because this scheme does not involve an accumulation of savings, pensions will substitute for savings to some degree. Hence the partial equilibrium effect of pensions is postulated to reduce national savings and capital accumulation (the prerequisites for growth). Blanchard and Fischer demonstrate that the direction of this effect remains unchanged when general equilibrium considerations such as wages and interest rates are taken into account - although the magnitude may be altered.

Kotlikoff (1979) has used microeconomic data in an attempt to estimate the impact of each of these forms of transfers on the historic level of savings and hence - by neoclassical reasoning - the capital stock. Whilst a simple Keynesian consumption function with a constant and identical marginal propensity to save out of disposable income for all age groups predicts no change in aggregate savings arising from social security transfers, the life cycle theory implies different consequences. The positive life-time wealth effect will shift the consumption profile up for every age group. This reduction in savings at every age implies a greater than one-for-one substitution of private accumulation by social security transfers. Specifically, the predicted coefficient of the intertemporal effect in a savings regression should, ceteris paribus, equal minus one, if the implied rate of return on social security taxes is equal to the market rate of interest.
Evans (1983, p. 601) has disputed the fundamental appropriateness of using the life-cycle model to model personal savings behaviour, and advocates a return to the simple Keynesian focus on the relationship between social security and current income, instead of perceptions of future wealth effects. By redistributing consumption across age groups and amongst heterogeneous individuals within age groups, he argues that "significant effects on saving and consumption can result even in the absence of the complex calculations of social security wealth invoked by Friedman". Moreover, Evans found little evidence of a reduction in aggregate savings at the time of introduction of the American social security system - at precisely the time when the effect should have been the greatest.

Evans highlighted the difference between the propensity to consume from transfer payments (unity) and non-transfer disposable incomes (0.7) and concluded that the decline in the United States saving ratio is a consequence of the increasing share of transfer payments in disposable income. Even Altitg and Davis' (1992) generalisation of the Ricardian invariance theorem allows for "important short run effects of... social security interventions... on capital's marginal product and aggregate savings". Boskin (1988) surmises that perhaps 20% of the population consumes from current income, whilst the remainder follow the standard life-cycle consumption behaviour.

A recent study by Carmichael and Hawtrey (1981) using Australian data, adopts a neo-Ricardian framework to show that the level of aged pensions have no substantial real effects on aggregate saving behaviour. The authors claim that the essence of social security neutrality is budgetary substitutability: a change in social security payments generates an intertemporal reallocation of an individual's life-cycle income. As individuals restore optimality, they perceive social security and intergenerational transfers to be perfect substitutes, because each involves intertemporal reallocation at the rate of population growth.

The main threat to this perfect substitutability and corresponding neutrality of social security, is the unequal distribution of taxes. In other words, there are three categories of agents at the
greater than their intergenerational transfer rate, those who observe a rate that is lower, and those who observe the two rates to be equal. Only the last group will behave in a neutral manner, in response to an increase in social security. The remainder will respond by adjusting some combination of their private savings and intergenerational transfers. Using a social utility function that includes the private transfers, Carmichael and Hawtrey's empirical results demonstrate that these two groups of people offset each other in aggregate, and that an increase in taxes used to finance an increase in social security pensions has no significant impact on savings behaviour.

However, the aggregate consumption function approach suffers from several flaws as a vehicle with which to model the savings effects of pensions. Empirically, Hall's (1978) specification and it's variants have tended to perform poorly. The response by many economists has been to adjust their models, but this has all too often occurred as an ad hoc adjustment to the final specification, rather than as a modification to either the utility function or the budget constraints. Carroll and Summers (cited in Edey and Britten-Jones (1990) p. 39), argue that the representative consumer paradigm is itself questionable because there is too much diversity in household decision-making to justify representing them all by a single agent. They demonstrate that the bulk of saving and consumption is done by widely different groups of people.

Sheng Hu (1979) adopted a neoclassical growth model to demonstrate that age-related transfers can induce increases in public capital formation and hence create increased demand for labour and higher economic growth. He argues that such dynamic efficiencies of social security transfers outweigh any short run decrease in static efficiency brought about by the negative labour incentive response. In a model which incorporates both labour market effects and bequests, Hu proposes that the short run effects of social security primarily depend upon the demand and supply of labour, whilst the long run effects are additionally influenced by the elasticities of savings and bequests. The a priori theoretical effect of pensions on consumption is indeterminate - since the negative substitution effect is counteracted by a positive income effect, resulting from an excess of interest rates over population growth. The latter effect
effect, resulting from an excess of interest rates over population growth. The latter effect entails a change in the lifetime budget constraint of the 'representative individual' because the government may pay a rate of return on social security taxes that exceeds the market interest rate. In contrast to the seminal contribution of Feldstein (1974), Hu does not restrict himself to a partial equilibrium analysis, by including the general equilibrium consideration of the wage effects of pensions.

The neoclassical life-cycle growth models derived by Diamond (1965) and Samuelson (1975) allow the effects of social security to be examined in a dynamic overlapping generations framework. These models are simply general equilibrium versions of the original life cycle model developed by Modigliani. At any time, it is assumed that individuals of different generations are alive and trading with each other, although the preferences of unborn generations may not be registered in current market transactions (Blanchard and Fischer 1989, p. 91).

In contrast to the basic life-cycle model, this approach permits a theoretical examination of the conditions of a long run competitive equilibrium in a growth context. This is achieved by describing the evolution of the capital stock over time. A central feature of the analysis is the relationship between the steady state capital stock level and the 'Golden Rule' level. The economic side-effect of social security thus depends on whether it brings the economy closer to, or further away from, this golden rule level. In other words, social security consequences are interpreted in terms of their effect upon the dynamic efficiency of the economy. As per the comparative static approach to modelling aggregate consumption, the derivation involves choosing a consumption time path which maximises life-time utility subject to the constraint that the present discounted value of all consumption is equal to life-time disposable resources.

Whilst the microeconomic theoretical foundations of this approach are commendable, there remain problems with empirically validating it. Importantly, it represents a substantial break with the simple two-period models explicated thus far, in that there is little scope to estimate the key parameters. Instead the analysis generally proceeds as an elaborate algebraic
exposition, based upon highly debatable assumptions. The practical intent of the present paper, with its emphasis on econometric evaluation, will mean that these general equilibrium complications shall be set aside for another time.

A modern adaptation by Feldstein (1985) of Samuelson's (1975) overlapping generations life-cycle model goes beyond assessing the basic impact of social security on private savings and investment. He explicitly introduces an analysis of the tradeoff between protecting the welfare of those with a myopic attitude who do not save sufficiently for retirement, with the probable consequences of the negative savings distortion examined earlier. Feldstein's objective was to derive an optimal level of social security benefits, which took into account the extent of myopia-induced lack of provision for old age throughout the economy. He argues that "unless a substantial fraction of the population is completely myopic... the optimal level of benefits may be quite low" (Feldstein 1985, p. 318).

Throughout the investigation, Feldstein focuses on the savings distortion, choosing to bypass the seemingly less significant welfare losses associated with the distortion of retirement behaviour and the tax distortion of the labour supply. The necessary assumptions which permit him to do this are that the retirement date of the representative agent is exogenous, and that labour is supplied inelastically. One of the more interesting points he raises is that the implicit rate of return individuals receive from the unfunded social security system will partially offset the welfare loss caused by decreased saving - thereby raising the optimal value of aged pensions.

He also notes that a government which accumulated an adequately large social security trust fund, could thus be sufficient to bring the economy to Golden Rule efficiency. The present day realities force Feldstein to instead derive the optimal benefit levels for an unfunded pay-as-you-go program. Once again, the applicability to Australia is limited because of Feldstein's simplifying assumption that social security 'taxes' equal benefits. The absence of such taxes in Australia underscores a much less rigid relationship between the sources and uses of pension funds in this country. Feldstein concludes that in the reference case of some fraction of the
population being completely myopic - saving less for retirement than perfect foresight and utility maximisation imply - it is clearly sub-optimal to have no social security program. Nevertheless, in the case of a heterogenous population largely composed of individuals who are substantially, but not completely myopic, Feldstein shows that the optimal level of social security benefits to earnings may range from 0.20 to zero. But even if one individual is completely myopic, a positive social security system will still be optimal.

Feldstein's models reveal an optimal social security program which is related to the steady-state rates of growth of population, productivity and the marginal product of capital. In light of current concerns about the role of social security in an environment of productivity slowdowns and population growth, this model has practical policy implications. Not surprisingly, a fundamental assumption Feldstein makes is that social security has a negative impact upon savings and hence capital accumulation. It is thus unfortunate that this overlapping generations model does not lend itself to empirical verification.

At present, the only conclusive statement that can be made about the LCH and other savings-consumption model variants (as is the case for numerous branches of economic thought), is that fundamental disagreement on both theoretical and empirical grounds, tends to be correlated with differences in a priori beliefs. In summation, the enormously diverse range of models in the literature corresponds to an equally diverse array of applications.

In this Chapter, a detailed examination has been conducted into the theoretical premises of the standard LCH model and its variations. The basic postulate is that, under a pay-as-you-go system, the higher the growth of pensions, the greater will be the reduction in the growth of household savings. However, there is sufficient theoretical opinion to pose doubts about the final net effect. Barro's bequest motive, Hayashi's emphasis of liquidity constraints, and Cagan and Katona's separate formulations of irrational behaviour, are several of the more prominent contradictions to the unadulterated life-cycle approach which may lead to contrary empirical results. A brief examination of the PIH theory has also been undertaken to broaden the scope of the Chapter.
However, research in the LCH field has been most greatly influenced by Feldstein’s (1974) inclusion of an offsetting induced retirement effect - despite the later discovery of a calculating error in the original analysis. More recently, Evans has boldly suggested that the intergenerational effects of pensions systems may be more significant than the traditional intertemporal effects. Finally, a study of the relative merits of comparative static versus general equilibrium modelling frameworks has been undertaken, in which we have found favour with the former, for present purposes.

