

An Empirical Analysis of Personal Saving in South Africa: 1960-1995

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Thesis presented in partial fulfilment for the degree of Master of Commerce in the
Department of Economics, University of Cape Town
August 1996

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Preface

I wish to sincerely thank my supervisor Iraj Abedian for his patience and constructive criticism. I would also like to thank Murray Leibbrandt for his useful comments regarding technical aspects of the analysis. Of course, the errors and omissions which still remain in this study are mine.

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Abstract

This study analyses personal saving in South Africa over the period 1960-1995. The main focus is to identify the key determinants of personal saving. The results indicate that because of declining real income growth and the shift towards contractual (retirement fund) saving, policy options available to increase the personal saving rate are limited. The estimates show that contractual saving is associated with a slight dampening of the personal saving rate. This supports the notion that retirement funds reduce the need for precautionary saving. Because of the structure of personal saving in South Africa, increasing government saving, and creating an environment conducive to attracting foreign direct investment, appears to be a more effective policy vehicle to generate finance necessary for economic development.

Introduction

This study seeks to empirically identify the major determinants of personal saving in South Africa. The paper uses the empirical results to examine whether personal savings can be an effective policy instrument for generating economic growth. Chapter one begins with a brief discussion of the link between savings and economic growth. The nature of personal savings in South Africa is then reviewed. Because of the composition of personal savings, it is argued that using personal savings as a target of policy will be ineffective. Firstly, pension funds (contractual saving) reduce the need for other forms of saving (i.e. discretionary saving). Policy measures to increase the level of contractual saving will merely result in a change in composition of personal savings. If a wealth effect is induced which reduces the need for precautionary saving, then total saving may fall (because consumption increases). Secondly, because contractual saving dominates the composition of personal saving in South Africa; and is less liquid than other forms of saving, it is suggested that policy measures (e.g. saving incentives) to boost the personal savings rate will be impotent. Policy ineffectiveness results because savings cannot be easily substituted back to discretionary savings plans. Lack of substitutability is exacerbated by low real income growth. These issues raise the following questions which must be answered to aid policy formulation;

1. Have pension funds had a positive impact on personal saving, or would saving be higher in the absence of pension funds? If so by how much?
2. Will taxation of pension funds result in a shift in the composition of total savings? If a shift does result, will this affect total saving?
3. To what degree will saving incentives encourage additional saving?

These questions have not been adequately addressed in earlier research because empirical evidence has not been provided to support conclusions. Answering these

using rigorous econometric techniques will be the main focus, and contribution of this paper.

The anecdotal evidence presented in chapter one is supported by empirical analysis. Chapter two specifies a framework for modelling personal savings behaviour and describes the data. Chapter three presents the results of the econometric estimation and discusses how each variable impacts on personal savings behaviour in South Africa. Chapter four offers policy implications and conclusions based on the empirical results.

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Chapter one

Saving and the Economy

This chapter provides an overview of the importance of saving in the South African economy. Firstly, it is shown that conflicting views on the role of saving in the growth process concern whether saving can shift an economy from one steady state to the next. However, it is not disputed that while an economy is in transition between steady states, saving can stimulate economic growth. Secondly, given that saving is important at a macroeconomic level, attention is paid to the role of personal saving in the South African economy. As will be shown, the composition of personal saving biases heavily towards contractual saving. It is argued that this bias may leave few policy options to strengthen the personal saving rate. A review of the empirical literature on the impact of pension funds on saving, and the effectiveness of using the interest rate as a policy tool to strengthen the personal saving rate is also provided.

1.1. How does saving affect economic growth?

It is not disputed that savings are required to maintain the capital stock. The issue on which economists do disagree is the role of saving in the long-term economic growth process. Exogenous growth theorists argue that saving increase the growth rate of income in the short-run, but in the long-run will only increase the level of capital and income per head, but not the growth rate. Endogenous growth models argue that there are feedbacks between saving and growth in the long-run. The following sections explore these models.

1.1.1 Neoclassical exogenous growth theory

In the neoclassical growth model pioneered by Solow's (1956) seminal paper, saving influences economic growth in the following way. Saving is used to finance additions to the capital stock. An economy with an initially low capital-labour ratio¹ will have a

¹ For instance a developing economy

high marginal product of capital. If a proportion of the income generated by (say) an addition to the capital stock is saved, and if the resultant increase in new investment is enough to offset depreciation of the existing capital stock, then capital per worker will rise. If production faces constant returns to scale² and existing technology is fixed, then the marginal product of capital will decline. If the marginal product continues to fall, the saving generated by the additional capital will fall. Eventually, saving will be just enough to cover depreciation and equip new workers. In this case the economy reaches a stationary state with unchanged living standards with output, capital, and labour growing at the same rate. Saving therefore will increase the growth rate of output in the short-run. In the long-run it will raise the long-run level of capital and output per head, but not the growth rate of output. Long-run growth of production is determined by technological progress and the growth rate of population. The production function can be expressed as $Y = AY(K,L)$, where A, K, and L are technology, capital, and labour respectively. Technology and population growth are exogenous and therefore bear no relationship to saving.

In South Africa there are many proponents of the neoclassical theory. Prinsloo (1994:25) in his analysis of the saving situation in South Africa argued that:

an increase in the share of domestic income devoted to saving and investment does not necessarily affect the growth rate indefinitely if it is not accompanied by changes in the production structure or by technological progress resulting in improved techniques or organisation of production.

Others argue³ that saving indirectly influences economic growth by promoting macroeconomic stability which is a prerequisite for investment. However endogenous growth theory asserts that saving is endogenous in the long-run growth process.

² Solow (1994) points out that this is not an essential assumption. It is merely for simplification purposes.

³ See for instance The Katz Commission First Interim Report (1994) on the investigation into the tax structure of South Africa. They concluded that "saving is not a significant determinant of economic growth. This is supported by the theory of economic growth which denies any causal link between an increase in the saving ratio and an increase in economic growth" (p.244).

1.1.2 Endogenous growth theory

Proponents of endogenous growth models include Lucas (1988), Romer (1986), and Grossman and Helpman (1994). In these models, economic growth is influenced by investment in human capital, research and development 'spillovers', and innovation-based growth. New investment, incorporating current technology, increases the growth of factor productivity, and consequently economic growth. Financing of this investment requires saving, bringing out the relationship between saving and economic growth. This results in a different transmission mechanism than in section 1.1.1. A higher saving rate initially results in a higher capital-labour ratio. Per capita output increases as before. A portion of this income is devoted to (for example) human capital development. This increases the rate of growth of the *effective* labour force. The improvement in labour productivity resulting from the higher capital-labour ratio acts as an incentive for firms to devote more resources to capital accumulation. When the growth of the capital stock declines following an increase in capital intensity, the growth of the labour input rises. Therefore, with endogenous technical change, both the capital-labour ratio and long term growth of per capita output increase when domestic saving increases.

At a theoretical level, endogenous growth theory has become recently more popular than exogenous growth theory i.e. saving does influence the long-run economic growth rate. While the economy is adjusting to a steady state, there is no theoretical dispute over the role of saving in the economic growth process - saving lead to higher economic growth. However, bear in mind that there are likely to be feedbacks, so that unilateral causality is unlikely. Duisenberg and Wellnik (1995) cite Abel *et al* (1989) who calculated optimal saving ratios for various countries based on the "golden rule of saving". Their evidence suggested that the sample countries' actual saving ratios were lower than their optimum. Therefore, increasing saving and investment ratios *will* increase economic growth.

1.2. Saving in South Africa

Based on the discussion above, we can conclude that unless the saving rate in South Africa is at its optimum, steady-state level, there is no dispute that increases in the

saving rate will have a positive impact on economic growth. There is ample empirical and anecdotal evidence that the saving rate is not at its optimum level. The *Annual Economic Report of the Reserve Bank* (1994) asserts that aggregate saving will have to be raised to 22 percent of gross domestic product to support a real economic growth rate of 2½ percent per annum, and 24 percent to maintain a 3½ percent annual growth rate. More recently, the Growth, Employment and Redistribution macroeconomic strategy (GEAR) forecasts GDP growth assuming the implementation of an integrated macroeconomic strategy. In their forecasts, gross domestic saving need to be maintained at around 22 percent of GDP to sustain a 6.1 percent growth rate in real GDP by the year 2000.⁴ In 1995 the ratio of gross domestic saving to GDP was 16.7 percent. This implies that gross domestic saving will have to increase by around 32 percent (R25,579 million)⁵ to meet this target.

Therefore, there is significant potential for increases in the saving ratio to positively impact on economic growth in South Africa.

1.2.1 Personal Saving

Given that saving is important at a macroeconomic level, should public or private sector saving be the focus of policy? This study will partly answer this question by analysing personal saving in South Africa. Issues relating to corporate and public saving, although very important, are beyond the scope of this study.

In the national accounts personal saving is measured as the surplus of current income over current expenditure during a particular period. Current income includes direct remuneration of employees, employer contributions to retirement funds, income from property and investments (including investment income of retirement funds), and retained income of non-profit institutions serving households. Any current expenditure financed by credit is treated as negative saving.

⁴ One assumption of this forecast is an increase in foreign direct investment from 1996-2000 of around 419 percent.

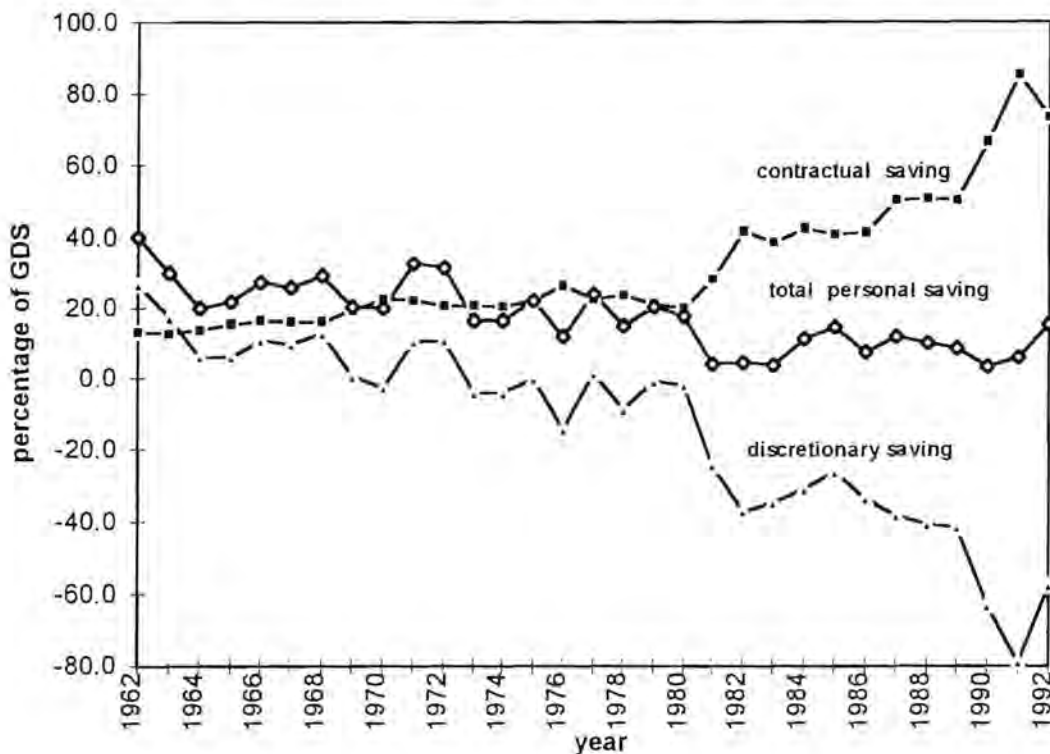
⁵ In 1995 rands.

Personal saving is estimated with a high margin of error. When calculating gross domestic saving, the assumption is made that national accounting identities hold and that the other components of aggregate domestic saving are more accurately calculated. Because of these assumptions, personal saving is the balancing item on the capital finance account.⁶

1.2.1.1 The composition of personal saving

Personal saving can be divided into contractual and discretionary saving. Contractual saving, often called managed saving, consists of those commitments such as premiums on insurance policies, contributions to pension funds, and households' mortgage loan repayments. Discretionary saving is where individuals have direct control over the flows, and are not bound by any commitments. Figure 1.1 shows the level and composition of personal saving over a thirty year period.

Figure 1.1: Personal saving in South Africa 1962-1992



NB: Discretionary saving was calculated as total personal saving less contractual saving.
Source: South African Statistics, The Mouton Report.

⁶ The capital finance account describes how physical capital is accumulated and how this accumulation is financed. Gross fixed investment and changes in inventories are the means of accumulation. The main source of the finance is gross domestic saving. Any shortfall is made up by foreign inflows.

The first observation from Figure 1.1 is the decline in personal saving from the early 1980s. It is argued by some commentators that the cause of the decline is low levels of households' after-tax real income.⁷

The second observation is that the composition of personal saving changed significantly from the early 1980s. Contractual saving in 1992 totalled more than 70 percent of gross domestic saving. It is often argued that the differentiation between contractual and discretionary saving is unimportant from a macroeconomic viewpoint.⁸ However, Munnell (1976) argues that at a macroeconomic level, in order to predict the future supply of finance, it is vital to establish if the reserves accumulated in pension funds are being offset by lower individual saving or whether these reserves represent a net addition to the supply of capital in the economy.

One of the reasons for the shift in saving is the disparity in rates of return available between contractual and discretionary saving. Retirement saving has long had favourable tax treatment which has increased its return relative to self-managed saving plans.⁹ The margin available from investing in a managed (contractual) saving scheme i.e. the real return from contractual saving less the real post-tax return from discretionary schemes is reflected in the Figure 1.2. The tax advantage from investing in a contractual saving scheme would encourage new saving generated from income growth to flow to those schemes.