Since we are attempting to ascertain the link between pensions and savings in the economic growth context, our next intention is to apply an appropriate version of the LCH model in an attempt to resolve a theoretically intractable issue. To reiterate, this will be achieved by using Australian data and applying unit root, co-integration and other relevant testing procedures. The implications our modelling and estimating exercise will have for LCH theory more generally, will also be considered.
It is remarkably difficult to find a direct analysis of the savings growth consequences of aged pensions in the literature, since the 1982 publication by Leimer and Lesnoy. The major purpose of this Chapter will be to outline some of these developments in economic growth theory, and to assess their likely implications for the long neglected subject of aged pensions. The sheer size of government outlays on aged pensions in this country, renders it far too significant a variable to be omitted a priori, from any analysis of economic growth. However, there is one other potentially useful approach to modelling the growth consequences of aged pensions: income redistribution analysis. This much neglected alternative will also be briefly examined in this Chapter, although we are primarily interested in intertemporal growth patterns rather than intergenerational effects.

A key assumption of the LCH is that the economy is fully employed. If an economy is less fortunate in reality, savings may actually increase if the expansion of aggregate demand - induced by pension transfers - is sufficiently large. The literature has tended to avoid questioning the full employment assumption, yet the present experience of world unemployment suggests that this is an attitude which requires urgent re-evaluation. This requirement is especially important given the possibility that the aggregate demand effect may partially or completely negate any reduction in savings due to asset-substitution.

Hence another potential method of analysing the impact of social security on growth would be through quantifying the effect of levels - or changes in levels - of pensions upon aggregate demand. In the absence of countervailing demand management policies or exogenous shocks, one might expect increasing social security payments to raise aggregate demand because the recipients on average, will have a higher marginal propensity to consume than taxpayers, given that their current income is generally low.

This problem may be approached by modelling an aggregate consumption function comprising two distinct categories - recipients and taxpayers. Kaldor (1960) has pioneered much work in
the field of growth consequences of income distribution. His theory models consumption as a function of the distribution of income. The Kaldor Hypothesis divides society into wage earning workers and profit earning capitalists. Workers are assumed to have a higher average propensity to consume out of their incomes than capitalists. The testable version of the Kaldor Hypothesis portrays the APC as being dependant on the functional distribution of income: the division of income between wages and profits. Specifically, the APC varies inversely with the ratio of profit income to wage income, because of the differences in the APC's of workers and capitalists. This approach constitutes a radical deviation from the more popular LC-PIH approach outlined in the previous Chapter. A key reason for this is the empirical difficulty in delineating workers from capitalists. In reality, many people earn both labour and non-labour incomes simultaneously. Perhaps even more significantly, the policy implications of the model render it politically unpalatable at the present time.

However, Kaldor's two categories of 'workers' and 'capitalists' are not appropriate for an examination of social security - however, Blinder (1975) has more specifically addressed this issue. Blinder investigated and dismissed the impact of income redistribution on economic growth. In fact, he discovered that an equalisation of the distribution of income would either leave aggregate consumption unchanged or actually diminish it slightly. Whilst the established theory suggests that increases in progressive transfers will increase consumption, Blinder notes that the theory is ambiguous with respect to the effect on consumer expenditures, which are the figures commonly listed in national income data. As stated previously, these figures will differ from actual consumption by the amount of purchases on durables, less durable good depreciation. Fortunately, Blinder was able to access specially constructed consumption estimates for his empirical work.

Blinder has suggested that perhaps the only rigorous means of testing for the existence of distributional effects on the aggregate consumption function, is to directly estimate separate marginal propensities for each income class. Since data limitations restrict this approach, Blinder has employed several second best techniques. The various MPC's were firstly constrained to be equal to each other, then an Almon lag procedure was used to constrain the
fluctuations in MPC's. The final method involved inserting an income inequality variable into the consumption function. In the final analysis, the results suggested that income distribution improvements have either a neutral or slightly negative impact on aggregate consumption.

Blinder proposes two explanations for the unusual results obtained. If Duesenberry's (cited in Blinder, 1975, p.451) relative income hypothesis holds true, then unequal changes in the transfer system may lead to higher consumption via 'demonstration' effects. Here, utility is derived not from consumption, but from the ratio of own consumption to a weighted average of the consumption of others, where the weightings represent the frequency of contact with others. It is possible that an equalising change in social security transfers could reduce the number of contacts people have with those better off than themselves, thus leading to a decline in aggregate consumption.

A more plausible argument concerns the vastly increased participation of women in the workforce over the sample period. Had they been included as 'zeroes' in the early data records instead of being omitted, then Blinder hypothesises that the observed increase in post-war American aggregate consumption would have been associated with a fall, rather than a rise in income inequality. If this is the case, then Blinder's empirical work must be interpreted with caution and a final judgement must be reserved until the appropriate data is made available.

We have already examined in the previous Chapter, how the behaviour of short term aggregate demand - which may be influenced by the government's macroeconomic policies - will critically influence the evolution of the economy's dynamic growth path to the extent that it induces a large component of aggregate investment. It is via this mechanism that economists have traditionally envisaged another avenue through which aged pensions may alter an economy's rate of growth, in addition to life-cycle considerations. Whilst they do not typically constitute part of the government's armoury of discretionary fiscal strategies, the sheer size of the aged pension program ensures that they will nevertheless play a significant role in the determination of aggregate demand and in turn, national investment. We will now turn to an investigation of possible supply side effects of aged pensions. This will necessitate a focus
upon the interaction of pensions with the traditionally accepted sources of growth - capital, labour and technology.

It must be emphasised that here we shall merely highlight some of the more theoretically appealing ways in which the literature has discovered potential new linkages between pensions and savings in the growth context. The rigorous empirical procedures that further investigation along this course would entail, will not be directly pursued here. The reason for this, in part, is that the modern supply side theories of the relationship between pensions and economic growth are still in the early developmental stage, and are thus too tenuous to readily lend themselves to rigorous empirical testing for policy purposes.

Economic growth is a long run phenomenon insofar as the factors which are theoretically assumed to be held constant in the short run - such as capital, technology, natural resources and human capital - will eventually vary. If these fluctuations are largely positive, they will lead to economic growth, as represented by an outward shift of the economy's production possibilities frontier (P.P.F.). The prevalence of unemployed and underemployed resources throughout the world economy prevents most countries from attaining the boundary of their hypothetical P.P.F. It is the existence of unemployed labour resources in particular, that maintains a sizeable distance between potential and actual output levels.

One of the most familiar neoclassical beliefs is that deferred consumption today will yield increased investment and an expanded P.P.F. tomorrow, by directly increasing the size of the savings pool available to investors. Whilst this aggregate demand approach is concerned with the short term problem of locating the economy as close as possible to the P.P.F., the methodology adopted in this paper will focus on the longer term objective of optimising the shifts of the P.P.F. Naturally however, it is accepted that the position of the economy within today's P.P.F. will constrain the potential locations of future P.P.F.'s. Capital goods not produced today cannot be used to produce capital or consumption goods in the future.
The resurgence of interest in economic growth provoked by the recent development of endogenous growth models represents an interesting new alternative through which the connection between social security transfers and GDP may be analysed. Thus far, there has been little in the way of theoretical development to allow for the direct inclusion of social security directly in a production function. Aged pensions are intertemporal resource transfers: because they do not share the characteristics of the factor inputs - land, labour and capital - they do not directly affect the location of the economy's P.P.F. Instead, the growth consequences of pensions must operate through their impact on one or more of these factor inputs. It has been traditionally unthinkable to enter transfer payments into a production function relating outputs to inputs. Yet however unusual this idea may seem, there exist prominent studies in the recent literature which represent a substantial step in this direction. Ram (1986) and Barro (1989) have explicitly added government consumption to their variations of the standard Cobb-Douglas production function - even though government consumption more accurately constitutes a use, rather than a source, of resources. The reasons provided for this unconventional approach are founded on the concept that much government expenditure - especially that which develops infrastructure - indirectly enhances the productivity of an economy's labour and capital resources, and will thus assist in the overall determination of national income.

The discovery of particular relevance for present purposes, was that estimates of the impact of social security on growth - which are usually included as an ad hoc aside - have consistently been found to exceed the significance of the total government consumption variables themselves, which formed the basis of the studies in the first place. Naturally one must be suspicious of lending credence to empirical results that are lacking in a priori theoretical justification, but continued evidence here must surely lead to a re-examination of growth theory at some date.

The new endogenous growth theories differ from the traditional Solow-Swan neoclassical growth models in that they allow for the possibility of positive long run growth to occur via internal mechanisms, rather than merely through exogenous shocks. The dubious 'residual' of
the growth accounting equation and its nebulous qualifications are no longer required to justify the existence of sustained economic growth throughout the developed world.

The common feature of these endogenous growth models is that they are capable of predicting long-run growth in per capita consumption on the basis of accumulation of stocks of capital. In the majority of such models, this has been achieved by replacing the traditional assumption of constant returns to scale with that of increasing returns to scale of production. Although this procedure raises the objection of violating the equality between the marginal and average products, hence threatening the assumption of price-taking competitive behaviour and causing unbounded solutions to the optimisation of household choices between current and future consumption, these problems have been demonstrated to be crucial and surmountable.

The early Harrod-Domar and neoclassical growth theory formulations shared the belief that exogenously determined, fortuitous and costless technical progress, was the third vital ingredient in growth, alongside labour and capital resources. Where they differed however, was in the role each assigned to government policy. The former theory emphasised the ability of budget surpluses to substitute for domestic savings and thus aid growth. Neoclassicals countered that the exogenously determined rate of population growth was the ultimate determinant of the growth rate. Fiscal policy was assigned the rather limited role of aiding the return of the economy to the steady state path of growth, in the event of temporary disturbances from that path.