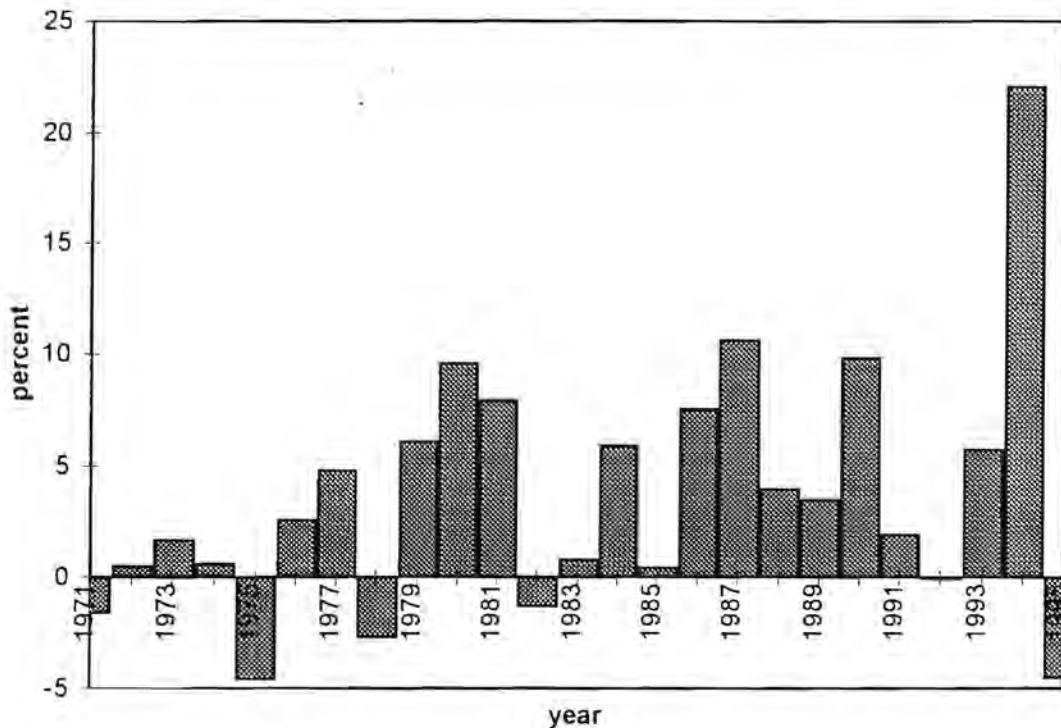
The third observation is that when contractual saving began to increase dramatically from the early 1980s, real per capita personal saving declined significantly. From 1962 until 1980, real per capita personal saving averaged 23.4 percent of gross domestic saving. From 1981 until 1995, real per capita personal saving averaged just 9.7 percent.

⁷ See for instance the Mouton Report (1992,64)

⁸ See for instance Prinsloo (1994).

⁹ Barr & Kantor (1994) cite Margo Commission calculations that life offices had paid an average rate of tax of 7.9 percent on all investment income. Investment income of self-managed saving plans is taxed at progressive rates (excluding the first R2,000 of interest income)

Figure 1.2: The premium from contractual saving in South Africa: 1971-1995



Source: The nominal return from retirement funds until 1990 was extracted from the Mouton Report. From 1990 until 1995, the return to unit trusts was used to rate forward the Mouton Report figures. The real after-tax return to bank deposits was taken from Prinsloo (1994).

Is the timing of the fall in saving and the increase in contractual saving in Figure 1.1 coincidental or has contractual saving had a dampening effect on total household saving? This study seeks to answer this question.¹⁰

High flows to contractual saving schemes limits the income available for discretionary saving. This is because once an individual is committed to a managed saving scheme, there are disincentives to break the contract. Thus, contractual saving imposes a form of liquidity constraint on the individual. Any increase in discretionary saving must therefore come from growth in real income given that consumption is to be maintained. It follows that if real income growth is low, growth in discretionary saving will also be low. More, formally, discretionary saving at time t will be positive if:

¹⁰ The Mouton Report (1990) argues that pension funds have not dampened the saving rate but have contributed to the supply of capital in the South African economy, "the role and importance of retirement funds in marshalling personal saving funds is clear and cannot be overemphasised . . . in terms of the long-term saving funds required for financing fixed capital investments, is being harnessed by way of personal contractual saving, most of which is with retirement funds" (p.64).

$$Y_t - C_t - PC_t - D_t > 0 \quad (1-1)$$

where Y is disposable income, C is consumption, PC is pension fund contributions, and D is debt repayments. If we assume C is proportional to lifetime income (i.e. $C = \alpha Y$) and PC is fixed over the individuals lifetime,¹¹ then any increase in discretionary saving must result from either real income growth or reduction in household debt. A reduction in credit can only directly result from an increase in real income. Therefore, real income will be the main determinant of discretionary saving growth. Household debt increased markedly during the 1980s.¹² One reason for this is that to maintain consumption while real income growth declined, households borrowed to contribute to contractual schemes. In other words, the discounted present value of future benefits exceeded the present value of future liabilities incurred by borrowing.¹³ To illustrate, total saving flows since the 1980s can generally be represented as:

$$\downarrow Y_t - C_t - \uparrow D_t = \uparrow PC_t + \downarrow DS_t = \downarrow S_t \quad (1-2)$$

where Y , C , D , and PC are defined as before. DS and S are discretionary and total personal saving respectively. The arrows indicate the movement in the variables. Equation (1-2) offers the possibility that households borrowed to meet pension scheme obligations.

The shift in composition of personal saving has fiscal policy consequences. The avoidance of tax by investing in a contractual scheme reduces potential tax revenue. Furthermore, the favourable tax treatment of pension schemes provides an incentive to invest in a managed scheme (because of the tax-induced superior rate of return). This

¹¹ The assumption of consumption being constant over the individuals lifetime is a key result of the Life-Cycle hypothesis discussed in chapter two. The assumption of PC also being constant is based on the observation that individuals pay a fixed contribution to retirement funds.

¹² See Prinsloo and Van der Walt (1995) for an analysis of household debt in South Africa. Consumer credit extension by monetary institutions as a percentage of total credit extension to the domestic private sector in the 1970s averaged around 10½ percent. In 1984 this ratio increased to 25½ percent. From 1985 until 1994 growth in consumer credit slowed but consumer credit as a percentage of total credit extended to the private sector still averaged 19½ over the period.

¹³ Contractual scheme members would also be encouraged to borrow if surrender penalties exist.

means that any increase in real income will be directed towards a managed scheme i.e. PC will increase. This will have a favourable impact on *total* saving, but will be partially offset by a wealth effect. The wealth effect arises because of the certainty retirement funds provide for the future.¹⁴ A wealth effect would be reflected in α increasing, and/or D rising. This means that other saving for retirement, or for *precautionary* purposes may fall.¹⁵

An implication of this is that *if* favourable tax treatment in the past has induced additional flows to retirement funds (increasing PC) which would have otherwise been used in a self-managed scheme, and pension funds depress the personal saving rate (through a wealth effect), then total personal saving may have been higher in the absence of contractual saving. This is exacerbated if individuals borrowed to invest in contractual schemes because rising real interest rates over the 1980s (which increases the cost of borrowing) reduces discretionary income. The trends of consumption, income, and contractual saving are reflected in the following table.

Table 1.1: Consumption, income and contractual saving in South Africa: 1971-1992

period	real disposable income (R1990)	real consumption (R1990)	consumption-income ratio	contractual saving-income ratio (percent)
1971-1980	5263	4775	0.91	9
1981-1992	5286	5146	0.96	18
1971-1992	5276	4977	0.94	14

Source: SARB Bulletin, Mouton Report

The table shows that from 1980 contractual saving doubled as a percentage of income. The level of consumption also increased while real income remained relatively constant. Real income growth over the same period has been declining. From 1971-1980, real income growth averaged 2.0 percent. From 1981-1995 it averaged -0.6

¹⁴ The size of the wealth effect will depend on the credibility of fund managers to produce a return on investment in the case of a private pensions. In the case of public pensions, the size of the wealth effect will depend on whether individuals anticipate that in the future, government will increase taxes to finance social security benefits. If they do anticipate future tax increases, then the wealth effect will be insignificant. In other words, Ricardian Equivalence holds.

¹⁵ Precautionary is used in the context that without contractual schemes, consumers would have to operate self-managed schemes which would induce greater uncertainty in the level of their retirement saving.

percent. This leaves little room for discretionary saving growth. This provides some weight to the argument that contractual saving may have encouraged additional consumption. Low income growth also has implications for the effectiveness of saving incentives to boost personal saving. This is dealt with in section 1.3.

Therefore, the low discretionary saving rate reflects low disposable income growth, and increased contractual saving prompted by a superior rate of return.

The semi-technical analysis above does not provide conclusive empirical proof of contractual saving schemes dampening the personal saving rate. Chapter three attempts to econometrically quantify the impact pension fund saving has had on total saving. It also attempts to identify other key determinants of personal saving behaviour.

1.3. Personal saving and policy

The issues discussed above raises various policy considerations;

1. If pension funds have dampened the personal saving rate, then policies designed to encourage retirement saving will have a negative impact on total saving.
2. Taxation of retirement funds is a new policy initiative in South Africa. During 1996, a 17 percent tax on interest income of retirement funds was introduced. The discussion in section 1.2.1.1 suggests that taxation of pension funds will not result in a significant flow of funds back towards discretionary saving because retirement saving are less liquid than other forms of saving. Thus, taxation of retirement funds could increase gross domestic saving if the revenue derived from retirement fund taxation contributes to public saving/reduces public dissaving. Of course, because taxation of pension funds currently only applies to interest income, the extent of potential tax revenue will depend on the extent that fund managers substitute away from bonds towards equities or other investments not subject to the tax.
3. The effectiveness of saving incentives (e.g. lenient tax treatment of personal saving) to encourage additional personal saving will be limited because households

are constrained by low income growth and contractual saving commitments i.e. the responsiveness of personal saving to changes in the interest rate will be low.

In conclusion the high contractual saving commitments relative to disposable income, combined with low real income growth, has made personal saving inflexible. Thus, personal saving may not be an efficient target of government policy for generating saving to finance investment and subsequent economic growth, particularly if past commitments to pension schemes have discouraged other forms of saving.

What have other studies found regarding the impact of pension funds on saving, and the effectiveness of using interest rates as a policy tool to boost personal saving? The following sections review the empirical literature on these topics

1.3.1 Pension Wealth

The discussion above showed that contractual saving in the form of pension funds is dominating the composition of personal saving. The literature distinguishes between public and private pensions and their implications for saving behaviour. As the following discussion illustrates, at a theoretical and empirical level, the effects of retirement funds on personal saving is ambiguous.

Smith (1990) outlines various ways public old age pensions affect private saving. Firstly, financing the pension benefits through debt or taxes impacts on patterns of consumption. Secondly, social security benefits have a *wealth effect*. The need to save is reduced because social security wealth is substituted for private wealth. Thirdly, there is a *retirement effect* as expected future benefits alter retirement timing. Individuals desiring to retire earlier requires a higher propensity to save during their years of employment. Another effect working in the same direction as the retirement effect is the *recognition effect*. This is where individuals realise the importance of sufficient saving for old age as a result of their taking part in a contractual saving scheme. This causes other forms of saving to increase. Because the wealth effect works in the opposite direction to the retirement and recognition effects, the net effect (i.e. which effect dominates) on total saving must be determined empirically.

An additional effect, based on Hubbard (1984, 1986) is that social security provides insurance for retirement consumption due to uncertain life spans. These pensions reduce the uncertainty associated with retirement saving targets. As a result, pensions reduce the need for precautionary saving, thereby identifying a further channel where social security can depress the saving rate.

Sandmo (1985) illustrates these effects at a microeconomic level. Following Sandmo (1985:284), incorporating retirement funds into the standard two period intertemporal model results in the conventional budget constraint becoming:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} - c + \frac{b}{1+r} \quad (1-3)$$

where c is the lump sum contribution paid in period 1, and b is the retirement benefits received in period 2. Sandmo assumes that b is calculated as a multiple of some reference contribution \bar{c} which does not necessarily have to equal c . If the multiplicative factor is $(1+g)$ then $b = (1+g)\bar{c}$, where g is the rate of return offered from the retirement fund. Substituting this into (1-3) gives:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} - c \left(1 - \frac{(1+g)\bar{c}}{(1+r)c} \right) \quad (1-4)$$

From (1-4), Sandmo draws several conclusions:

1. Lifetime consumption is unaffected if $c = \bar{c}^{16}$ and $g = r$. Personal saving falls by an amount equal to the retirement fund contribution. The scheme therefore has no effect on present or future private consumption.
2. If $c = \bar{c}$ and $g \neq r$. There is an income effect on consumption which is positive or negative depending on whether g is greater or less than r . In the case of $g > r$, the

¹⁶ If $c = \bar{c}$ then it implies that the present value of pension benefits equals the present value of pension contributions. \bar{c} can thus be regarded as an indicator of the degree of over/under funding.

income effect is greater than zero, encouraging individuals to save less in the present and therefore increase present consumption. This is equivalent to the 'wealth effect' described above. This case is particularly relevant in South Africa as Figure 1.2 illustrated. In addition, the implicit yield on pension contributions may be more certain than that available in the private capital market because the government may have a diversification advantage over individuals. This reduces the need for precautionary saving. However if the credibility of the government's commitment to benefit obligations is questioned, private saving may increase. If the model was extended beyond two periods, the 'retirement effect' could be illustrated by contributions (c) increasing over time.