The essence of modern endogenous growth theory is that the technical progress residual is accounted for by endogenous human capital formation. Romer's (1986) variant of Arrow's learning by doing model centred on the increasing marginal productivity he assigned to capital. This feature opposed the 'convergence' theory of economic growth between countries of different levels of development, by allowing the opportunity for per capita incomes to grow without limit. This premise was based on a rate of return to capital which may remain constant or even increase, as investment expands. Under this scenario, for as long as the return to capital exceeds the real interest rate, investment and growth will increase indefinitely.
In Romer’s model the ultimate determinant of growth became the amount of funds invested in research and development to create new knowledge. It is here that Romer places a global restriction on growth possibilities by assuming that this investment in research technology exhibits diminishing returns to scale. Crucially however, the production of goods resulting from this new knowledge still demonstrates increasing returns, owing mainly to the inadequacies of patent protection. The three key elements of the Romer model - externalities, increasing returns in the production of output and decreasing returns in the production of new knowledge - have been proven to be mutually consistent with a competitive equilibrium. However, Romer admits that it is difficult to empirically validate his theory because measuring long run growth requires the elimination of business cycle effects.

However, as Jones and Manuelli (1990) have noted, it is not the prevalence of increasing returns to capital in themselves which are necessary or sufficient for endogenous growth, but rather the floor limit they place on the marginal product of capital. Hence long run growth is still recognised as depending on the relationship between the marginal product of capital and the rate at which households discount future consumption - only now, the former term is assumed not to decline to zero in the long term.

Other models of endogenous growth which have been developed since Romer’s path-breaking paper include those which emphasise increasing returns from accumulation of human capital (eg. Lucas 1988), physical investment (eg. Scott 1992), or those which focus on the returns to the stock of knowledge generated by research and development.

Although this represents an overdue replacement of the prior economic management focus of adapting policy to correct static inefficiencies in resource allocation, there is clearly no direct recognition of the implications for social security spending in this basic setting. In fact, the very use of a ‘representative-agent’ framework may be cited as the critical factor which limits the analysis of any economic implications arising from income inequality issues.
Kaldor's (1960) starting point is that the community's savings propensities (which determine the rate of capital accumulation), the flow of innovation (which determines the growth rate of productivity) and population growth, are the critical factors responsible for the trend rate of economic growth. However, he departed from his peers - and most contemporary economists - by claiming that these variables are not exogenous to the determination of the rate of increase in production. Rather, he views the progress of capitalist economies as being the outcome of a mutual interaction of forces which can be only be described by functional relationships (like supply or demand curves), instead of by constants which government policies manipulate. To that end, he purported to demonstrate how observed constancies in the capital-output ratio, the share of profit and the rate of profit, can be described as the consequence of endogenous forces operating within the economy, rather than being mere coincidences. Crucially, his analysis is based upon alternative specifications for the determination of savings and investment, in contrast to the contemporary assumption that these two variables are synonymous (in the ex post sense).

Barro (1989) conducted one of the earliest attempts to introduce a measure of government expenditure in a neoclassical production function, in his cross-national survey of growth and savings. The function has a Cobb-Douglas form:

\[ y = A k^{1-\alpha} g^\alpha \]

where \( y \) is output per person, \( k \) is capital per person, \( g \) corresponds to real government purchases per person and \( 0 < \alpha < 1 \). However, the definition of the government variable is restricted to infrastructure spending, because these outlays act as an input to private production and also raise the marginal product of capital. Social security spending is notably absent from the theoretical derivation, since it is notoriously difficult to model in a representative-agent framework. This is largely because social security entails financial transfers between agents.
Barro thus finds an optimum condition for maximising growth, where a unit increase in $g$ generates just enough output to balance the resources used up by the government. Beyond this point, the growth rate diminishes. Thus a major advancement of this paper is the portrayal of a non-monotonic growth path for the economy, based upon government outlays (narrowly defined).

Using cross-country data on 68 countries, Barro regressed a 15 year averaged variable of social security as a ratio of income, against the log of initial real per capita GDP. His results reveal an increase of 10% in the log of initial real per capita GDP, for each 0.5% increase in social security spending. Barro downplays this surprisingly strong result by attributing it to 'Wagner's Law' induced reverse causation. That is, if we treat social security transfers (including pensions) as a luxury good, there is a likely to be a positive effect of economic growth upon it, in addition to the causation that operates in the opposite direction. This suspicion was partially confirmed when Barro discovered the social security ratio to have a negative coefficient in an investment regression.

Ram (1986) has also produced an updated growth accounting framework within which the impact of government size on economic performance can be examined. In contrast to the optimising models base upon individual maximisation preferred by Barro, this approach is markedly more simple. The major limitation here is the inability to disentangle the causation from government growth to GDP growth, from the reverse causation from GDP growth to government growth - which accords with Wagner's Law. Ram's endogeneity problem has been documented by both Rao (1989b) and Dowrick (1993). Once again, there is no possibility of inferring the independent impact of pensions on economic growth in the model, because all estimates of the government size variable refer to the aggregation of the broad spectrum of government outlays: investment, consumption, interest repayments as well as transfer payments, such as pensions.

The most significant feature of his model is the adoption of separate functions for the government and nongovernment sectors. Private labour inputs, private capital inputs and the
externality effect of the government sector enter into the specification of the nongovernment production function. The government production function, in turn, consists of government labour and government capital resources. The determination of national income can thus be viewed as a simple summation of each of these sectors. Various substitutions yield a testable aggregate growth equation - the rate of change of national income - which depends on the investment-output ratio, the rate of growth of the labour force and the rate of growth of the government sector. For comparability purposes, Ram also tests a more traditional growth specification which incorporates the static variable of government size divided by output.

The cross-sectional estimation of the growth equations required the substitution of population growth for labour force growth, due to data constraints in several of the 70 countries surveyed. The major finding was an overall positive impact of government size on growth in almost all cases. Moreover, this effect appeared to be stronger for low income nations. Notably however, the regression of Australian data was the one result which yielded a negative and significant coefficient for government size. Furthermore, Ram found general empirical support for the hypotheses that the externality effect of government is positive and that factor productivity in the government sector exceeds that of the nongovernment sector.

Sala-i-Martin (1992) has prepared possibly the most direct analysis of pensions and economic growth yet considered within the endogenous growth framework. The basic rationale behind this is that the removal of pension recipients from the labour force will raise the average human capital stock. The model he has constructed was specifically designed to measure the effects of transfers on long run growth - a motivation which coincides with the work being undertaken here. Unlike Barro, he permits transfers to enter into an aggregate production function, as well as the utility function. His theory of intergenerational transfers implies that they are a means of inducing retirement - or of buying the elderly out of the workforce. Contrary to much previous theorising, Sala-i-Martin argues that the economic implications of such a strategy are actually quite valid. In what is possibly a first in this field of economics, he speaks of pensions as being more of a necessity on efficiency grounds, rather than on equity considerations.
The central feature of his model is that the average human capital stock has substantial externalities. The production function used depends not only on individual's abilities, but also on the abilities of the people surrounding them. Since skills depreciate with age on average, the elderly thus have a negative effect on the productivity of the young. (There is evidence that productivity at 65 is less than one third of the peak, which occurs at around 45). If the difference between the skill levels of the young and the old is large enough, Sala-i-Martin demonstrates that aggregate output will be higher when the elderly do not work. In fact, the preliminary empirical work which is carried out, reveals that transfers are the sole component of public spending which is positively correlated with growth in a cross section of countries, although the above caveats with respect to endogeneity still apply. Public consumption is found to be negatively related to growth, whilst the public investment coefficient is insignificant.

Sala-i-Martin's production function contains the standard physical and human capital variables along with a technology coefficient, but it is amended with two externality factors. The first - the ratio of human capital to employed labour - represents the externality from the average human capital stock of a firm's workers on its own workers. That is, the marginal contribution of one worker is equal to the sum of his/her private productivity, plus their contribution to the average capital stock - which in turn influences everybody else's productivity. The second externality factor is similar, but applies to the average human capital stock of the whole economy. Hence these externalities emphasise social interactions and learning by doing effects, which occur amongst workers both within and between firms.

The fact that less developed countries rarely have a social security system is also explicable. At lower levels of development, the rate of innovation is lower, and thus the rate of human capital depreciation is also moderate. Hence the difference between the skill levels of young and old workers is not sufficient to warrant the introduction of a social security system.
The aggregate nature of the model was adopted for simplicity, but the fundamental results should remain unaltered. Skill levels, skill depreciation rates and human capital externalities all differ across sectors of the economy. Sala-i-Martin concludes that changes in the pension system or retirement laws will have similar impacts upon the business cycle as do productivity shocks: the removal of a large number of less productive elderly from the workforce at any one time will increase the productivity of the young and shift the aggregate production function to the right, just like an improvement in technology.

Whilst theoretically appealing, the Sala-i-Martin model suffers from difficulties of empirical verification. Such a procedure would require the development of satisfactory proxy variables both for the externality generated internally by the firm - through the pension-induced substitution of old for young workers - and for the corresponding external average human capital effect upon other firms in the economy. Until such times as suitable variables are constructed, this highly original theory will remain an unknown quantity.

In this Chapter we have examined endogenous growth models, which are designed to model the externality effects of government consumption on the economy's rate of growth. An interesting outcome is evidence of pensions having a more significant economic effect on economic growth than government consumption - despite being included on an ad hoc basis. Most recently, Sala-i-Martin has commenced an attempt to incorporate aged pensions directly into a theoretical model, through citing a unique externality effect of pensions on labour productivity. A brief survey of the possible income redistributing effects of pensions, has also been undertaken, with some surprising empirical results being recorded by Blinder.

Whatever growth framework aged pensions is examined within in the future - be it via a re-examination of Kaldor, an application of the Cobb-Douglas production function, or an empirical analysis of the Sala-i-Martin model - it should precipitate an improved cohesiveness in thinking on the subject. Perhaps in a future where the study of 'the growth consequences of aged pensions' and the study of 'aged pensions within a growth model' converge, this area of economics will exhibit a more desirable degree of consistency.
But until such times as a greater degree of consideration is given to these alternative avenues, we shall continue our investigation with an application of LCH theory. It was within this general context that the hypothesis that pensions depress savings growth was first postulated, and it is within this same context that we shall test that hypothesis for Australia. In particular, we will be interested to note the theoretical implications of the dynamic interaction of pensions and savings over time - a relationship which the assorted endogenous growth and income distribution models are not designed to measure, as these do not explicitly examine savings.

Accordingly we will use a growth version of the LCH model to describe growth dynamics. Furthermore, modern econometric practice has become increasingly focussed on testing the causalities of variables expressed in growth terms, and hence an LCH growth model would potentially provide clear empirical answers via the methods of unit root testing and co-integration. Such a model would also cater for regression analyses of the pensions and savings variables in proportionate growth terms, should these be applicable.
4. CONSTRUCTING A MODEL

What is patently obvious to the modern researcher, is that *a priori* considerations alone will not confer a theoretically certain result in this subject matter. Nevertheless, it will be the purpose of this Chapter to derive a modern adaptation of the life-cycle model, applied to the Australian pensions and savings growth environment. As will be explained, we believe our formulation to represent the most appropriate means of quantifying the impact of aged pensions growth on household savings growth. But despite the solidity of the model, our final judgement must be reserved for the following Chapter, where the empirical content of the model will be assessed.

The traditional techniques of examining the effect of social security growth implications, fall into two broad categories. The first is the partial equilibrium comparative statics approach; the second is the general equilibrium approach. Under the partial equilibrium methodology, a savings or consumption function is derived from microeconomic principles, then aggregated and estimated. Anticipated aged pensions usually enter the analysis as a wealth variable, influencing the consumption-savings decision via the asset-substitution and offsetting induced retirement effect pioneered by Feldstein.

The original method of analysing the effect of pensions on capital accumulation, was through the estimation of a consumption function which included some measure of social security wealth. Since the pioneering work of Modigliani and Brumberg (1954) and Friedman (1957), the aggregate consumption function has been derived in the following way. In a model of intertemporal utility maximisation, the objective which is maximised is the representative agent's life-time utility - subject to the constraint that the agent's life-time resources are finite. This is undertaken through the selection of the appropriate consumption path. Consumption enters into the utility function in two ways. It directly contributes to utility in the present, and it is indirectly represented by the contribution of current net investment to productive capacity which generates higher consumption in the future. Hence the utility function employed is
additively separable: the utility derived from first-period consumption is distinct from that derived during second-period consumption.

In obtaining the aggregate consumption function from its microeconomic foundations, the aggregation problems implied by Arrow’s Impossibility Theorem are generally noted, requiring the further assumptions that society’s members have identical preferences and budget constraints. If certain simplifying assumptions are made, such as: that individuals of the same age have identical consumption functions; and that the age structure of the population, relative income distributions, net worth and expected future incomes are all constant, then the case of the individual consumer may be aggregated over all consumers to obtain an aggregate consumption function (Surrey 1976, p. 76).

However, in a more recent development, Evans (1983, p. 609) recommends that social security payments should enter the model more appropriately as a current flow variable, rather than as an artificially created stock variable. His reasoning is twofold. Firstly, he points out that "the construction of a social security wealth variable requires forbidding assumptions and imputations relating to such matters as choice of discount rate, modelling of expectations, future productivity growth, future labour force participation... etc" such that the current flow of social security may be a preferable proxy for expected future social security flows. Evan’s second justification relates to the distinction between stock and flow variables. He argues that human wealth in the aggregate consumption function is proxied by the flow of disposable income rather than by the stock value of some discounted present value, primarily because capital markets rarely permit agents to borrow against their future labour income. That is, the stock of human wealth is notional, not realisable. (Applying similar logic, the liquid nature of nonhuman wealth permits it to be proxied by a stock wealth variable). Extending this rationale of realisability once more, Evans claims that the inability to borrow against social security wealth necessitates the use of a flow measure.

Using Australian data, Carmichael and Hawtrey (1980) find cause to similarly oppose the concept of a net wealth effect of social security. They argue that "the essence of social security..."
neutrality is budgetary substitutability" and that this concept is independent of wealth considerations. Rather, they suggest that any analysis should focus on the intertemporal response by consumers to a change in pension provisions - which is best represented by a flow specification of social security.

From an empirical viewpoint, Leimer and Lesnoy's (1982) empirical results using a variety of stock measures of social security wealth, repeatedly demonstrated that there is no relationship between Feldstein's corrected social security wealth variables and United States savings. This constitutes a final reason for rejecting the implementation of a constructed stock variable proxy of social security wealth, in our model.

Perhaps the most significant critique of the basic LCH is also one of the most recent. Many economists now dispute the idea that savings are primarily governed by life-cycle considerations. The much publicised correlations between savings and inflation in the global economy since the 1970's, (see for example Molana 1991), provide a strong indication that many individuals optimise a substantial portion of their consumption-savings behaviour over a much shorter time span than a lifetime. However, as previously stated, the precise mechanism through which this effect operates, remains a point of contention.

On the other hand, Hurd (1987) amongst others, has highlighted the possibility that an actuarially unfair social security system - that is, one in which the discounted present value of benefits does not equal the discounted value of payments for some individuals - may generate net income effects which would reinforce any reduction in aggregate savings. Blinder's income redistribution analysis and Sala-i-Martin's endogenous growth model constitute further approaches which examine the pensions-growth problem from perspectives which are as divergent from the LC-PIH as they are from each other.

The second analytical technique of studying the implications of social security growth, involves setting up a dynamic system of general equilibrium equations, whereby the interactions of several economic variables outside the specific area of analysis, are permitted to
influence the outcome. Diamond and Samuelson were the creators of the original dynamic neoclassical growth model. Sheng Hu (1979) and Blanchard and Fischer (1989) are amongst those who have constructed latter day variants of this approach. By taking time to be a continuous variable, these models typically assume the form of an optimal control problem. Constrained optimisation yields optimal trajectories for a variety of per capita formulations, including consumption. In contrast to the partial equilibrium approach, savings here interacts with capital accumulation: through the effect of a changing return to investment. Ultimately, mathematical conditions may be derived to directly assess the effect of pensions on the economy's growth path.

Appealing in its thoroughness, the general equilibrium approach nevertheless remains empirically intractable due to the difficulties of modelling the infinitesimally numerous interactions involved. A second-best solution is to simulate the evolution of the individual equations with the aid of phase plane diagrams. Given the degree of complex interactions still involved with even this approach, it is especially vital that the underlying theory be rigorously specified. Yet even in this second-best general equilibrium version, slight variations to the basic assumptions typically lead to drastically altered results. Consequently - for reasons of clarity and robustness - the estimation procedure to follow will be based upon a comparative static model.

The model we will employ here is an adaptation of the Samuelson (1958) - Diamond (1965) two-period neoclassical life-cycle growth model considered in Chapter 2. This model was selected because it exhibits greater transparency and is more widely used, than the general equilibrium alternative outlined above. Moreover, it leads to the simple but desirable result of a social security flow variable occurring as a determinant of household savings, rather than Feldstein's controversial social security wealth variable. As an added bonus, this particular approach will permit us to examine the dependent variables directly, instead of interpolating the results from a consumption specification. A key difference between our model and the Samuelson-Diamond model, is that we shall proceed without including a 'bequest motive'. The economic importance of bequest motives remains on uncertain theoretical grounds.
Furthermore, the issue poses risks in terms of accurate empirical testing. Thus in order to obtain a specification which can sensibly be estimated, the bequest motive has been omitted from subsequent analysis.

In our model, will assume that the economy is infinitely lived. This reflects that the young in the last period of the economy’s life will still save despite their own mortality, thus ensuring the accumulation of capital for that last period. The economy consists of overlapping generations of identical individuals and cost-minimising firms, which face the standard neoclassical production technology. Furthermore, population growth is constant and all markets are assumed to operate competitively. These assumptions are described by the following conditions:

\[ N_t = N_0 (1 + n)^t \]  \hspace{1cm} (1)

\[ y_t = f'(k_t) \]  \hspace{1cm} (2)

\[ r_t = f'(k_t) \]  \hspace{1cm} (3)

\[ w_t = f'(k_t) - k_t f''(k_t) \]  \hspace{1cm} (4)

where \( N_t \) is the population at time \( t \), \( n \) is the population growth rate, \( y_t \) represents output per capita, \( r_t \) is the real interest rate, \( k_t \) is the capital-labour ratio. \( w_t \) represents per capita wage income and the prime represents the first derivative with respect to \( k_t \). The final two equations illustrate competitive behaviour in the asset and goods markets of the economy.

In the economy of our model, firms produce a single good with constant return to scale production technology, using a combination of capital and labour inputs. This good may be either consumed or used in the production process to manufacture future goods. In addition, the population is assumed to grow at the exogenous rate \( n \) and the decisions of individuals are made with perfect foresight.
We will now describe the representative agent’s optimisation problem which is made within the boundaries of this economy. We will assume that savings takes the form of capital accumulation. Individuals, when they are ‘young’, will select their intertemporal consumption-savings bundles according to the constraint that they work during the entirety of the first period, and refrain from work in the second period (that is, they save in period one for consumption in period two). Thus the lifetime utility of a representative individual born at the beginning of period $t$, will depend on his/her consumption in each of two periods lived:

$$U = U(c_t^1) + \frac{1}{1+\theta} U(c_t^2),$$

(5)

where $c_t^1$ and $c_t^2$ are the levels of consumption in period 1 and period 2 for a representative individual, $\theta$ is the constant discount rate and $U$ is the instantaneous utility function - the sum of the present values of utilities derived from consumption. It will be further assumed that the lifetime utility function $U$, is increasing and strictly quasi-concave with respect to $c_t^1$ and $c_t^2$ and moreover, it is everywhere continuously differentiable.