3. The now well known Ricardian Equivalence proposition reformulated by Barro (1974), may also impact on private saving. Suppose a pay-as-you-go pension fund scheme was introduced which immediately reduced private saving (through increased taxation). This would lead to a lower capital stock in the future, and thus burden future generations. However, the foresighted present generation would anticipate this, and increase their bequests (provided they care about the welfare of their descendants) which exactly offsets the reduction in saving. This is tantamount to social security not inducing a wealth effect on consumption. Therefore, if Ricardian Equivalence does not hold, then support is given to the argument that pension saving reduces the need for precautionary saving.
4. Equation (1-4) assumes that public pension benefits are financed by lump sum taxes. In practice, financing usually takes place through distortionary income taxes which have additional effects on saving through changes in after-tax interest and wage rates.

1.3.1.1 Public pensions and total saving

Public contractual saving schemes may reduce personal saving (through e.g. higher taxes to fund the scheme, or because of wealth effects). Whether this decreases total saving for the economy depends on how the government uses the contributed funds. If the funds are used for public consumption and transfers, total saving will fall. In other words the social security scheme is not "funded" but operates on a pay-as-you-go basis. This system is one where no assets are held i.e. the contributions paid in any one year are just equal to the benefits paid in that year. Under this scheme the reduction in

private saving is not offset by increases in public saving. This fall in total saving has implications for the level of the capital stock and therefore the level of national income. Alternatively, if the contributions are left to accumulate in a fund, the overall rate of saving will be maintained or may increase.

In South Africa, financing of national social security schemes operates on a pay-as-you-go basis as each year a budget allocation is voted equal to the benefits to be paid.¹⁷

1.3.1.2 Private pensions and total saving

Private pensions affect the need for individuals to save in other forms. The extent that this form of household wealth is offset by decreases in discretionary personal saving determines how much private pensions add to total saving. The retirement, and recognition effects, combined with the fact that pension benefits are less liquid than other forms of saving suggests that private pension plans are likely to add to total saving. This is supported if a pension scheme is fully funded.¹⁸ However, if private pensions reduce the need for precautionary saving, then the net effect will be ambiguous.

1.3.1.3 Public pensions: empirical evidence

Feldstein (1974) is credited as the first to formally attempt to econometrically model the effect of public pensions on private saving. Feldstein (1974) cites Friedman (1957: 123) as recognising that social security “would clearly tend to reduce the need for private reserves and so as to reduce saving”. Others argue that saving may increase due to social security. Cagan (1965) cited in Feldstein (1974) found that the average saving rate was higher for those covered by pensions than those who were not. His empirical results suggested that an increase in an individual’s pension contribution was related to an increased level of discretionary saving. Katona (1965) cited in the same article randomly surveyed households and found that participation in a pension plan raised saving rates. These studies were the first to identify the recognition effect.

¹⁷ See the Mouton Report (1992:42) for a discussion on the social security system in South Africa.

¹⁸ The Mouton Report (1992:42) states that in South Africa “all retirement provision schemes in the private sector...are funded, i.e. assets are built up to secure the pension benefits”.

Feldstein adapted the Ando and Modigliani (1963) Life Cycle model by including a social security wealth variable. His empirical specification was of the form:

$$C_t = \alpha + \beta_1 Y_t + \beta_2 RE_t + \gamma_1 W_t + \gamma_2 SSW_t$$

where

C_t is consumer expenditure;

Y_t is permanent income;

RE_t is corporate retained earnings;

W_t is the stock of household wealth at the end of year t (excluding social security wealth);

SSW_t is social security wealth.

The social security wealth variable was defined by Feldstein as the “present value in year t of the retirement benefits which could be eventually claimed by all those who are either in the labor force or already retired in year t ” (p.911). He distinguished between gross and net social security wealth, net social security wealth being gross social security wealth less the present value of the social security taxes anticipated by current workers.

Based on the results of his estimation, Feldstein concluded that “in the absence of social security, personal saving would be at least 50 percent higher ... and probably closer to 100 percent higher” (p.916). This suggests the wealth effect outweighs the retirement effect (and/or recognition effect). Therefore, public pensions significantly depress personal saving.

Munnell (1974) using the same social security wealth series as Feldstein, found the wealth and retirement effects to be significant. The “apparent neutral influence of social security on saving has really been the net result of two strong but offsetting influences” (p. 563). However, she did anticipate that the retirement effect would weaken because of a slowing in the decline in labour force participation by the aged.

Smith (1990) cites later studies by Feldstein (1977, 1978, 1980, 1982, 1983), and with Pellechio (1979), which supported his initial findings. In his 1982 paper, Feldstein estimated that “the level of social security wealth in the final year of the sample (1971) depressed personal saving by an amount equal to 44 percent of the actual personal saving in that year” (p.630).

Other studies using U.S. data supported Feldstein’s conclusions. Hendershott and Peek (1985) cited two factors acting to depress the personal saving ratio over the 1950-1981 period. These were;

1. a significant increase in the retired portion of the population, and;
2. rapid growth in unfunded pension wealth (social security and pensions for government employees).

Gultekin and Logue (1979) cited in Smith (1990) concurred with Feldstein but argued that the negative effect of social security on private saving may be due to social security taxes rather than pension wealth.

King and Dicks-Mireaux (1982) found a wealth effect, although smaller in size than Feldstein’s. They estimated that an additional dollar of social security wealth would be offset by a 25 cent fall in other saving. Diamond and Hausman (1984) using microdata for the United States obtained similar results. They found a range between 25 and 40 cents. Hubbard (1986) obtained a 33 cent estimate.

Smith (1990) cites additional evidence from research into Japanese saving. Shibuya (1988) analysed the period 1955-1985 and concluded that “public pension benefits are a perfect substitute for personal saving” (p.16). Yamada and Yamada (1988) looked at the post World War Two period and found a smaller effect, although still significant. They concluded that over the 1970-1980 period, pension wealth depressed personal saving by between 53 and 68 percent. A later study by Yamada, Yamada and Liu (1990) estimated that “a 1 percent increase in social security retirement benefits depressed personal saving during 1973 and 1982 from 2 percent to 3.7 percent” (p.13).

The above discussion points to social security significantly reducing private saving i.e. the wealth effect outweighs the retirement effect. Estimates range from 25 percent to 100 percent. However, for every study which supports this hypothesis, there is another which refutes the claim that social security depresses the saving rate.

Leimer and Lesnoy (1982) exposed an error in the computation of social security wealth in Feldstein's 1974 paper. Correction for this error led them to conclude that the time series evidence "does not support the hypothesis that social security has substantially reduced personal saving . . . the postwar evidence suggests that social security may have increased saving" (p.617). Feldstein (1982), in a reply, argued that correction for the error did not substantially affect his original results, although the estimated coefficient was smaller.¹⁹

Barro and MacDonald (1979) examined the behaviour of sixteen industrialised countries between 1951 and 1960. They found that cross-country evidence did not provide empirical support for the hypothesis that social security reduces private saving, but "does not permit an empirical refutation of that hypothesis" (p. 287).

Further cross-country studies cited by Smith (1990) found evidence in favour of the proposition that social security depresses private saving. Kopits and Gotur (1980) found the retirement effect to outweigh the wealth effect. They concluded that social security systems "were more likely to increase private saving in industrial countries than to reduce it" (Smith 1990:25). Modigliani and Sterling (1983) concluded that the net effect of social security was close to zero. Koskela and Viren (1983) analysed 16 industrial countries and found that social security had no effect on the household saving rate.

Barro (1978) using the Feldstein social security wealth variable, estimated conflicting results to Feldstein. In his study, social security was statistically insignificant. Horioka

¹⁹ Feldstein's 1982 paper began with "I am embarrassed . . ." (p.630). The source of the difference between the Leimer and Lesnoy estimates and Feldstein's corrected estimates is because of social security legislation changes in 1972. Feldstein allowed for these changes which he claims influenced the public's perception of social security wealth.

(1986) (cited in Smith, 1990) using Japanese time-series data found the wealth effect was exactly offset by the retirement effect resulting in a net impact on private saving of around zero. Browning (1982), analysed the effect of public pensions on United Kingdom. He found public pensions to increase consumption (wealth effect), but that the effect was very small and only marginally significant. Markowski and Palmer (1979), cited in Smith (1990), studied the Swedish pension plan. They found that the public pension program “contributed to an increase in the level of national saving” (p. 214). Boyle and Murray (1979) found no effect of Canadian pension plans on household saving behaviour. Other studies cited in Smith (1990) supported Boyle and Murray’s conclusions. A German analysis by Pfaff, Hurler, and Dennerlein (1979) also concluded that social security had not reduced personal saving. Oudet (1979) examined social security in France. He found that social security programs had not reduced the private saving rate. More recently, Duisenberg and Wellink (1995) conducted a study using data for eight industrialised countries. Their results suggested that the retirement effect outweighs the wealth effect.

The reasoning for the lack of evidence of social security reducing personal saving is that “a pay-as-you-go system may decrease the consumption of the working young by more than it increases the consumption of the elderly, particularly since the elderly have a tendency to leave estates. The result would be a social security system that increases rather than reduces saving” (Smith 1990:26). A further justification cited by Smith is that the saving situation did not change dramatically with the introduction of a pay-as-you-go system. This is because a similar private system existed previously i.e. families provided for their aged relatives.

Therefore, the hope of discovering a clear policy direction regarding the impact of social security on saving has proved to be unsuccessful.

1.3.1.4 Private pensions: empirical evidence

The effect of funded pensions on total saving at an empirical level has been less ambiguous. Munnell (1976) using cross section data from men aged between 45 and 59 from the United States found that private pensions add to total saving about one third of the amount contributed to the private plans. This amounted to around \$8

billion in 1973. Hubbard (1986) used microdata also for the U.S.. He concluded that “an increase in private pension wealth of one dollar reduces nonpension net worth by sixteen cents” (p.174). Smith (1990) cites other studies which provide similar conclusions. Gultekin and Logue (1979) estimated nonpension wealth reductions between the range of 10 and 19 cents. A further study by Munnell (1988) cited in Smith (1990) concluded using U.S. data that if a dollar in a private plan added 30 to 40 cents to total private (household plus corporate) saving, the addition to private saving in 1985 was around \$57 billion. Barros (1979), also cited in Smith (1990), credits the recognition effect as being an important stimulus for higher levels of saving in Britain.

1.3.1.5 South African evidence

There have been no studies conducted in South Africa on the effect pension funds have on saving. This is surprising given the significance of contractual saving in South Africa. The Mouton Report (1992) looked at the results of studies conducted in other countries, and concluded that recommended extensions to the social security system “are unlikely to have undesirable side effects on personal saving” (p.386). However, the discussion in section 1.2 offers the possibility that pension funds have not boosted the personal saving, and may have dampened the saving rate. The analysis in chapter three is therefore the first attempt at quantifying the impact of pension funds on saving using South African data.

1.3.2 *The interest elasticity of saving*

Important questions for policy purposes are firstly: if a tax is imposed on interest income (which reduces the real return to saving), will saving rise or fall?, by how much will personal saving change i.e. what is the interest elasticity of saving? Secondly, how does a tax imposed on the income of contractual saving schemes affect personal saving?²⁰ It seems reasonable that a reduction in the return of contractual schemes would encourage (some) investors to redirect saving flows back to discretionary schemes,²¹ or encourage dissaving. But to what extent? In other words, what is the intra-elasticity of personal saving? At a theoretical and empirical level, the answers to

²⁰ e.g. the 17 percent tax recently introduced on interest income of retirement funds.

²¹ This does not imply that investors would terminate contracts with pension schemes. What it does suggest is that flows to *new* schemes might fall.

these questions are ambiguous and depend on such factors as the stage of the country's economic development, and exogenous taste and technology.

The effect of changes in the rate of return on saving is usually analysed in a two-period intertemporal framework.²² An increase in the rate of return involves income and substitution effects which operate in opposing directions. A higher rate of return reduces the present cost of purchasing a rand of future consumption, making it attractive to save more now. This is the substitution effect. Simultaneously, in order to achieve a given level of consumption in the future, the consumer does not require as much saving. The individual can save less now and consume more in the present and the future. This is the income effect. The net effect of changes in the interest rate on saving depend on the relative strengths of these forces.

Because the sign of the interest elasticity of saving is theoretically ambiguous, economists have turned to empirical evidence to settle the debate. There has been a significant amount of literature on saving and consumption behaviour.²³ Many of these studies have reported positive interest elasticities. These studies indicate that saving may change dramatically with a change in interest rates, and that large welfare losses may be created by taxes that discourage capital accumulation by sharply reducing the after tax rate of return. Tullio & Contesso (1986:4), cited in Smith (1990), found "unambiguously that after-tax interest rates, either real or nominal depending on the country, have a very significant negative effect on private consumption".

Other studies, however, have concluded that no relationship exists (i.e. an elasticity of zero). Howrey & Hymans (1978) analysed the effect of interest rate changes on personal cash saving, excluding owner-occupied buildings and consumer durables from saving. They found no significant relationship. Their conclusion was that personal saving cannot be influenced by policies aimed at manipulating the after-tax rate of return (Smith, 1990). Smith cites other examples. Hendershott & Peek (1985) concluded that the real after tax return does not have a direct influence on saving.

²² See for instance Sandmo (1985).

²³ Smith (1990) provides a useful survey.

Montgomery (1986) found a small elasticity, while Baum (1988) concluded that real interest rates have a statistically insignificant impact on consumption-saving decisions.

Various studies have found a *positive* relationship between consumption and the real after-tax rate of interest, implying the income effect outweighing the substitution effect. Friend and Hasbrouck (1983) concluded that the real rate of return was positively related to consumption. Evans (1983) included intergenerational transfers, and found a similar result.