It is worth recalling here that this basic two-period specification could be readily modified into a multi-period framework designed to examine the longer term dynamics of the relationship between pensions and savings. However, as previously noted, such general equilibrium modelling in this field has thus far remained unable to allow for transparent empirical results. Nevertheless, the empirical results flowing from our two-period model would be ideally interpreted with an open mind towards the likely implications for such longer term growth dynamics. It is for this reason that we purposefully use the two period notation relative to time, $t$.

The lifetime allocation problem for the individual is to choose $c_t^1$ and $c_t^2$ so as to maximise his/her utility function according to the following budget constraint:

$$c_t^1 + a_t^1 = w_t^1$$
\[ c_t = (1 + r_t^2) a_t \]  \hspace{1cm} (6)

where \( a_t \) is real savings, and \( r_t^2 \) is the second period real rate of return on capital purchased in period one.

Now a representative individual’s problem may be represented as follows:

\[
\text{Max } U = U(c_t^1) + \frac{1}{1+\theta} U(c_t^2)
\]

subject to (6).

Setting up the Lagrangian function for this maximisation problem gives:

\[
L = U(c_t^1) + \frac{1}{1+\theta} U(c_t^2) + \lambda [c_t^1 - w_t + c_t^2/(1 + r_t^2)].
\]

where \( \lambda \) is the lagrange multiplier.

The first order conditions are as follows. With respect to \( c_t^1 \) we have:

\[ U(c_t^1) + \lambda = 0 \] \hspace{1cm} (i)

With respect to \( c_t^2 \) yields:

\[ \frac{U(c_t^2)}{(1+\theta)} + \lambda \left[ (1+\theta)(1+r_t^2) \right] = 0 \] \hspace{1cm} (ii)

With respect to the lagrange multiplier gives:

\[ c_t^1 - w_t + c_t^2 / (1 + r_t^2) = 0 \] \hspace{1cm} (iii)

Combining (i) and (ii) gives:
Now assuming that the real interest rate in period 2 is positive implies that the nominal interest rate exceeds the rate of expected inflation. It then follows that positive marginal utilities will ensure positive consumption in both periods of an individual’s life.

Equilibrium in the capital market represents temporary equilibrium in the aggregate economy and is described by the equation:

\[ a_t^1 = (1 + n) \ k_t \]  

(8)

where \( a_t^1 \) is the reduced form solution for a savings function from the individual's optimisation problem, and \( k_t \) is the inverse capital demand function implicit in (3). That is, planned savings here equals planned investment, allowing for the consideration of population growth. The steady-state definitions of first and second period consumption are found by substituting the steady-state equivalents of equations (3) and (8) into the budget constraint (6), to obtain:

\[ c_t^1 (k) = w_t^1 (k) - (1 + n)k_t \]

\[ c_t^2 (k) = (1 + n) (1 + r_t^2 (k) )k_t \]  

(9)

The steady-state properties of the system can be analysed by substituting (9) into the marginal condition (7). Thus we may obtain the steady-state marginal condition:

\[ U_1 (k) / U_2 (k) = 1 + r (k) \]  

(10)

where \( U_i (k) = (c_t^1 (k), c_t^2 (k)) \), for \( i = 1,2. \)
Under a pay-as-you-go social security system, the government taxes the young to pay the old directly; no capital fund is accumulated to meet the cost (as is the case under a fully-funded system). Now the individual's original budget constraint in (6) will be modified accordingly:

\[ c_t^1 + a_t^1 = w_t^1 - x_t^1 \]  \hfill (11)

\[ c_t^2 = (1 + r_t^2) a_t^1 + sP_t^2 \]  \hfill (12)

where \( x_t^1 \) is the tax contribution paid by the 'young' worker in period one, and \( sP_t^2 \) is the benefit received by the 'old' individual during period two when he/she is retired.

The individual benefit received by the 'old' under a pay-as-you-go system is the amount of tax paid by each 'young' individual of the preceding generation reduced by the rate of population growth.

\[ x_t^1 = sP_t^1 (1 + n) \]  \hfill (13)

Because the social security tax contributions are not invested directly, there is no real interest rate effect and so the condition for capital market equilibrium is still given by (8).

By generalising this model across generations and time, aggregating and expressing all variables in reduced form, the following unrestricted reduced form linear representation of a possible savings function is obtained:

\[
\text{Savings} = \beta_0 + \beta_1 \text{Household} + \beta_2 \text{Taxes} + \beta_3 \text{Aged} + \beta_4 \text{Interest}
\]

Here we have included the key variables of equations (11) and (12) as determinants of real, per capita savings, that is: real, per capita household income, taxes, pensions and the real interest rate. The household income variable has been generalised to better accord with
economic reality. It represents the sum of real, per capita wages and non-labour incomes such as government transfers and other income.

From a purely theoretical standpoint, this specification represents the final stage in our consideration of all the relevant factors impacting upon the relationship between aged pensions and GDP growth, via the mechanism of household savings.

Now because our model incorporates a two period assumption relative to time, t, it is a logical extension to re-consider the formulation in proportionate growth terms, defined as the difference between two data observations taken at time t and t-1, as a proportion of the observation taken at time t-1.

This methodology is particularly valid because this thesis is focussing upon the relationship between pensions and savings in the economic growth context - a context which lends itself to the examination of such data constructions. Indeed, such a formulation would moreover be consistent with the concepts of the endogenous growth literature reviewed earlier. Hence the proportionate growth version of equation (14) is:

\[
\text{Savings}_t - \text{Savings}_{t-1} = \beta_0 + \beta_1(\text{Household Income}_t - \text{Household Income}_{t-1})/\text{Household Income}_{t-1} + \beta_2(\text{Taxes}_t - \text{Taxes}_{t-1})/\text{Taxes}_{t-1} + \beta_3(\text{Aged Pensions}_t - \text{Aged Pensions}_{t-1})/\text{Aged Pensions}_{t-1} + \beta_4(\text{Interest Rate}_t - \text{Interest Rate}_{t-1})/\text{Interest Rate}_{t-1} (15)
\]

Much of our discussion has been concerned with the pension variable specified in levels. But given the dynamics explicit within the preferred theoretical model derived here as well as the investigations into the implications of pension dynamics (in the context of endogenous growth models) reported in the previous Chapter, it is worth canvassing a more dynamic model at this stage.
Accordingly it is necessary to investigate the intertemporal characteristics of the variables in these two equations, namely savings, wages, taxes, the real interest rate and the aged pension, as well as their interrelationships. Current econometric techniques permit such analysis both individually (unit root testing), pairwise (Engle-Granger co-integration testing) and collectively as a system (the Johansen technique). Indeed, such pre-testing is increasingly becoming practiced as an essential precursor to the more conventional econometric linear regression procedure. Thus in the empirical Chapter to follow, we shall endeavour to clarify the variable relationships in such a manner, before proceeding to estimate the multiple regressions (14) and (15).
The present econometric analysis will test the postulate that aged pensions influence household savings in an LCH growth framework.

The model described by equation (14) is replicated here:

\[
\text{Savings} = \beta_0 + \beta_1 \text{Household} + \beta_2 \text{Taxes} + \beta_3 \text{Aged} + \beta_4 \text{Interest Income Pensions Rate} \tag{16}
\]

where Household Income = Wages + Other Income + Transfers (excluding Aged Pensions) and Interest Rate = Nominal Interest Rate - Inflation.

The proportionate growth model derived as equation (15) in Chapter 4, is likewise reproduced here as estimating equation (17).

\[
\text{Savings}_t - \text{Savings}_{t-1} = \beta_0 \\
+ \beta_1(\text{Household Income}_t - \text{Household Income}_{t-1})/\text{Household Income}_{t-1} \\
+ \beta_2(\text{Taxes}_t - \text{Taxes}_{t-1})/\text{Taxes}_{t-1} \\
+ \beta_3(\text{Aged Pensions}_t - \text{Aged Pensions}_{t-1})/\text{Aged Pensions}_{t-1} \\
+ \beta_4(\text{Interest Rate}_t - \text{Interest Rate}_{t-1})/\text{Interest Rate}_{t-1} \tag{17}
\]

For estimation purposes, all variables - with the exception of the real interest rate variable - will be expressed in real per capita terms. Increases in the household income composite variable and interest rate would be expected to impact positively on savings. Conversely, increases in the tax variable would clearly be expected to reduce savings; whilst the crucial aged pension variable - for the various reasons outlined above - has a theoretically indeterminant effect. The dependent variable is defined to be real per capita household savings. All variable definitions are provided in the Appendix.
Annual data was adopted in all regression analysis, because it is theoretically preferable to either quarterly or monthly data - due to the nature of consumption-savings decisions. For the majority of households, a stable relationship between consumption and income is only observed on an annual basis. For shorter time periods, Suits (cited in Johnson 1983, p.2) argues that consumption depends on several 'accidental' short run variables, which will obscure its relationship with income. The sample period is from 1961 to 1990, giving 30 observations for the model expressed in levels.

Each data time series was deflated using the implicit price deflator for private final consumption expenditure. The fallacy of using the GDP deflator alternative, has been highlighted by Evans (1983, p. 610). Comparing the two deflators in the context of an aggregate consumption specification, Evans demonstrated that the use of a national income deflator significantly biased the income variable estimates.

The theoretical model which has been derived to obtain the initial econometric specifications (16) and (17) includes a dynamic relationship between the variables due to intergenerational factors. Thus it is important that unit root tests shall be performed upon each variable, to ascertain whether the empirical evidence supports either a static (equation (16)) or dynamic (equation (17)) specification. It is also important to test for stationarity because spurious results may occur when there are common trends in the variables.

Consider the autoregressive model:

\[ Y_t = \beta Y_{t-1} + \varepsilon_t, \quad t = 1, 2... \]

where \( \beta \) is a real number, and \( \varepsilon_t \) is a sequence of independent normal zero-mean random variables with variance \( \sigma^2 \). Now non-stationarity will occur if \( |\beta| > 1 \), and the variance will grow exponentially with time. This is because more weight is assigned to past shocks than to prevailing shocks - a situation which is generally considered to be implausible in the economic context. If \( |\beta| = 1 \), then the variance of \( Y_t \) grows unbounded at the constant rate of \( t\sigma^2 \).
Only if $|\beta| < 1$, is the time series $Y_t$ stationary: past shocks will dissipate over time. (Dickey et. al. 1986, p.15).

The results of the standard Augmented Dickey-Fuller (ADF) tests are shown in Table 1.1. with and without deterministic trends.
### Table 1.1: Augmented Dickey-Fuller Unit Root Tests

<table>
<thead>
<tr>
<th>Variables In Levels</th>
<th>No Trend</th>
<th>With Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>-1.92</td>
<td>-1.76</td>
</tr>
<tr>
<td>Pensions</td>
<td>-1.23</td>
<td>-1.89</td>
</tr>
<tr>
<td>Income</td>
<td>-0.48</td>
<td>-1.45</td>
</tr>
<tr>
<td>Taxes</td>
<td>-0.06</td>
<td>-3.24*</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>-2.67*</td>
<td>-4.49*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables In First Differences</th>
<th>No Trend</th>
<th>With Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>-3.02*</td>
<td>-3.21*</td>
</tr>
<tr>
<td>Pensions</td>
<td>-2.65*</td>
<td>-2.78</td>
</tr>
<tr>
<td>Income</td>
<td>-3.70*</td>
<td>-3.91*</td>
</tr>
<tr>
<td>Taxes</td>
<td>-2.94*</td>
<td>-2.86</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Note: at the 10% level of significance, the critical value for a test without trend is -2.57 and with trend it is -3.13. Rejected null hypotheses are indicated by *.
From the SHAZAM (White, 1983) calculations, two conclusions were readily apparent. Firstly, the null hypothesis of non-stationarity could only be rejected for the real interest variable. Thus the decision was made to exclude the interest rate variable from all further estimation procedures.

Secondly, it was discovered that the savings and income variables were stationary in first differences, in both the untrended and trended cases. This rendered them I(1), that is, integrated to the order of one. For all such non-stationary data, no valid statistical inferences can be drawn when they are regressed in levels as specified in equation (16).

On the other hand, the null hypotheses of non-stationarity in first differences could only be rejected for the pensions and tax variables with the untrended tests. In the case of the tax variable, no clear conclusion could be drawn as to whether it was I(0) or I(1). The results show that the key pensions variable may be integrated to an even higher order than one.

Whilst these results are highly revealing, their robustness may be worth testing from another perspective. The unit root test was performed upon the logarithms of the key savings and pensions variables. This specification is useful because taking first differences of variables in logs is equivalent to specifying them in proportionate growth terms as per equation (17). The results are reported in Table 1.2.
Table 1.2: Unit Root Testing of Log-Values

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Trend</th>
<th>With Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>-2.15</td>
<td>-1.79</td>
</tr>
<tr>
<td>Pensions</td>
<td>-1.23</td>
<td>-1.55</td>
</tr>
<tr>
<td>ΔSavings</td>
<td>-3.32*</td>
<td>-3.71*</td>
</tr>
<tr>
<td>ΔPensions</td>
<td>-1.90</td>
<td>-1.95</td>
</tr>
</tbody>
</table>

Notes: 1. Δ refers to the first difference of a variable.

2. at the 10% level of significance, the critical value for a test without trend is -2.57.
and with trend it is -3.13. Rejected null hypotheses are indicated by *. 
From the above results, it can be clearly seen that when expressed in logs, the crucial savings and pensions variables are not stationary in levels. However, upon taking first differences of the log series, it was interesting to note that whilst the savings variable indicated a result of first difference stationarity, the pensions variable did not. This key finding confirms our suspicions from the unit root testing procedure in levels, that the proportionate growth equation (17) is most appropriate in obtaining meaningful results, for the dependent variable, savings. However and importantly, the appropriate formulation of the pensions variable remains unclear.

In economic time series, if two variables are non-stationary, but a linear combination of those variables is stationary, then it may be said that the two variables are co-integrated. In other words, they co-exist in a long run equilibrium relationship. The most common means of testing for the existence of co-integrating relationships, is the procedure devised by Granger (1981). For a co-integrating relationship to occur, two conditions are required. Firstly, the two relevant variables must be integrated to the same order. Secondly, a linear combination of the two series should be stationary. The results are included in Table 2.1 with and without trend for the co-integrating equation, whilst Table 2.2 includes equivalent results for the reverse specification of the variables.
Table 2.1: Augmented Dickey-Fuller Tests for Pairwise Co-integration

<table>
<thead>
<tr>
<th>Regressand</th>
<th>Regressors</th>
<th>No Trend</th>
<th>With Trend</th>
<th>No Trend</th>
<th>With Trend</th>
<th>No Trend</th>
<th>With Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Savings</td>
<td>Pensions</td>
<td>Income</td>
<td>Taxes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coefficients</td>
<td>-1.94</td>
<td>-2.22</td>
<td>-1.73</td>
<td>-4.99*</td>
<td>-1.84</td>
<td>-2.09</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.263</td>
<td>0.374</td>
<td>0.219</td>
<td>0.913</td>
<td>0.107</td>
<td>0.131</td>
<td></td>
</tr>
<tr>
<td>D.W.</td>
<td>0.41</td>
<td>0.49</td>
<td>0.35</td>
<td>1.27</td>
<td>0.38</td>
<td>0.42</td>
<td></td>
</tr>
</tbody>
</table>

Note: at the 10% level of significance, the critical value for a test without trend is -3.04, and with trend it is -3.50. Rejected null hypotheses are indicated by *.
Table 2.2: Augmented Dickey-Fuller Tests for Pairwise Co-integration:

Reverse Equations

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Regressands</th>
<th>No Trend</th>
<th>With Trend</th>
<th>No Trend</th>
<th>With Trend</th>
<th>No Trend</th>
<th>With Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>Pensions</td>
<td>-0.96</td>
<td>-1.09</td>
<td>-0.08</td>
<td>-4.69*</td>
<td>-0.20</td>
<td>-4.09*</td>
</tr>
<tr>
<td>coefficients</td>
<td>Income</td>
<td>0.266</td>
<td>0.860</td>
<td>0.219</td>
<td>0.050</td>
<td>0.107</td>
<td>0.989</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>0.12</td>
<td>0.26</td>
<td>0.99</td>
<td>1.22</td>
<td>0.06</td>
<td>1.27</td>
</tr>
<tr>
<td>D.W.</td>
<td></td>
<td>0.12</td>
<td>0.26</td>
<td>0.99</td>
<td>1.22</td>
<td>0.06</td>
<td>1.27</td>
</tr>
</tbody>
</table>

Note: at the 10% level of significance, the critical value for a test without trend is -3.04, and with trend it is -3.50. Rejected null hypotheses are indicated by *.
By assessing the obtained critical values, it was apparent that the null hypothesis of non-stationarity was rejected in both directions, in only the savings-income test with trend. In other words, Australian real per capita savings and household income are co-integrated and therefore exist in a long run equilibrium relationship.

With the exception of the reversed savings-tax test with trend, the null hypothesis was not once rejected. Given the non-rejection of the savings-tax co-integration in the conventional direction, there was insufficient evidence of a co-integrating relationship here. Most importantly, no long term relationship was found to exist between savings and the pensions variable, where the null hypothesis was not rejected on all counts. This lack of evidence of a long term relationship between pensions and household savings is expected, in light of the ambiguous order of integration of the pensions variable.

A qualification of these outcomes, is that co-integration is generally considered to be a long run procedure, with substantial data requirements. Hence the 30 observations used here, may be considered too small. On the other hand, whilst there is thus likely to be an element of small sample bias, this effect will be mitigated if the sample size encompasses at least one business cycle of data. From 1961 to 1990, it is indisputable that the economy experienced more than one business cycle, and in this sense the sample (as distinct from the number of observations) may be large enough.

To further explore any possible short run connections between savings and pensions, we carried out multiple regressions on the growth specification (17).

At this point we note that a critical weakness of the single equation approach is the omission of feedbacks from consumption to income which is usually incorporated in complete macroeconomic models. The major consequence of this is an underestimation of the initial response of consumption to an increase in income. But this single equation bias can be avoided through the use of simultaneous equations or instrumental variable (IV) techniques. For ease
of interpretation, equation (17) will be most appropriately estimated with instrumental variables.