More recently, Ogaki *et al* (1996) found that lack of conclusive evidence maybe due to the fact that many countries are not able to respond to changes in interest rates because their income levels do not permit it. To be able to save, households must first be able to achieve a subsistence consumption level. In developing countries where people live at the subsistence level, and so have little discretionary income, raising real interest rates will not increase private saving. According to Ogaki *et al*, these subsistence considerations suggest two predictions regarding saving behaviour:

1. Saving rates should increase with the level of real income. Consumers in developing countries will be liquidity constrained. Thus, changes in consumption are influenced by changes in income, rather than changes in the interest rate;
2. As countries become more developed, the interest elasticity of saving should increase. Thus, incentives to save will only affect the proportion of discretionary income available to the consumer once subsistence considerations are met.

The proxy used by Ogaki *et al* for subsistence was the total expenditure on food as a proportion of total spending. As a country becomes more developed, the proportion of income spent on food decreases. The subsistence indicator, including South Africa is shown in the following table:

Table 1.2: Food as a share of consumption expenditure in low, middle, and upper-income countries (1990).

Country groupings	Percent
Low-income	55.6
Lower-middle-income	32.1
Upper-middle-income	30.5
High-income	13.0
South Africa	28.6

Source: Ogaki *et al* (1996).

South Africa, therefore, falls into the upper-middle-income group. The results of Ogaki *et al*'s analysis of interest rate sensitivity are shown in the following table.

Table 1.3: The interest elasticity of saving in low, middle, and high income countries

Country groupings	Initial real interest rate		
	3 percent	4 percent	5 percent
Low-income			
Average for group	0.312	0.306	0.300
Average for 10 poorest	0.177	0.174	0.171
Lower-middle-income	0.532	0.522	0.512
Upper-middle-income	0.560	0.549	0.539
High-income	0.584	0.573	0.562
South Africa	0.576	0.565	0.554

Source: Ogaki, Ostry, & Reinhart (1996). Note that the sample period was

The size of the interest elasticity therefore is related to the stage of economic development - "the relationship between a country's income level and the interest elasticity of saving varies as one moves up the income scale" (Ostry & Reinhart, 1995:18). In the case of South Africa, their findings suggest that a one percentage point increase in the real interest rate will increase the saving by almost three-fifths of a percentage point.

To determine whether this conclusion is consistent with other empirical results in the literature, other studies are summarised in Tables 1.4 and 1.5 according to income level.

Table 1.4: Interest elasticity of saving: developing countries

Authors	$\delta s/\delta r$	Country	Period
Fry (1978)	0.2	7 LDC's	1962-72
Giovannini (1983)	0.0	7 LDC's	1964-80
Campbell & Mankiw (1991)	0.0	5 MDC's	1957-88
Barro (1992)	0.6	10 MDC's	1957-90
AVERAGE	0.2		

Source: Gylfason (1993).

NB: $\delta s/\delta r$ denotes the effect on the saving rate of an increase in the interest rate r by one percentage point. The values of $\delta s/\delta r$ were computed from estimates of elasticities by assuming $s=0.1$ and $r=0.04$ when representative values of s and r were not presented or derived from a study.

The results from the table above indicate elasticities lower on average than Ogaki *et al*'s sample. It is notable, however, that the interest elasticity for the middle developed countries was greater than the less developed countries.

Table 1.5: Interest elasticity of saving: developed countries (United States)

Authors	$\delta s/\delta r$	Country	Period
Wright (1967, 1969)	0.5	USA	1897-1959
Taylor (1971)	2.0	USA	1953-69
Heien (1972)	4.4	USA	1948-69
Juster & Wachtel (1972)	0.7	USA	1954-72
Blinder (1975)	0.0	USA	1949-72
Boskin (1978)	0.7	USA	1929-69
Howrey & Hymans (1978)	0.0	USA	1951-74
Blinder (1981)	0.0	USA	1953-77
Gylfason (1981)	0.7	USA	1952-78
Mankiw (1981)	0.0	USA	1948-80
Carlino (1982)	0.0	USA	1957-78
Friend & Hasbrouck (1983)	0.0	USA	1932-80
Blinder & Deaton (1985)	0.0	USA	1954-84
Mankiw <i>et al</i> (1985)	0.5	USA	1950-81
Montomery (1986)	0.0	USA	1953-82
Baum (1988)	0.0	USA	1952-82
Campbell & Mankiw (1989)	0.0	USA	1953-85
AVERAGE	0.56		

Source: Gylfason (1993).

NB: $\delta s/\delta r$ denotes the effect on the saving rate of an increase in the interest rate r by one percentage point. The values of $\delta s/\delta r$ were computed from estimates of elasticities by assuming $s=0.1$ and $r=0.04$ when representative values of s and r were not presented or derived from a study.

The results from Table 1.5 accord with the findings of Ogaki *et al* (1996) on average, but 10 of the studies in the United States could not identify a positive relationship. The differences are probably due to different methodological approaches. Most studies have used a Life Cycle approach, whereas Ogaki *et al* adopt a two-good framework that distinguishes between traded and non-traded goods. They estimate the intratemporal elasticity between traded and non-traded goods, and the intertemporal elasticity of substitution. The responsiveness of the saving rate to changes in the real

rate of interest was calculated by estimating $\frac{\partial S}{\partial r} = \sigma \frac{1 + \delta}{(1 + r)^2}$ where σ is the

intertemporal elasticity of substitution, δ is the rate of time preference (assumed to be constant), and r is the real rate of interest.

Although Ogaki *et al* (1996) provide evidence that the level of development determines the responsiveness of saving to changes in interest rates, the relationship may in fact be due to individuals in less developed countries not having access to banking facilities. Thus, even if individuals in these countries would like to save with a bank, they are unable to because the institutional facilities do not exist.

Although the empirical evidence provides no clear answers, economists have taken positions on the issue. Smith (1990) quotes Shoven (1984) as concluding that the interest elasticity of saving is "one of the most important behavioural parameters affecting the economy." On the other hand, Gylfason (1993:518) quotes Alan Blinder as saying". . . there is *zero* evidence that tax incentives that enhance the rate of return on saving actually boost the national saving rate. *None*. No evidence. Economists now accept that as a consensus view."

Gylfason (1993) argues that the inconclusive empirical results are not surprising given that saving and interest rates are jointly determined endogenous variables. These rates can move in the same or opposite direction depending on the movements of the exogenous variables that affect both of them. He concluded that the failure to show a clear cut positive link between saving and interest rates does not refute the hypothesis that such a relationship exists. This is because the "structural relationship may be shifting about in a way that is consistent with *any* type of reduced form correlation between interest rates and saving" (p.521).

1.3.2.1 South African evidence

The result of Ogaki *et al* of a significant positive interest elasticity is surprising because there are various reasons why it should be low. One reason relates to the conventional measure to estimate the interest elasticity of saving. As explained in section 1.2.1.1, the high proportion of contractual saving limits the amount of discretionary income

available. Therefore, individuals may not be able to respond to changes in the interest rate, *even if they wanted to* because their funds are 'tied-up' in a contractual scheme. In other words, a second liquidity constraint exists.

As reflected in Figure 1.2 the return on bank deposits has been historically inferior to retirement funds. Thus, the inherent positive interest elasticity of saving, if it exists, will be low because the return on discretionary saving has been lower *relative* to contractual saving. In other words, individuals have not been responsive to changes in the interest rate in the past because they could obtain superior tax-free returns in a contractual scheme.

The rest of this section examines the empirical results of interest elasticity estimation in South Africa.

Wilkins (1993) conducted a study into financial repression in South Africa. He tested a saving function based on Fry (1978). The model was of the following form:

$$\frac{S_d}{Y} = f \left\{ g, y, d - \pi^e, \frac{S_f}{y}, \left(\frac{S_d}{Y} \right)_{-1} \right\}$$

where

$\frac{S_d}{Y}$ = real saving/GDP ratio,

g = real growth rate in GDP,

y = real GDP per capita,

$d - \pi^e$ = real rate of return on money,

$\frac{S_f}{y}$ = foreign saving ratio (real trade balance/real GDP).

The variable which is of interest to this study is the measure of the real rate of return on money, or the *ex ante* real interest rate. In estimating expected inflation (π^e) Wilkins assumed the South African financial market can accurately predict the inflation rate at the beginning of the period. This suggests that the actual rate of inflation is

taken to be the inflation rate expected, *ex ante*, to occur during that period. The observed rate can be used if inflation is stable. Although inflation in South Africa did not appear to show any significant trend over Wilkins' estimation period, the high volatility of inflation would result in individuals' expectations of inflation rates differing markedly from prevailing rates.

Estimation of the interest elasticity of saving was carried out using OLS separately on seasonally adjusted and seasonally unadjusted data.

His results were poor. The coefficient on the real return on money was significant but *negative*. The adjusted R^2 for each equation were also low. His conclusion was that misspecification distorted the results.

The lack of statistical significance is not surprising given the approach adopted by Wilkins. His study makes no mention of testing variables for stationarity i.e. the constancy over time in the process generating the data.²⁴ Stationarity implies that the mean, variance, and temporal autocorrelations of a time series do not alter over time. The danger of running regressions with non-stationary data is that the results can be meaningless or *spurious*. A non-stationary series must be differenced before it can be used in an OLS regression. To ascertain whether the variables used in Wilkins' study are stationary, unit root tests were performed on the same data.²⁵ The real saving/GDP ratio and real GDP per capita were both found to be non-stationary (I(1)) at the 1 percent level.

Because Wilkins made no attempt at correcting for nonstationarity, his findings of a negative relationship between saving and real returns on money should be treated sceptically.

²⁴ This issue, as well as other econometric criticisms are dealt with in chapter three.

²⁵ The method of unit root testing is provided in Appendix B.

A recent study by Pretorius and Knox (1995) analysed the consumption equations used in the Reserve Bank's macro-econometric model. As a starting point, they plotted the real interest rate with changes in real private consumption expenditure on durable goods. Their initial conclusion was that "a fairly strong lagged inverse relationship exists between changes in the real interest rate and changes in real private consumption expenditure on durable goods. This seems to indicate that the substitution effect of changes in the cost of credit dominates the income effect of changes in the interest rate" (pps.35,36). The results of the authors' econometric results confirmed these initial findings. The real interest rate was negatively related to consumption with an elasticity of around 0.02. Based on simulation exercises their conclusion was that "private consumption expenditure can be expected to decline by R500 million (at current prices), or by 0.2 percent with an increase of one percentage point in interest rates" (p.40).²⁶

Two criticisms of this study regarding the choice of the interest rate variable are worth mentioning. Firstly, they use a prime lending rate which is essentially testing whether consumption is related to costs of borrowing rather than to returns on saving. Whether this is their intention is unclear as earlier in their paper (p. 35) they discuss how changes in the interest rate can affect saving in terms of income and substitution effects. Secondly, the interest rate was not adjusted for taxes. The after-tax interest rate is significantly different from the pre-tax return. The implicit assumption that the authors are making is that consumers do not consider the effects of taxes on their return to saving, which may not be a reasonable assumption.²⁷ On the other hand, other studies have not considered tax effects (e.g. Blinder, 1975). But as Sandmo (1985) notes, "while earlier studies used nominal before-tax rates of interest, the increases in both the rate of inflation and marginal tax rates have made it important to use some measure of real after-tax rate of return" (p.282). Other criticisms of their analysis are dealt with in chapter three.

²⁶ This conclusion does not include the impact interest rate changes would have on real income due to changing home mortgage commitments.

²⁷ Using nominal interest rates assumes money illusion exists.

1.4. Summary

This chapter has attempted to identify issues relating to personal saving in South Africa. Key points raised were;

1. The personal saving rate has declined, particularly since the early 1980s. This is primarily due to low real income growth. The analysis also suggests contractual saving may also have played a minor role
2. The composition of personal saving has shifted considerably towards contractual saving. It is possible that this shift may have contributed to the decline in personal saving if contractual saving induces a wealth effect on consumption, and/or individuals borrowed to meet contribution obligations.
3. The literature finds no consensus on the effect of pension funds (public and private) on total personal saving, although it appears that funded pensions generally contribute to total saving. Few studies have dealt with the issue of pension funds reducing the need for precautionary saving. No studies have been conducted on the relationship between pension funds and personal saving in South Africa.
4. The empirical literature is also not agreed as to the responsiveness of saving to interest rate changes. However, support is given to the notion that the interest elasticity of saving is dependent on the level of economic development. Previous investigations into the interest rate-saving relationship in South Africa have been econometrically inadequate. They have also not identified how changes in relative returns on different forms of saving affect the interest elasticity.

The objective of the rest of this study is to deal with these issues by jointly modelling the impact of pension funds, and the interest elasticity of saving. Chapter two outlines the theoretical model and discusses the explanatory variable used. Chapter three econometrically estimates the model and extends previous studies by testing the interest elasticity of saving and the relative return elasticity of saving.

Chapter two

Framework for Modelling Personal Saving

This chapter outlines the theoretical model for analysing personal saving behaviour. The framework used is the Life-Cycle-Permanent-Income hypothesis. Definitions and the rationale for the explanatory variables used in the empirical estimation is also provided.

Early models of saving were heavily influenced by Keynesian insights. Saving behaviour was governed by the so called psychological law - an increase in income should lead to a positive but smaller change in consumption. Income was viewed as the main determinant of individual and national saving. The Keynesian interpretation of consumption was formalised by expressing consumption as a linear function of income with a substantial positive intercept. This implies that the average propensity to consume falls as income rises.

The simple Keynesian description of saving behaviour was refuted by evidence from Kuznets (1946). His study showed that the saving ratio (or average propensity to consume) had not altered significantly over the nineteenth century despite large increases in per capita income (Modigliani, 1986). The Life Cycle hypothesis (LCH) and the Permanent Income hypothesis (PIH) are able to offer a possible theoretical justification for this phenomena. Their similar conclusions and policy implications have resulted in the literature applying elements of both models. Because the models are well known, and detailed accounts of both theories are available,²⁸ a brief overview of each is sufficient.