The instruments selected should preferably exhibit a high degree of correlation with the independent variables, but a correspondingly low correlation with the residual term. If the prior condition is not met, then the resulting estimates will lack efficiency. Alternately, if the latter condition is not satisfied, then serial correlation problems will arise. The instruments selected for our analysis bore these conflicting criteria in mind. They comprised: the one period lagged growth values of the endogenous variables - household income and taxes; and the current period growth values of the assumed exogenous variables - pensions, and the M3 measure of money supply. The inflation rate was also adopted as an instrument. The matrix of partial correlations are shown in Table 3.1.
Table 3.1 Partial Correlation Coefficients of Proportionate Growth

**Regressors and Instruments**

<table>
<thead>
<tr>
<th></th>
<th>Pens</th>
<th>Income</th>
<th>Taxes</th>
<th>Pens.1</th>
<th>Income.1</th>
<th>Taxes.1</th>
<th>Inflation</th>
<th>M3</th>
<th>Pens</th>
<th>Income</th>
<th>Taxes</th>
<th>Pens.1</th>
<th>Income.1</th>
<th>Taxes.1</th>
<th>Inflation</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pens</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>-0.66</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxes</td>
<td>0.40</td>
<td>-0.60</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pens.1</td>
<td>-0.50</td>
<td>0.14</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Income.1</td>
<td>-0.61</td>
<td>0.56</td>
<td>-0.58</td>
<td>0.04</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxes.1</td>
<td>0.03</td>
<td>-0.06</td>
<td>0.17</td>
<td>0.16</td>
<td>-0.44</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>0.68</td>
<td>-0.60</td>
<td>0.30</td>
<td>-0.34</td>
<td>-0.75</td>
<td>0.22</td>
<td>1.00</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>0.29</td>
<td>-0.63</td>
<td>0.49</td>
<td>0.21</td>
<td>-0.47</td>
<td>0.28</td>
<td>0.39</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pens, Income, Taxes, Pens.1, Income.1, Taxes.1, Inflation, M3.
### Table 3.2: Regression of Savings in Proportionate Growth - Estimated Jointly

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Regressands</th>
<th>OLS Estimation</th>
<th>IV Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Savings coefficients</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>t-values</td>
<td>-3.65</td>
<td>-0.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.63</td>
<td>-0.48</td>
</tr>
</tbody>
</table>

**IV Estimation**

<table>
<thead>
<tr>
<th>Savings coefficients</th>
<th>Pensions</th>
<th>Income</th>
<th>Tax.</th>
<th>D.W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.032</td>
<td>-0.268</td>
<td>7.137</td>
<td>-2.994</td>
<td>2.48</td>
</tr>
<tr>
<td>t-values</td>
<td>-0.56</td>
<td>4.09*</td>
<td>-2.84*</td>
<td>2.48</td>
</tr>
</tbody>
</table>

**Note:**
1. at the 5% level of significance, the critical value for a t test is 2.145. Rejected null hypotheses are indicated by *.
2. Instruments applied in the IV estimation were all in proportionate growth terms for lagged income, lagged taxes, lagged pensions, current inflation and current M3.
3. Both D.W. statistics yield non rejection of the null hypothesis of no serial correlation of the residuals.
### Table 3.3: Regression of Savings in Proportionate Growth - Estimated Individually

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Regressands</th>
<th>OLS Estimation</th>
<th>IV Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>Pensions</td>
<td>0.943</td>
<td>-0.387</td>
</tr>
<tr>
<td>coefficients</td>
<td></td>
<td>1.52</td>
<td>-0.40</td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td>6.939</td>
<td>5.734</td>
</tr>
<tr>
<td></td>
<td>Tax</td>
<td>-2.14</td>
<td>-2.03</td>
</tr>
<tr>
<td></td>
<td>t-values</td>
<td>7.43*</td>
<td>3.43*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3.16*</td>
<td>-2.33*</td>
</tr>
</tbody>
</table>

Note: 1. at the 5% level of significance, the critical t-value obtained here is 2.145. Rejected null hypotheses are indicated by *.
2. Instruments applied in the IV estimation were in proportionate growth terms for lagged income, lagged taxes, lagged pensions, current inflation and current M3.
The Ordinary Least Squares (OLS) estimates will incur single equation bias, but will be included to present a perspective of the robustness of our results. Hence for the sake of completeness, both ordinary least squares and instrumental variable techniques were applied to the proportionate growth specification (17), excluding the real interest rate variable as explained earlier.

The results in Table 3.2 illustrate that the two estimating methods yields broadly comparable results, once more underscoring the inherent robustness of the various causalities. Under both OLS and IV procedures, the proportionate growth income and proportionate growth tax variables were found to be significant. But once again, the most important outcome is the pension variable, which is statistically insignificant throughout.

In the IV equation of Table 3.2, real per capita household savings growth declined by -3.0 units for each unit increase in real per capita taxation growth. On the other hand, the dependent variable increased by 7.1 for each unit increase in real per capita household income growth. The directions of the effects of these two variables accord with the theory presented previously.

The t-ratios fell in transferring from ordinary least squares to the instrumental variables technique, reflecting the loss in efficiency. However, the signs of the coefficients remained unchanged from those obtained under OLS, with the income and tax coefficients remaining significant with IV estimation. This suggests that the tradeoff of more consistent estimates for less efficient ones, is quite favourable here.

In addition, the Durbin-Watson results suggest that autocorrelation of the residuals is not a problem, ensuring consistent estimates. In both of the multiple regression models, the null hypothesis of no autocorrelation could not be rejected.

It is furthermore pertinent to note that these results support the specification of the dynamic version of the model summarised by equation (15), in Chapter 4.
Table 3.3 illustrates the regressions of the proportionate growth in savings individually on the proportionate growth in each of the other variables. It reveals a pensions variable which is insignificant in both the OLS case (t-ratio=-1.52) and the IV case (t-ratio=-0.40). This result sheds some more light on any potential multicollinearity problem, which could yield erroneous statistically insignificant t-ratios. It would be reasonable to suggest that the observed statistical insufficiency of pensions on savings in the joint equation, is not due to the presence of a high correlation between pensions and either income or taxes, because omitting the latter variables does not render pensions significant.

In the interests of thoroughness, we can also mention the result of the joint proportionate growth equation when amended to include the real interest rate variable measured in levels. Whilst this approach was recommended by our original theoretical model, empirical considerations cannot be ignored. In this instance, the real interest rate variable yielded a coefficient of -0.01 and an insignificant t-ratio of -1.562. This result confirms our decision to omit the incomparable real interest variable from subsequent analysis.

A Chow diagnostic test was next applied to the complete set of proportionate growth data. This procedure was conducted with the object of ascertaining the strength of the econometric specification of the model (17). In other words, we were interested to find out whether the parameters of our model were consistent across time. Specifically, the data was split into the two approximately equal sub-periods of 1962-1975 and 1976-1990.
Table 3.4: Chow Tests for Structural Stability on the Proportionate Growth Savings Regression

<table>
<thead>
<tr>
<th>Year of Data Split</th>
<th>F Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974/75</td>
<td>0.194</td>
</tr>
<tr>
<td>1975/76</td>
<td>0.168</td>
</tr>
<tr>
<td>1976/77</td>
<td>0.133</td>
</tr>
</tbody>
</table>

Note: at the 5% level of significance, the critical F-value is 2.87. Rejected null hypotheses are indicated by *. 
The resultant Chow value of 0.168 was less than the critical F value of 2.87 at the 5% level of significance. Moreover, this outcome was confirmed by insignificant Chow values one year either side of this sample split. Consequently the hypothesis of consistent parameters across sub-periods, could not be rejected. Hence the proportionate growth data series for the savings exhibited no evidence of a structural break - a further strengthening result of our conclusions.

In order to further examine the striking robustness of the results thus far, the Granger causality testing procedure was applied to the relationship between the proportionate growths in pensions and savings. According to the Granger interpretation of causality, the question that will be asked below is: do movements in pensions precede movements in savings in proportionate growth terms, or is it the opposite way around, or are the movements contemporaneous? The results are shown in Table 4.
Table 4: Granger Causality Tests

<table>
<thead>
<tr>
<th>Direction of Causality</th>
<th>Optimal Lag Lengths</th>
<th>F Value</th>
<th>F Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pensions → Savings</td>
<td>savings_{t-1,...,t-2}, pensions_{t-1,...,t-4}</td>
<td>0.49</td>
<td>2.90</td>
</tr>
<tr>
<td>Savings → Pensions</td>
<td>pensions_{t-1}, savings_{t-1}</td>
<td>2.58</td>
<td>4.28</td>
</tr>
</tbody>
</table>

Note: 1. The test statistic was obtained by the formula: \( F = \frac{(\text{SSE}_R - \text{SSE}_U)}{r - r, n-k, \text{SSE}_U/(n-k)} \)

where \( \text{SSE}_R \) is the restricted error sum of squares, \( \text{SSE}_U \) is the unrestricted error sum of squares, \( r \) is the number of restrictions imposed by the null hypothesis, \( n \) is the sample size and \( k \) is the number of regressors (including the constant term).

2. Rejected null hypotheses at the 5% level of significance are indicated by *. 
The optimal lag structures of both regressors were obtained for each equation by monitoring the F.P.E. (Final Prediction Error) as step-wise regressions were carried out. Each variable was then regressed upon the optimal lag structure, firstly without restriction, and then after imposing the restriction that the sum of the coefficients of the lagged values of the tested variable, was zero. In this manner, it was possible to apply the F test statistic described in Table 4 to discover whether or not the lagged values of another variable had a significant relationship with the current value of each regressand.

These results do not reveal a causal relationship between pensions and savings in either direction. The respective F values fell well short of the critical values, and hence the null hypothesis that the two variables are independent of each other, could not be rejected. Once more, this reaffirmed the evidence that pensions have not influenced savings in Australia over this period.

Further testing - not reported here - indicated a unidirectional causality from savings to taxes, thereby demonstrating that lagged values of savings have a significant effect upon taxes. However, this result was treated with some caution, owing to possible misspecification surrounding the uncertainty of the order of integration of the tax variable, from the unit root testing. Additional testing revealed that savings and income were related, but only in the contemporaneous sense.

One possible critique of our model testing is that the measure of pension benefits expected by individuals - the ratio of actual benefits per aged person, to average per capita income - is a crude one. This is because it is based upon past benefit levels and income levels, which may differ from what individual's actually perceive they will receive. In the absence of an elaborate and potentially arbitrary constructed data set measuring the ratio of expected benefits received to income, our proxy will suffice.

However, our application of estimating procedures to Australian data has made the fundamental insight for present purposes abundantly clear. Applied to a variety of estimation
techniques, these results permit a surprisingly robust conclusion to be made: aged pensions apparently do not significantly influence household savings behaviour in Australia. For the Australian case at the very minimum, these outcomes suggest that the theoretical arguments postulated by those proponents of a negative impact of aged pensions upon national savings, require further scrutiny.

Thus the preliminary empirical findings in this paper, are that the variables of our model are optimally treated as growth formulations, and that under a variety of tests, aged pensions are not a significant determinant of national savings. The strongest policy signal produced by this analysis, is that if the government wishes to enhance national savings in a growth context, it should not consider discretionary changes to the pensions system.
6. CONCLUSION

There are several methodological aspects which clearly set this study apart from previous work on the relationship between aged pensions and savings in the growth context. The most obvious feature is the application of Australian data for the first time, to a life-cycle analysis of a subject which has been heavily researched in the United States, yet which has - in terms of the LCH - been curiously ignored in Australia. Secondly, this paper represents the first time that co-integration methods have been applied within the pensions growth context. Thirdly, a range of econometric techniques have been utilised in an attempt to attain robust results. These techniques include Chow tests of parameter stability, the use of instrumental variables estimation and Granger causality testing. Try as we did, we could uncover no semblance of a causality from pensions to savings. Finally, the nature of the results obtained have not only provided a clear new signal for government policy - they have lent further weight to the prospect that the life-cycle model itself, may be serving an increasingly inadequate role as a model of long term savings behaviour.

In this paper, the standard LCH model and numerous adaptations of it, have been assessed in considerable detail, including the PIH. Contrary to the fundamental postulate that pensions growth and savings growth vary inversely, under a pay-as-you-go-system, there was substantial evidence to cast a priori doubt upon the final net effect. An evaluation of comparative static and general equilibrium modelling frameworks was also carried out, in which the former approach was deemed preferable for this analysis.

Two types of endogenous growth models designed to measure externality effects of government consumption and aged pensions respectively, on the economy's rate of growth, were assessed. In the case of government consumption, there is a hypothesised external benefit of infrastructure spending on capital and labour productivity. In the latter case, Sala-i-Martin suggests that pensions enhance productivity through removing pension recipients from the labour force - thereby raising the average human capital stock. An investigation into the
intergenerational income redistributing effects of pensions, was also undertaken, with a surprising lack of evidence.

Given our results, and their subsequently powerful policy implications, it is perhaps pertinent to reinterpret some of the theoretical arguments which predict a negative effect of aged pensions on savings. In addition, several conceivable alternative explanations of our empirical findings, will be discussed. In so doing however, we must bear in mind the finding suggested by our empirical testing: that analysis of pensions and savings in levels does not seem appropriate. Henceforth - at least in the Australian case - our unit root tests have demonstrated that this relationship should at least be examined in proportionate growth terms.

The self-evident qualification by Feldstein (1981 p. 12) himself, that "empirical findings for the United States economy should not be extrapolated to other countries where differences in institutions could result in a quite different response to social security", appears to have been long forgotten. If nothing else, this paper has highlighted the dire consequences of ignoring this warning.

In considering the disparity of our results with those obtained by Feldstein for the United States, it must not be forgotten that an enormous amount of credibility in the 'pensions depress savings' argument was immediately lost when Leimer and Lesnoy (1982) discovered the crucial calculating error Feldstein had made in his construction of time series data for social security wealth. However, there was an eight year gap between the publication of Feldstein's breakthrough 1974 paper and the response by Leimer and Lesnoy. During this time, the popularity of Feldstein's original erroneous results was immensely consolidated. Whilst Feldstein produced additional empirical evidence to support his hypothesis, this did not dispel the fact that his original aggregate consumption function analysis had been the catalyst for his original hypothesis.

It would be misleading to assume that this is the first study besides Leimer and Lesnoy's (1982) which strongly contest Feldstein's body of work. Several prominent articles in the
literature have also disputed the extended LCH - although the reasons provided have usually varied. For example, Barro persistently argued that the offsetting effect of private intergenerational transfers, would void any impact public transfers may have upon the savings-consumption decisions of individuals. Hayashi instead suggested that the existence of liquidity constraints would prevent the key asset-substitution effect from effectively functioning. In addition, Cagan's 'recognition effect' and Katona's 'goal gradient hypothesis were proposed as explanations of empirical findings which indicated that people covered by pensions actually saved more than those who were not.

Feldstein (1974) himself has suggested another explanation for a potential positive impact of pensions on savings. If the consumer's perceived budget constraint is expanded by the pension program, then both consumption and savings may increase. This conclusion is reached by considering the wealth impact on consumption, of the induced reduction in private wealth caused by pensions. Only the direct consumption effect of pensions is typically measured, and this technique has been carried over here, for simplicity's sake.

Perhaps of greater relevance, is the Australian evidence which strongly contradicts Feldstein's original postulates. The unrestricted savings function featured in Carmichael and Hawtrey's (1981) paper, yielded a substantially positive (and significant) effect of pensions on savings. At a minimum, this result is strongly suggestive of the possibility that the different system of pension provision in Australia, could be sufficient to precipitate divergent empirical results from the American case. Taken to an extreme however, these results provide substance to the possibility that the majority of savings - in any Western economy - is actually carried out for non-life cycle purposes.

Kotlikoff and Summers' (1981) longitudinal analysis of earnings and consumption levels (examined earlier) provides one such fundamental attack upon the LCH. Their profile of female savings behaviour provided strong evidence that the LCH is not a useful predictor of savings behaviour for at least half the population. Thus on the most fundamental level, by combining the results obtained in our study with the existing body of literature which dissents
from the Feldstein hypothesis, we may surmise that the basic life-cycle theory itself may provide an inadequate explanation of individual savings behaviour for Australia. All in all, given these propositions, the seemingly 'heretical' empirical findings we have obtained for Australia, are not so unreasonable as they might first appear.

The central feature of the foregoing econometric analysis was the contradiction of the hypothesis that aged pensions depress household savings. As far as Australia is concerned, our over-riding conclusion is that aged pensions and savings growth are not related. By thoroughly testing a dynamic proportional growth model of pensions and savings, we were able to focus on that key relationship between these two variables which the endogenous growth and income distribution models neglect. Our growth version of the LCH served well as a model for empirical testing. In particular, given the important discovery that neither pensions nor savings are stationary in levels, our LCH model was adapted to test for any relationship between the two variables measure in proportionate growth terms. A series of procedures carried out in these terms, eventually yielded the compelling result that there is no evidence of any causality occurring between pensions growth and savings growth in Australia.

There clearly remain means by which our understanding of pensions and growth might be further enhanced. It is one thing to empirically test an economic theory and analyse the unexpected implications. It is a completely different matter to reformulate and retest a theory which better corresponds to the data. Although this paper has applied a rigorous set of econometric tests to a well specified model of pensions and savings, it is perhaps time to reconsider the theoretical possibilities that the data itself has raised.

However, these thoughts must not obscure us from the fact that the empirical application of our model may suffer somewhat as a transparent representation of the underlying theory. It could be argued that our representation of the pension variable, is perhaps a rudimentary measure of the true impact of aggregate pensions upon aggregate savings - inasmuch as we have used a flow measure in preference to a stock measure. However, this choice was primarily made on the basis that social security wealth is not a realisable wealth in the sense
that capital markets permit individual's to borrow against it. In addition, formidable assumptions are required to construct an artificial aged pension wealth series. Ultimately, given the strength of our results, it is unlikely that any minor revisions to the formulation of the pension variable, would be sufficient to induce a sudden statistical significance.

Thus in contrast to the conclusion reached by Feldstein (1981, p. 19) for the United States, we have found that the Australian data strongly rejects the notion that the unintended consequences of the 'well-meaning' policy of aged pensions, are economically undesirable. The pension debate applied to Australia seems far removed from Feldstein's analysis which comprises the competing factors of asset-substitution and induced-retirement. Whilst our results are consistent with the theory of a positive effect of the latter, they do not support the theorised negative effect of the former.

Overall, the most obvious policy implication of our study is that government decisions about the level and extent of financial provision for the retired community should not be biased against public aged pensions because of national savings fears. The direct economic costs and social benefits must remain the primary considerations, and if anything, savings consequences should bias any decisions in the positive direction. In other words, there appears to be no tradeoff between the objectives of equitable income distribution, and that of a sufficient national savings rate. Fortunately for the government, we now have evidence that the aged pension system is a powerful device which facilitates the simultaneous attainment of both goals.

A deeper implication suggested by our study, is that the LCH itself, may be in need of revision. Within the framework of the standard LCH, our results may be explained by liquidity constraints, or by a higher than anticipated rate of time preference. Given our finding that pensions and savings are integrated to the order of one, future researchers may thus find it profitable to further investigate a growth version of the LCH model, such as has been performed here.
APPENDIX

Savings: The dependant variable of savings, was obtained from measures of household savings levels.

(Australian Bureau of Statistics, Cat. No. 6501.1)

INC: Household income was obtained by summing five components - wages, salaries and supplements; unincorporated enterprise income and dwelling rent; interest and dividends; personal benefit payments and other unclassified income. This definition bore a clear correspondence to the definition which was theoretically derived.

(Australian Bureau of Statistics, Cat. No. 6501.1)

TAX: The tax variable was measured as the total yearly government tax revenue.

(Australian Bureau of Statistics, Cat. No. 6504.0)

PEN: Separate data on aged pensions were available from 1972. Because separate figures for aged pensions were not available before this date, earlier data was extrapolated from the combined aged and invalid pension figures. This was achieved by simply calculating aged pension recipients as a proportion of total pension recipients, and then multiplying this ratio by the total funds allocated to total pensions for the years 1960 to 1971.

(Department of Social Security Annual Reports 1978-79 and 1991-92)

INF: Inflation was measured by movements in the implicit private consumption deflator.

(Australian Bureau of Statistics, Cat. No. 3201.0)

INT: The real interest rate variable was proxied by subtracting the rate of inflation from the rate of return on 90 day bank accepted bill.

(Reserve Bank Special Bulletin: 1960 - 1990)

M3: The M3 aggregate measure of money supply was obtained from Reserve Bank data.

(Reserve Bank Special Bulletin: 1960 - 1990)
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