²⁸ See for instance Modigliani (1986).

2.1. The Permanent Income hypothesis (PIH)

This theory was introduced by Friedman (1957). He argued that people gear their consumption towards permanent consumption opportunities, not to their current level of income. Consumption is assumed to be proportional to an individual's permanent income i.e. $C=cY_P$ where Y_P is permanent disposable income.

This assumption means that temporary fluctuations in income will be saved, while permanent changes in income will impact on consumption.

Modelling consumption this way results in a stable long-run consumption profile, and long-term constancy of the average propensity to consume.

2.2. The Life Cycle hypothesis

The LCH model was developed by Ando and Modigliani (1963). The premise of their model is that consumers maximise utility by smoothing consumption over their lifetime in accordance with their lifetime income. Wealth, defined as current asset holdings, is incorporated to provide additional resources for lifetime consumption. Fluctuations in income will have little impact on current consumption because consumption decisions depend on lifetime income. Saving is thus influenced by the extent to which current income differs from lifetime income.

Household consumption depends on labour income, wealth, and the expected return on saving. The age structure is also an important determinant of saving. The larger the proportion of the working-age population, the larger the aggregate lifetime income, and thus, the higher total saving. Moreover, the marginal propensities to consume (labour) income and wealth depend on the position of the consumer in the life cycle. The closer the consumer is to the end of the life cycle, the higher will be the marginal propensity to consume wealth. The consequence of this is that saving over the consumer's lifetime is hump-shaped. In early and later stages of life, the consumer dissaves or saves very little, while during peak working years, saving is at its maximum.

2.3. Policy implications

An important conclusion of both models is that the significance of current income in explaining current consumption is reduced. Any change in current income which does not feed into a change in expected future or permanent income will cause a relatively small change in current consumption. Modigliani (1986) summarises the policy implications of this finding in terms of short and long propositions;

2.3.1 *Short-run stabilisation policy*

The monetary mechanism

Because wealth enters the short-run consumption function, monetary policy can influence aggregate demand through its affect on the market value of assets and consumption, as well as the traditional channel of investment.

Transitory income taxes

Attempted aggregate demand management through transitory income tax changes will have only small effects on consumption because consumption depends on lifetime income which is little affected by transitory tax changes.

2.3.2 *Long-run policy implications*

Consumption taxes:

“A progressive tax on permanent income is more equitable than one on current income because it more nearly taxes permanent income” (p.310).

Short and long-run effects of deficit financing:

Expenditure financed by deficits are paid by future generations, while those financed by taxes are paid by the present generation. Because private saving is controlled by life-cycle considerations, private wealth should be independent of the national debt. This conclusion differs from the Ricardian Equivalence theorem which asserts that when the government runs a deficit, the private sector will save more to allow their offspring to repay the debt in the future.

2.4. Adequacy of the LCH-PIH approach

One could argue that there are too many restrictive assumptions in the LCH and PIH models. Ideally it would be desirable to capture the differing characteristics of individuals when aggregating. This would need to allow for systematic differences (e.g. age) between individuals, and also allow for imperfections in the capital market, and the changing composition and distribution of assets over time. The differences in characteristics are particularly evident in South Africa due to the large income and wealth disparity between social groups. As noted by Pretorius and Knox (1995), in reality, consumers may not base consumption decisions on permanent income, but on current income. In addition, it is more realistic that imperfections in credit markets, and uncertainty regarding future income would prevent households from borrowing the amounts required to satisfy their constrained optimisation plan. This would be more prevalent in developing countries as some households (particularly young) do not have the credit history or wealth to meet borrowing requirements or qualify for consumer credit. According to Modigliani (1986), dropping the assumption of no liquidity constraints results in consumers postponing present consumption while the wealth-income ratio, and saving increase.

In terms of using the LCH-PIH approach to capture the effect of social security wealth on saving, the conclusions of Leimer and Lesnoy (1982:617) were that “the life-cycle model provides an inadequate explanation of individual saving behaviour, a view that is receiving increased attention”.

Despite these criticisms, the literature acknowledges no other framework which comes as close to the ideal as the LCH model (Atkinson & Stiglitz, 1980). As Smith (1990:12) concludes, “for those seeking to understand saving behaviour, neither the life-cycle model nor any other model fits all of the evidence”. Because there is no suitable alternative to the LCH-PIH approach, the analysis in chapter three uses this framework, despite its weaknesses.

2.5. Empirical modelling

The discussion above has shown the close similarity between the LCH and the PIH. Either model can be specified to capture pension fund behaviour. Feldstein (1974) refers to this as the “extended life-cycle model”. As discussed in chapter one, pension saving affects an individual’s saving through two offsetting forces. The first is the wealth effect whereby saving is reduced because the expectation of future pension benefits reduces the need to accumulate assets for retirement. The second is because of social security inducing earlier retirement. To retire earlier requires a higher saving rate during the individual’s working life.

The net effect on saving depends on the strength of these two forces. Which effect is stronger must be determined empirically.

The model employed in this study to investigate the relative strengths of the wealth and retirement effects is based on Feldstein (1974). From chapter one, the specification of the consumption function is of the form:

$$C_t = \alpha + \beta_1 Y_t + \beta_2 RE_t + \gamma_1 W_t + \gamma_2 PW_t + \gamma_3 R_t \quad (2-1)$$

where:

C_t is consumer expenditure;

Y_t is permanent income;

W_t is the stock of household wealth at the end of year t (excluding social security wealth);

RE_t is corporate retained earnings;

PW_t is retirement fund wealth;

R_t is the real interest rate.

Additional variables were incorporated into the model. The next section explains the rationale for including additional explanatory variables, and discusses measurement issues regarding the data.

2.6. Explanatory variables: theoretical and measurement issues

2.6.1 Theoretical issues

2.6.1.1 Wealth (W)

Wealth is a crucial determinant of saving under the Life Cycle hypothesis. The LCH predicts that with given expected income, an increase in current real wealth decreases the share of current disposable income saved because it provides a greater lifetime consumption level. Thus, wealth is hypothesised to be positively related to consumption. The coefficient on wealth in the consumption function can be interpreted as the marginal propensity to consume wealth.

2.6.1.2 Retained earnings (RE)

Retained earnings is included to ascertain the relationship between personal and corporate saving. The literature on the structural relationship between corporate and personal saving has focused on answering the question of whether households 'pierce the corporate veil'. Since retained earnings produce future income flows, a household that completely pierces the veil takes business saving into consideration in its lifetime consumption decision. This can cause corporate and household saving to be inversely related.

The inverse relationship between corporate and household saving was first observed by Denison (1958), and later supported by David and Scadding (1974). Feldstein (1973) and Feldstein and Fane (1973) agree that corporate saving is a substitute for household saving, but it is an imperfect substitute. They show that an increase in corporate saving is only partially offset by decreases in household saving. Feldstein estimated the marginal propensity to consume retained earnings in the United States to be 0.5. The marginal propensity to consume disposable income was 0.75. Therefore, if the corporate sector saves 1 dollar, (which means the household forgoes 1 dollar in disposable income) then total saving should increase by 25 cents. In other words, if the marginal propensity to consume disposable income is greater than the marginal

propensity to consume retained earnings, then an increase in corporate saving will increase total saving, and *vice versa*.

Feldstein (1974:913) argues that rising marginal tax rates (in the U.S.) have induced companies to increase the proportion of total earnings that are saved. He suggests that this “tax-induced substitution of retained earnings for dividends . . . has reduced household consumption”. Therefore, because corporate saving is an imperfect substitute for personal saving, policymakers can encourage additional saving by shifting taxes from corporations to individuals.

2.6.1.3 Unemployment (U)

The rate of unemployment is included in the short-run estimation to allow for the cyclical variation between consumption and income. In other words it is to account for differences between current and permanent income.²⁷ Barro and MacDonald note that *U* is a positive predictor of future income so the coefficient should be positive.

2.6.1.4 Inflation (INFL)

Inflation can lead to a lower effective rate of return on saving because the interest income necessary to keep real wealth constant²⁸ is included as taxable income. Therefore, if the interest elasticity is positive, the saving rate falls if the inflation rate increases.

Unanticipated inflation can decrease saving if money illusion exists. In this case, if individuals mistakenly perceive nominal income growth as real income growth, they may experience a temporary wealth effect and increase consumption.

There are also channels which inflation may raise personal saving. The first is when consumers mistake nominal for relative price increases i.e. there is a price confusion effect whereby individuals cannot distinguish unanticipated inflation from relative price increases. In response to this, they delay purchases. Unanticipated inflation therefore leads to involuntary saving (Deaton, 1977). Secondly, inflation dampens consumer

²⁷ See Ando and Modigliani (1963) for the rationale for using the unemployment rate.

²⁸ Additional interest income arises due to an inflation premium on the nominal interest rate.

confidence by raising uncertainty regarding future income. The third is because inflation reduces consumption of households with relatively high debt because of liquidity constraints. This is because the inflation premium in nominal rates forces these households to accelerate the repayment of their real debt. Bovenberg and Evans (1990) claim empirical studies which have assumed a fixed real after-tax rate of return have found that inflation significantly raises saving.

It comes as no surprise that the theoretical ambiguity regarding the effect of inflation on the saving rate has led to mixed empirical results. As Kauffman (1995:49) notes, whereas a negative sign is generally regarded as reasonable, a positive coefficient must be attributed to greater macroeconomic uncertainty causing increased saving.

2.6.1.5 The budget deficit (DEF)

The rationale for using the government budget deficit in the consumption function is to test the Ricardian Equivalence theorem. For the theorem to hold, a tax cut leading to an increase in the budget deficit will induce individuals to increase their saving in order to meet future tax increases. Strict acceptance of Ricardian Equivalence implies a coefficient on *DEF* equal to unity.

2.6.2 Measurement issues

2.6.2.1 Consumption (C)

There is widespread debate over what consumption measure to use. Some researchers use purchases of nondurable goods and services as the proxy for consumption expenditure. Durable goods are excluded because the actual consumption of these goods does not occur at the time of purchase but is spread over the life of the good. Ideally one would like to measure the flow of services from durable goods and nondurable goods and services. Bovenberg and Evans (1990) do not adjust for durable purchases because “an overall consumer expenditure function may better represent the data and have superior predictive power compared with a disaggregated approach” (p.657).

Total consumption expenditure is also used in this study. It is divided by total population to express consumption on a per capita basis. The data are real (expressed in 1990 rands). The source for consumption data is the South African Reserve Bank (SARB) *Bulletin*. Population data are from the *South African Statistics* published by the CSS.

2.6.2.2 Disposable income (Y)

Income plays a critical role in the LCH in that saving cannot be maintained without income. The basic LCH-PIH theory suggests that consumption and therefore saving depends on current wealth and on current and expected future labour income. Blinder and Deaton (1985) omit income from capital from their income estimate because “the current market value of wealth is the best estimate of the discounted stream of income that will be derived from the assets currently owned” (p.482). Other studies such as Bovenberg and Evans (1990) use total disposable income. Feldstein (1974) notes that Modigliani (1971) abandoned the use of labour income because of the difficulties in defining and measuring disposable labour income.

Strictly, permanent income should be modelled. Usually a weighted average of past incomes is used to proxy permanent income. This is an oversimplification in light of the rational expectations hypothesis. The impact of any income change depends on whether the consumer perceives the change to be permanent or transitory.

Because it is not uncommon for current income to be used in empirical modelling, and because we do not know how consumers perceive their permanent income, the proxy used in this study for permanent income is simply per capita real disposable income from the *SARB Bulletin* expressed on a per capita basis.

2.6.2.3 Wealth

2.6.2.3.1 Non-pension wealth (W)

Unfortunately, official estimates of wealth are not produced in South Africa. In fact, little empirical work has focused on measuring wealth.²⁹ Because of this, the

²⁹ A study by McGrath (1982) did calculate estimates of household wealth (excluding Blacks) using an estate multiplier approach. This takes the value of deceased estates and extrapolates into an estimated distribution

derivation of household wealth used in this paper warrants a detailed explanation. This is given in sections 2.2.6.3.1.1 and 2.6.2.3.1.2.

2.6.2.3.1.1 Housing wealth (H_W)

To estimate housing wealth, volume and price indicators were required. The volume indicator was the number of dwellings from the 1991 census rated back by the movement in gross domestic fixed investment of residential buildings from the *SARB Bulletin*. This series was multiplied by average house prices to derive a current price series for gross housing wealth. The housing price series used was from Prinsloo (1994).³⁰ The total value of mortgage loans on dwellings and flats was subtracted from this series to arrive at net housing wealth. Current price housing wealth was deflated by the CPI to obtain real housing wealth.

2.6.2.3.1.2 Non-pension financial wealth

Non-pension financial wealth was more difficult to estimate. There is a lack of data on the stock of assets and liabilities in South Africa at a household level. There is, however, adequate information on flows of funds between various financial instruments. The total deposits of individuals at financial institutions is available from the *SARB Bulletin*. Unfortunately, this series only dates back to 1991. Therefore the 1991 stock was rated back using movements in net household flows to the banking sector (i.e. deposits less credit). Adequate data on the stock of non-mortgage liabilities are not available.³¹ Therefore, the final series for non-pension financial

of wealth among living persons using the reciprocal of mortality tables. Using this approach, McGrath derived an estimate for the wealth of households for 1975. His results are shown in the following table:

Age (yrs)	White		Coloured		Asian		Weighted average
	Men	Women	Men	Women	Men	Women	
20-29	8,828	2,873	707	0	1,111	113	6,958
30-39	17,116	7,028	615	495	2,055	334	15,575
40-49	14,030	6,795	1,246	731	3,511	4,662	15,005
50-64	24,837	12,914	2,453	890	8,457	6,133	28,981
65+	36,959	19,678	883	330	7,264	1,995	42,034

The table is consistent with the life-cycle theory in that wealth increases as people near retirement. However, the table does show a sizeable discrepancy in wealth by race. This is not in keeping with the LCH which assumes each household has identical consumption and saving behaviour. The problem with using estate duty revenue is that the tax is payable only on estates greater than R1,000,000. Because of this it is likely that there is significant tax avoidance by gifting or establishing trusts, thereby reducing the amount payable on death. Ideally one would like to obtain the total value of estates by age group and then extrapolate across the population. Unfortunately estate data is not readily obtainable.

³⁰ I am grateful to Vivien Ferguson from ABSA Bank for providing the latest prices.

³¹ A series of outstanding domestic credit is available. However, this also includes businesses so would overstate the true credit owed by households.

wealth can be regarded as gross wealth adjusted for net flows to non-retirement based financial institutions. The series is deflated by the CPI.

Total per capita non-pension wealth (W) is the sum of housing wealth and non-pension financial wealth divided by total population.

2.6.2.3.2 Pension wealth (SSW)

Feldstein (1974) estimated gross and net public pension wealth (or referred to as social security wealth by Feldstein) by defining gross social security wealth as the present value of future pension benefits. He calculated this using the following formula:

$$A_{a,t} = kY_t S_{a,65} \left[\frac{(1+g)}{(1+d)} \right]^{(65-a)} \times \sum_{n \geq 65} S_{65,n} \left[\frac{(1+g)}{(1+d)} \right]^{n-65}$$

where A is the present value of future pension benefits, k is the ratio of annual benefits to per capita disposable income, Y is current disposable income, a is the present age of the recipient, 65 is the retirement age, g is the rate of disposable income growth, d is the rate at which the individual discounts expected future benefits, and S_{ij} is the probability that an individual aged i will live to at least age j . The value for gross social security wealth is the weighted sum of the $A_{a,t}$ values for each type of worker³² and for each age group, weighted by the number of workers of that type and age covered by social security in year t .

To calculate net social security wealth, Feldstein estimated the present value of future social security taxes using a similar method. He assumed an individual forecasts the ratio of social security taxes to per capita disposable income at a rate θ . An average worker who is age a in year t pays a tax of $T_t = \theta_t Y_t$, irrespective of his age. The worker also expects that at age m he will pay a tax of $T_{t+m-a} = \theta_{t+m-a} Y_t (1+g)^{m-a}$. Based on these assumptions, the present value of all future taxes until 65 is then:

³² Feldstein divided workers into single men, single women, working wives, and married couples.

$$TAX_{a,t} = \sum_{m=a}^{64} S_{a,m} \theta_{t+m-a} Y_t \left[\frac{(1+g)}{(1+d)} \right]^{m-a}$$

The total present value of expected future taxes is a weighted sum of the $TAX_{a,t}$ values for different worker types and age groups, weighted by the number of covered workers in each group in year t . The net social security wealth in each year is the difference between gross social security wealth and the aggregate tax value.

Comprehensive demographic data was not available from insurance companies³³ which meant the Feldstein actuarial calculation could not be performed. This is unfortunate because calculating pension wealth in this way would allow simulations to be performed which could look at changes in taxation, and income growth. The second-best estimate available is the value of pension fund assets. This is an actuarial calculation of pension wealth, so it is based on the value of discounted future benefits. However, this series has two drawbacks. Firstly, it only represents the value of funded pensions. This does not allow an adequate analysis of the effect of pay-as-you-go pension schemes on total saving. Secondly, it is an aggregate value which means that specific taxation effects can not be analysed accurately. Other studies, such as Duisenberg and Wellnik (1994), have used less satisfactory measures than the one chosen in this study. Their proxy was real public pension scheme payments, which were based on current values, not discounted future values. The measure used in Barro and MacDonald (1979) is also less desirable than the one used in this paper. Their paper tested the hypothesis that a greater *expected* retirement benefit would increase the consumption-income ratio. The data used to test this was based on the value of *current* social security benefits. Thus, they used current benefits as a proxy for expected future values which are unlikely to be the same.

In summary, the measure used in this analysis to capture the expected future value of pension benefits is not as ideal as the Feldstein proxy, but is a better approximation than the measure applied in other time series studies. Total real pension wealth is

³³ It is available, but the insurance companies contacted were unwilling to provide the data.

divided by total pension fund members to obtain real pension wealth per member. The source for this series is the Mouton Report (1992), updated by the Report of the Committee on Strategy and Policy Review of Retirement Provision in South Africa (1995) (The Smith Commission).

2.6.2.4 Retained earnings (RE)

Retained earnings was calculated as corporate saving (including provision for depreciation) from the national accounts. The source of the series is various issues of the *SARB Bulletin*.

2.6.2.5 Return on saving

Most studies use an interest rate variable to proxy the return on saving. The choice of the appropriate nominal interest rate is subject to a measurement problem. In reality different borrowing and lending rates are observed. In most empirical research, judgement is used as to the choice of the interest rate. Blinder (1975) chose a weighted average of rates of return on time deposits paid by financial institutions. Other studies use annual rates of return computed as income from assets divided by asset value.

There has also been debate over whether to use real interest rates or tax-adjusted real interest rates. High and increasing marginal tax rates in South Africa has made it important to consider the use of real tax-adjusted returns. This study uses both a pre and post-tax measure, to identify any difference in their impact on saving. The real pre-tax interest rate is denoted as R , while the tax-adjusted real interest rate is RT . The real interest rate was calculated as the nominal interest rate on a one year fixed deposit less the growth rate in the consumer price index. The tax rate on interest income was extracted from Prinsloo (1994).

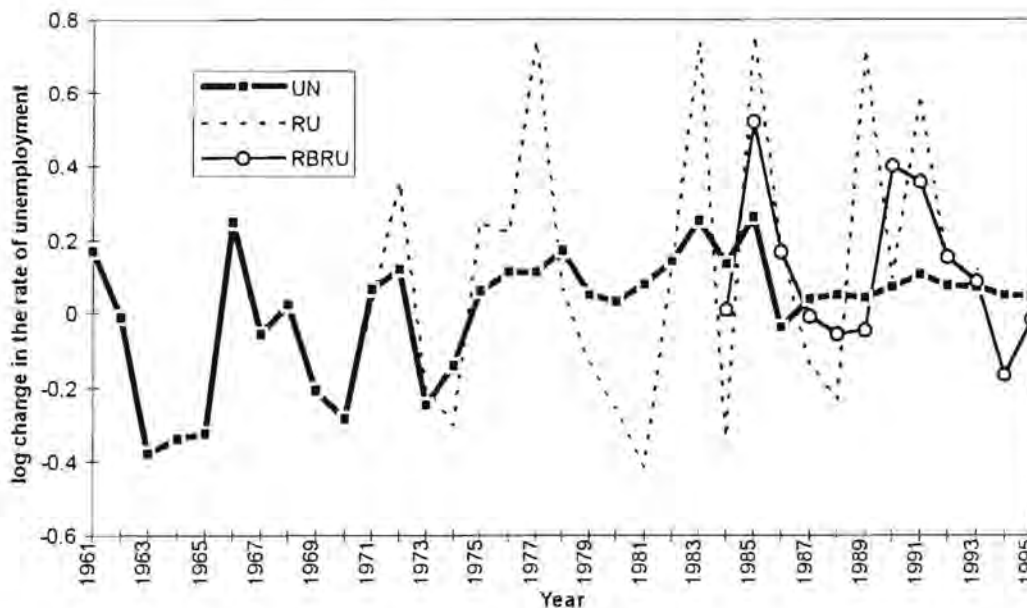
A relative return variable (RR) was also used to measure the intra-elasticity of personal saving. This variable was calculated as the real (post-tax) return from one year fixed deposits less the return from retirement funds. Thus, RR can be interpreted as the premium (positive or negative) from investing in a discretionary saving scheme. This variable is included to test the hypothesis that the relative interest elasticity of saving is

low because households are liquidity constrained, i.e. their contractual commitments limit their flexibility to change their personal saving portfolios.

2.6.2.6 Unemployment (U)

There is much debate in South Africa as to the correct measure of unemployment. Registered unemployment figures are considerably lower than other measures, such as subtracting the total economically active population from the total number employed.³⁴ However, econometric estimation is concerned with movements over time. Therefore, if movements in alternative unemployment series are comparable then it should not matter which measure is used. Figure 3.1 examines three measures of unemployment. These are: total economically active less total employment (UN),³⁵ registered unemployed from the Central Statistical Service (RU), and registered unemployed from the *SARB Bulletin* (RBRU).

Figure 3.1 Rates of change in unemployment measures in South Africa: 1961-1995



The Reserve Bank series is only available from 1984. UN and RU had the same movements until 1971. Since 1971, RU was more volatile than UN. Therefore it could be argued that empirical estimation will be sensitive to the choice of

³⁴ Subtracting total employment from the labour force includes individuals not technically classified as unemployed, such as those not actively seeking work.

³⁵ Total employment data was provided by A. Roulens and D Viljoen from the South African Development Bank.

unemployment measure. Because there is no consensus as to what the correct unemployment measure is in South Africa, the series used in this study is the total economically active population less the total number employed, as a percentage of the total economically active population.

2.6.2.7 Inflation (INFL)

The measure for inflation is the annual log (natural) growth rate in the consumer price index.

2.6.2.8 Budget deficit (DEF)

DEF was calculated as government consumption expenditure less direct taxes of households, as a proportion of GDP.

2.6.3 Summary

Official data series were used where possible. The drawback of the pension wealth series is that it does not permit simulations of key areas of interest, such as taxation and income changes. The wealth estimate does not capture all components of wealth, in particular the stock of liabilities. In addition, correlation between explanatory variables, such as income and wealth may influence the estimated parameters.

These data problems, combined with frequent revisions of official series, suggests that the empirical results in the next chapter be treated as a policy guide only. Estimated coefficients in the consumption function are likely to be estimated with a degree of measurement error.

Chapter three

Empirical Analysis of the Personal Saving Model

Empirical results of the personal saving model outlined in chapter two are presented in this chapter. The principal objectives of the estimation were to determine the extent that pension funds influence saving behaviour, and the responsiveness of personal saving to changes in interest rates. The results show that retirement funds in South Africa have had a small negative influence on total saving. Evidence is also provided supporting the hypothesis that policy measures designed to stimulate saving by increasing the interest rate will be impotent. The chapter begins by discussing the econometric methodology and presenting results of the analysis. A discussion then follows on the implications of the findings regarding personal saving

3.1. Empirical testing methodology

This section provides an overview of the econometric techniques used to estimate the model specified in chapter two (equation 2-1). The issue of stationarity is presented first, followed by a discussion on cointegration.

3.1.1 *Stationarity and unit roots*

When modelling time series data, econometric techniques rely on the assumption that the process generating the data is stationary.³⁶ In economics, many series do not meet the stationarity assumption. Series tend to change often dramatically as a result of behavioural or policy changes.

Modelling non-stationary series can lead to a spurious relationship.³⁷ The implication for regression diagnostics is significant. Hendry (1986) cited in McDermott (1990)

³⁶ This is where the underlying stochastic process that generates the series is assumed to be invariant with respect to time.

³⁷ For an example of a spurious regression see Hendry (1980).

provides a proof that the correlation between unrelated non-stationary series will be one or minus 1. Because of this, the R^2 of a regression of non-stationary variables will tend to one. Thus the R^2 becomes redundant as an explanation of goodness of fit. Granger and Newbold (1974) cited in McDermott (1990) also point out that the Durbin-Watson statistic tends to zero.

The Box-Jenkins approach to correcting for non-stationarity is to difference the data until stationarity is obtained. Once this is performed the problem of spurious regressions is overcome. The number of times a series must be differenced before it is stationary determines the order of integration. This is alternatively called the number of unit roots. For example, if a series must be differenced once, it has a unit root, or is $I(1)$. If a series is stationary in levels, it is $I(0)$.

Thus, a univariate time series X_t is integrated of order d (denoted $I(d)$), if it has a "stationary, invertible, non-deterministic ARMA representation after differencing d times" (McDermott, 1990:11). The procedure for testing for unit roots, and the results of the tests are provided in Appendix B.

3.1.2 Cointegration

The concept of cointegration is relatively new to South Africa, and therefore warrants further discussion. Cointegration is useful because it avoids the problem of spurious regression without having to difference the data, as is necessary when using the Box-Jenkins methodology. By differencing the data, important long-run relationships among the levels of the series are disregarded.

Cointegration was first introduced into the literature by Granger (1981), but was more widely applied after Engle and Granger (1987). Cointegration is the situation where two or more variables may be combined to form a stationary variable. The rationale for this is that non-stationary but cointegrated variables evolve together over time. As the series evolve the long run information in each series combines to eliminate the problems of non-stationarity. Two techniques are common in the literature, the Engle and Granger (EG), and the Johansen method.

3.1.2.1 The Engle and Granger two-step method (EG)

Estimating a cointegrating regression can be carried out using a two stage procedure.

3.1.2.1.1 Step 1: long-run model estimation

The first stage is to run ordinary least squares (OLS) on the model. This regression will form a linear combination between the variables. These linear combinations will produce a residual series with asymptotically infinite variance (random walk) unless that linear combination is a cointegrating vector. OLS always gives the minimal residual variance so if at least one cointegrating vector exists, OLS will find the cointegrating vector with the minimum variance. Because of this, cointegrated OLS estimates are said to be 'super consistent'.³⁸ The residuals of the series can then be tested for a unit root.

The procedure for testing for cointegration can best be illustrated using an example. Firstly, assume we have two I(1) series Y_t and X_t . Now assume:

$$Y_t = \alpha + \beta X_t + u_t \quad (3-1)$$

is a valid cointegrating regression. Applying OLS to this equation will produce $\hat{u}_t = Y_t - \hat{\alpha} - \hat{\beta} X_t$ where $\hat{\cdot}$ denotes an estimate. Y_t and X_t are cointegrated if \hat{u}_t is I(0). The test will be the same as the unit root test outlined in Appendix B. The regression:

$$\Delta \hat{u}_t = \lambda \hat{u}_{t-1} + e_t$$

is run. The null hypothesis ($\lambda=0$) is no cointegration (i.e. there is a unit root). Rejection of the null hypothesis occurs when the value of the 't' statistic is a larger negative value than the critical value obtained in the MacKinnon (1991) tables,³⁹ indicating the cointegration between X_t and Y_t .⁴⁰

³⁸ So called because OLS estimates converge in probability to true parameters at a faster rate than in the usual stationary case. Also, the consistency results imply that measurement error, simultaneity bias, and exogeneity problems are asymptotically negligible (McDermott, 1990:13). For a discussion on the merits of using OLS over other system estimators see Epstein (1987).

³⁹ The Dickey Fuller and the Augmented Dickey Fuller tests are sometimes used. However, Harris (1995:54) notes that the standard Dickey Fuller tables cannot be used for two reasons. The first is that the OLS

Despite the estimates from (3-1) being super-consistent, estimation problems may exist. Harris (1995) points out that the single equation approach of the EG method has other drawbacks. When there are more than two variables in the model, there can be more than one cointegration relationship i.e. cointegrating vectors can change depending on the choice of the normalisation variable. Even if there is only one cointegrating relationship, estimating a single equation is potentially inefficient. This is because unless all the right-hand-side variables are weakly exogenous, information is lost by not estimating a system which allows each endogenous variable to appear as a dependent variable. A finite sample bias also results from the cointegrating regression (although the estimates are consistent).⁴¹ Phillips and Durlauf (1986) derived an asymptotic distribution of the OLS estimator of β in (3-1) and its t -statistic. They found it to be non-normal, thus invalidating the standard t and F tests. The EG approach is therefore only really applicable when there is a single cointegration vector *and* when all the independent variables are weakly exogenous.

3.1.2.1.2 Step 2: short-run model estimation

The second step of the Engle-Granger approach is the estimation of the short-run error correction model (ECM). The error correction term is given by the lagged values of the residuals from the long-run cointegrating equation (\hat{u}_{t-1}). The coefficient on \hat{u}_{t-1} provides information on the speed of adjustment to equilibrium. The error correction model is based on the type pioneered by Davidson, Hendry, Srba and Yeo (1978). Because all variables used in the ECM are $I(0)$, the usual t and F tests are applicable.

estimator 'chooses' the residuals in (3-1) to have the smallest sample variance, even if the variables are not cointegrated. This makes the residual (e_t) as stationary as possible. This suggests that the Dickey Fuller tables would over reject the null. The second is because the distribution of the test statistic is affected by the number of regressors included in (3-1). This also affects the critical values. Fortunately, MacKinnon (1991) has derived response surfaces to obtain the appropriate critical value which are available in E-Views.

⁴⁰ There are other approaches available to test for cointegration. The first (and easiest) is the cointegration regression Durbin-Watson (CRDW) test. This test is based on the Durbin-Watson statistic obtained from (3-1). The critical values for this test are supplied in Sargan & Bhargava (1983). However, the critical value is only applicable when the residual from (3-1) follows a first-order autocorrelation process. Because higher-order residual autocorrelation is usually present, the CRDW test statistic is regarded as unsuitable. Another approach has been suggested by Kremers, Ericsson and Dolado (1992). They look at the error-correction term (residual) from (3-1). That is, once the long-run relationship has been estimated, they test to see if this relationship is significantly different from zero in the error-correction model. If the relationship is insignificantly different from zero (using the MacKinnon critical values) then no cointegration exists.

⁴¹ Banerjee *et al* (1986) show that for a fixed number of variables, this bias is inversely related to the R^2 of the cointegrating regression. Thus, R^2 can be used to determine the normalisation variable with the lowest bias.

3.1.2.2 The Johansen method

3.1.2.2.1 Long-run model estimation

Because of the problems with the EG method, when the number of independent variables is greater than two there is little advantage in *starting* from the single equation model. The Johansen method is viewed as a better starting point in investigating long-run relationships. This procedure allows the practitioner to firstly determine the maximum number of cointegrating relationships, and secondly obtain maximum likelihood estimates of the cointegrating vector and variable coefficients. This is achieved using so-called 'canonical correlation' analysis and utilising the eigenvalues and eigenvectors produced by the matrix of correlation coefficients.

Because the Johansen procedure is more complicated than the EG method, an attempt at summarising the methodology is given in Appendix A.

3.1.2.2.2 Short-run model

Obtaining the long-run estimates is only the first-step to estimating the complete model. A short-run model must also be specified because of the information it provides on the short-run adjustment of economic variables. Once the number of cointegration vectors has been determined, a vector error correction model (VECM) can be estimated. The residuals from each cointegration vector are included as error correction terms, along with any other variables which economic theory posits influence the model in the short-run. As with the EG method, the coefficients on the error correction terms provide information on the speed of adjustment to long-run equilibrium.

The Johansen procedure therefore suggests that a multivariate approach should be adopted when analysing time series data rather than a single equation approach. The suggested modelling strategy should be similar to the following:

- I. Use economic theory to identify the relevant variables.

2. Check for stationarity. If some variables are of a higher order (e.g. $I(2)$), then impose restrictions to make them the same order as the other variables (e.g. replace prices and wages by real wages).
3. Use the Johansen procedure to establish the number of cointegrating vectors, and estimate their coefficients. Tests should then be made to check whether the long-run relationships are statistically adequate.
4. Error-correction models can be formulated and estimated incorporating the residuals from the long-run equations. A general to specific strategy should be adopted.⁴²

3.2. Empirical results

Annual data was used in the estimation. Although annual observations allow just 35 observations, the sample size is comparable with the literature. For example Feldstein (1974) used a sample size of between 24 and 42 observations.

3.2.1 Long-run consumption function

3.2.1.1 Engle-Granger (EG) method

Despite the disadvantages of the EG method, estimation results using this method are included for two reasons. The first is to compare the results with the Johansen technique. The second is because the EG method is the main cointegration technique used in South Africa. Estimation of the long-run consumption function using the EG method produced the results in Table 3.1.

⁴² Estimation should begin with a large model with many parameters. The model is gradually reduced until a smaller, economically meaningful model is found. This contrasts to the specific to general approach which is criticised for 'data mining'.

Table 3.1 Long-run model coefficients

Equation	Variable							
	constant	Y	W	SSW	INFL	RE	R	DEF
(1)	973.68	0.659	-0.001	-0.001	33.481	0.138		
(2)		0.760	0.002	0.016	24.633	0.243		
(3)	933.858	0.610	0.002	-0.004	49.710	0.180	27.49	
(4)		0.708	0.005	0.013	41.956	0.282	28.69	
(5)	669.666	0.611	-0.006	-0.132	36.823	0.093	21.056	58.720
(6)		0.662	0.009	-0.009	24.958	0.099	17.923	93.32

NB: Y is real per capita disposable income, W is real per capita wealth, PW is real social security benefits per fund member, $INFL$ is the inflation rate, RE is real per capita retained earnings, R is the real pre-tax interest rate, and DEF is the budget deficit as a percentage of GDP.

The sign of W and PW depends on the specification of the model. The sign of the real interest rate (R) is surprising because this suggests that the wealth effect of changes in the interest rate outweighs the substitution effect. The implied long-run elasticities at means are shown in the following table:

Table 3.2: Long-run elasticities

equation	Y	W	PW	INFL	RE	R	DEF
(1)	0.701	-0.008	-0.004	0.065	0.003		
(2)	0.808	0.015	0.064	0.046	0.060		
(3)	0.649	0.015	-0.016	0.097	0.045	0.004	
(4)	0.753	0.038	0.052	0.081	0.070	0.005	
(5)	0.650	-0.046	-0.528	0.072	0.023	0.003	0.117
(6)	0.704	0.069	-0.036	0.048	0.025	0.003	0.085

Elasticity equals the long-run coefficient of the variable multiplied by the ratio of the mean of the variable divided by mean consumption.

The results of augmented Dickey Fuller tests on the residuals (adjusted in line with MacKinnon, 1991) and diagnostic tests are given in Table 3.3.

Table 3.3: Residual unit root tests

Equation	lag length	t_r	t_{α}	t
(1)	1	-3.71**	-3.57**	-3.64*
(2)	1	-3.51***	-3.47**	-3.52*
(3)	1	-4.84*	-4.81*	-4.90*
(4)	1	-4.36*	-4.42*	-4.50*
(5)	1	-4.87*	-4.87*	-4.96*
(6)	1	-4.88*	-4.95*	-5.03*

* denotes rejection of the null hypothesis at the 1 percent level

** denotes rejection of the null hypothesis at the 5 percent level

*** denotes rejection of the null hypothesis at the 10 percent level

The null hypothesis of no cointegration is rejected in all equations. The ' t ' value also increases as more independent variables are added. Based on these results, cointegration exists between the hypothesised long-run variables. Diagnostic tests are

shown in Table 3.4. The Durbin-Watson statistic is included although it only tests for first order autocorrelation, and it requires a constant term in the regression and no lagged dependent variables among the regressors. More general tests are given by the Breusch-Godfrey LM test, and the Ljung-Box Q statistic. The results of these tests, the ARCH LM test for autoregressive heteroskedasticity, and the White tests show that serial correlation and heteroskedasticity are evident in some of the equations. Heteroskedasticity affects the efficiency of the estimates i.e. the reliability of the t statistics. Because the t and F statistics are unreliable (due to a non-normal distribution) when using the EG method, one could argue that heteroskedasticity is not a major problem. However, the presence of any econometric problem is usually a sign that the model specification is unsound. The general model (equation (6)) appears to be the best specification given the data because it is the only equation without serial correlation. Tests for normality of the residuals were also not rejected.

The exclusion of lagged consumption and unemployment from the long-run model requires an explanation. Pretorius and Knox (1995) include a lagged dependent variable in their long-run equation. By doing this they are undermining the rationale of a long-run equation. The long-run by definition is a state of equilibrium where there is no inherent tendency to change since economic forces are in balance (Harris, 1995:5). Therefore, by including lagged consumption in their long-run equation, their model *must be adjusting towards* equilibrium, so cannot be a long-run model. Their inclusion of lagged consumption was probably to capture omitted variables. Including the rate of unemployment would improve the diagnostics. However, as chapter two pointed out the reasoning for including the rate of unemployment in the consumption function is to adjust for cyclical variation between consumption and income. In the long-run, steady state, there should be no cyclical variation.

Table 3.4: Long-run model diagnostics

DIAGNOSTICS	Model					
	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted R ²	0.94	0.94	0.97	0.95	0.97	0.96
DW	1.16	1.11	1.53	1.37	1.66	0.65
ARCH LM test	F _(1,35) 43.62 [0.04]	F _(1,35) 2.11 [0.16]	F _(1,35) 0.90 [0.34]	F _(1,35) 1.25 [0.27]	F _(1,35) 0.20 [0.66]	F _(1,35) 0.25 [0.62]
White test (no cross terms)	F _(9,26) 4.45 [0.01]	F _(9,26) 3.29 [0.01]	F _(11,24) 2.51 [0.03]	F _(11,24) 2.48 [0.03]	F _(13,22) 2.60 [0.02]	F _(13,22) 2.81 [0.16]
White test (cross terms)	F _(19,16) 3.08 [0.02]	F _(19,19) 7.53 [0.00]	F _(24,11) 1.14 [0.45]	F _(24,11) 5.19 [0.01]	F _(26,9) 36.00 [0.42]	F _(26,9) 36.00 [0.42]
Serial correlation LM test	F _(6,29) 3.62 [0.04]	F _(6,29) 3.45 [0.05]	F _(7,28) 2.59 [0.09]	F _(7,28) 2.4 [0.11]	F _(8,27) 1.84 [0.18]	F _(8,27) 1.77 [0.19]
Ramsey's RESET test	F _(7,28) 0.87 [0.47]	F _(7,28) 3.41 [0.03]	F _(8,27) 0.64 [0.59]	F _(8,27) 4.23 [0.01]	F _(9,26) 0.89 [0.46]	F _(9,26) 2.23 [0.11]
Wald test	9.51 [0.00]	0.76 [0.00]	11.80 [0.00]	84.09 [0.00]	5.04 [0.03]	90.91 [0.00]
Ljung-Box test F _(4,32)	9.20 [0.06]	6.79 [0.15]	12.75 [0.01]	5.11 [0.28]	9.30 [0.05]	5.89 [0.21]
Jarque-Bera test	2.02 [0.36]	4.90 [0.09]	1.11 [0.57]	1.90 [0.39]	2.06 [0.36]	2.81 [0.25]
Sample	1960-1995	1960-1995	1960-1995	1960-1995	1960-1995	1960-1995

The analysis of Pretorius and Knox (1995) is also questionable because they use the t statistics and R^2 as verification of the adequacy of their model. As already noted, the R^2 , t , and F tests are meaningless in the first step of cointegration estimation. They argue, incorrectly, that the reason the R^2 in their long-run equations is greater than in the short-run equations is because of the large fluctuations in the short-run time series. In fact the reason the R^2 is so high in the long-run equations is because a regression of non-stationary variables causes the R^2 to tend to 1. No other diagnostic tests for serial correlation or heteroskedasticity were carried out by Pretorius & Knox. Thus, the reliability of their consumption model (and the Reserve Bank's) must be questioned.

In summary, support is given for the adequacy of equation (6). However, there are econometric problems with the remaining equations. Most importantly, the EG method is questionable when more than two variables are modelled. Therefore, the Johansen method should be adopted. The results from this estimation are given in the next section.

3.2.1.2 Johansen method

Estimates of the model (i.e. β from Appendix A) with consumption as the normalised variable are given in the following table.

Table 3.5: Normalised coefficients

	constant	Y	W	W _H	PW	INFL	RE	R	DEF
(1)	5059.540	0.954 (3.56)	0.016 (1.46)		0.149 (1.67)	- 213.050 (-1.43)	3.176 (1.75)		
(2)	2952.620	0.809 (4.17)		0.013 (1.86)	0.107 (2.14)	- 154.274 (-1.71)	2.349 (2.28)		
(3)	830.510	0.767 (7.99)			0.053 (279)	-40.344 (-1.57)	0.942 (3.28)		
(4)		0.581 (9.81)	0.008 (4.40)		0.018 (2.36)	53.589 (4.74)	0.520 (4.59)	71.254 (6.32)	
(5)	1151.269	0.723 (6.30)	0.013 (2.15)		0.019 (0.85)		1.164 (3.15)	118.100 (2.90)	
(6)		0.827 (4.00)	0.012 (1.32)		-0.077 (1.23)		1.146 (1.83)	232.448 (1.696)	
(7)		0.636 (2.12)	0.018 (11.69)		-0.077 (-6.67)	0.165 (0.02)	-0.475 (-4.79)	18.466 (4.42)	300.760 (9.99)

NB: the sample period was 1960-1995. Y is real per capita disposable income, W is real per capita wealth, PW is real social security benefits per fund member, $INFL$ is the inflation rate, RE is real per capita retained earnings, R is the real pre-tax interest rate, and DEF is the budget deficit as a percentage of GDP.

The results from the Johansen test to determine the number of cointegrating equations are given in Appendix B. Equations (1)-(3) all indicate a single cointegrating equation, while specifications (4)-(6) indicate two cointegrating equations. The additional cointegrating relationship is due to the inclusion of the stationary variable R .⁴³ Equation (7) identified three cointegrating relationships. The additional equation, in this case, resulted from the stationary variables R and DEF being included. The coefficients are very sensitive to the variables included in the model. This is probably due to unavoidable collinearity between the explanatory variables. For example, pension wealth and disposable income are correlated because pension wealth is governed by the level of contributions, which in turn is determined by income. The inclusion of wealth without the real interest rate tends to upwardly distort the coefficients on the remaining variables to implausible levels.⁴⁴ Those equations with constants imply fitted values which are significantly greater than actual consumption. For example, the constant in equation (1) is as high as actual consumption in some years! Equation (7) produces an incorrectly signed coefficient on DEF with an implausibly high value. The inferred t -statistics are included in parenthesis.

Equation (4) was chosen as the final model because it produced the most plausible coefficients. Checks were made to determine if the residuals were free from specification error. An ARCH LM test produced an F -statistic of 3.63 with an associated probability of 0.07. Thus, the null hypothesis of no autoregressive conditional heteroskedasticity is accepted. The residuals were also tested for serial correlation using the Ljung-Box Q-statistic. The null hypothesis that the residuals were white noise was rejected for all autocorrelations lower than 16. However, at higher order lags, the residuals were white noise. For example, the Q statistic at 17 lags was 26.45 with an associated probability of 0.07. Thus, the problem of serial correlation is not evident for higher order lags. Unfortunately the problem of serial correlation cannot be corrected by adding additional explanatory variables because of an insufficient number of observations. The Jarque-Bera test of the normality of the

⁴³ See Appendix A for the reasoning for this.

⁴⁴ Taking two examples, the coefficient in equation (1) on PW suggests that individuals consume 15 percent of their pension wealth each year. The coefficient on retained earnings suggests that every rand saved by the corporate sector encourages individuals to consume an additional R3.18, which is clearly unsustainable.

residual was 0.04 (0.98) which is satisfactory. A histogram of the residuals is given in Appendix B. Accepting (4) implies the following long-run elasticities (calculated at means);

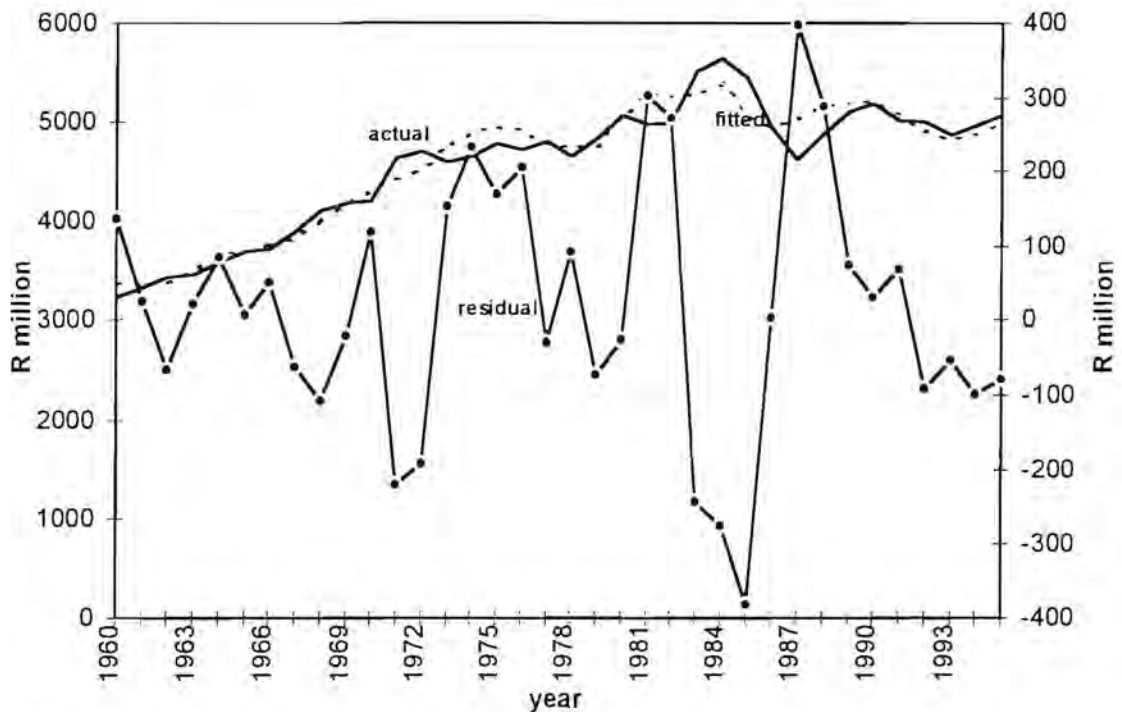
Table 3.6: Long-run elasticities - equation (4)

Y	W	PW	INFL	RE	R
0.618	0.062	0.072	0.104	0.129	0.011

Elasticity equals the long-run coefficient of the variable multiplied by the ratio of the mean of the variable divided by mean consumption.

Therefore, equation (4) is the best specification available given the data. The model's performance is shown in Figure 3.1.

Figure 3.1: Real per capita consumption in South Africa: 1960-1995 - actual and estimated



The fit is reasonably good except for outliers in 1985 and 1987. Dummy variables to allow for these outliers could not be modelled because the Johansen method requires additional observations as more variables are added. The correlation between actual and fitted values was 0.96 which is satisfactory.

3.2.2 The short-run consumption function

As discussed earlier, when using the Johansen technique the short-run is modelled using a vector error-correction model (VECM). Two cointegrating equations were produced from equation (4), one of which was due to the inclusion of a stationary variable, i.e. one cointegrating vectors contains just a single variable (R). Because of this, short-run consumption behaviour can be modelled using a single-equation error correction model (ECM). The error correction term can be defined as follows;

$$\hat{C}_t = 0.581Y_t + 0.008W_t + 0.018PW_t + 53.589INFL_t + 0.520RE_t + 71.254R_t$$

(9.81) (4.40) (2.36) (4.74) (4.59) (6.32)

$$Z_{t-1} = C_{t-1} - \hat{C}_{t-1}$$

A general to specific procedure was applied to arrive at a final model. The results of the estimation using OLS are shown in Table 3.7.

Table 3.7: Estimation results of (ECM)

Variable	Equation		
	(1)	(2)	(3)
$\ln\Delta Y_t$	0.236 (3.59)	0.170 (2.56)	0.122 (2.42)
$\ln\Delta Y_{t-1}$	0.219 (3.40)	0.240 (3.07)	0.204 (3.35)
R_t	-0.002 (-1.96)		
Z_{t-1}	-0.000 (-1.84)	-0.000 (-1.05)	-0.000 (-0.46)
$\ln\Delta W_t$	0.088 (4.44)	0.093 (5.62)	0.095 (4.94)
ΔU_t	-0.003 (-2.94)	-0.010 (-5.40)	-0.009 (-7.14)
$\ln DEF_{t-1}$	0.006 (3.93)	0.010 (6.87)	0.009 (4.33)
ΔRT_t		0.002 (0.78)	
RR_t			0.000 (0.64)

NB: $\ln\Delta Y_t$ is the annual log growth rate in real per capita disposable income, $\ln\Delta C_t$ is the annual log growth rate in real per capita consumption, R_t is the real pre-tax interest rate, Z_{t-1} is the lagged residual from the long-run model (4), $\ln\Delta W_t$ is the annual log growth rate in per capita real non-pension wealth, ΔU_t is the first difference in the rate of unemployment, ΔRT_t is the change in the real after-tax interest rate, RR_t is the relative return to discretionary saving, and $\ln DEF_{t-1}$ is the log of the budget deficit as a percentage of GDP.

Equation (1) determines the interest elasticity of the real pre-tax interest rate. Equations (2) and (3) were estimated to ascertain whether using the real after-tax interest rate, or the relative return to discretionary saving respectively, affected the size or the statistical significance of the elasticity.

When the after-tax return on saving was modelled, the coefficient changed sign but remained low and insignificant. The change in sign is probably due to a small sample size. To test this, equation (1) was estimated over the 1971-1995 sample period, and produced a positive coefficient on R_t .

Following Pretorius and Knox (1994), a dummy variable was included to capture the effects of the introduction of GST in 1978 and the subsequent increase in 1984 but was statistically insignificant. The reason for its insignificance is probably because of the effects of the tax being smoothed over the year. If quarterly or monthly data was used, then one would expect the effects of the tax to have an impact.

The ECMs were put through the usual battery of test. The results of these tests are given below.

Table 3.8: ECM evaluation diagnostics

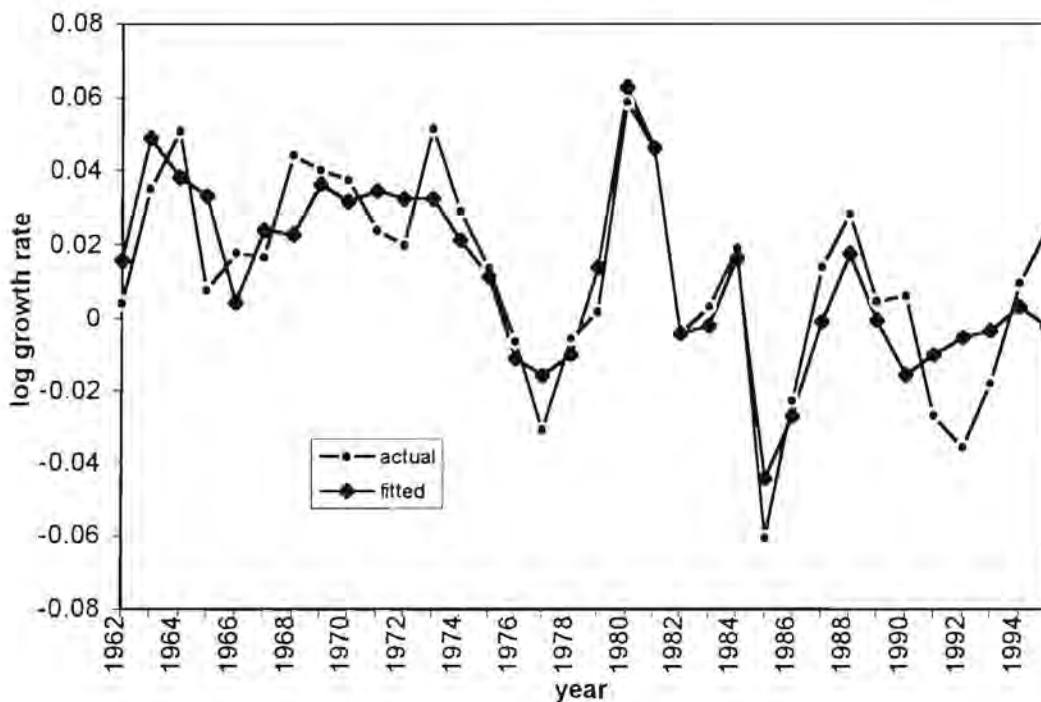
DIAGNOSTICS	Model		
	(1)	(2)	(3)
Adjusted R ²	0.69	0.78	0.77
F statistic	F _(6,27) 13.06 [0.00]	F _(6,17) 14.95 [0.00]	F _(6,17) 15.09 [0.00]
DW	1.86	1.45	1.47
ARCH LM test	F _(1,33) 0.07 [0.79]	F _(1,23) 0.03 [0.86]	F _(1,23) 0.13 [0.91]
White test (no cross terms)	F _(13,21) 0.66 [0.78]	F _(13,11) 0.68 [0.75]	F _(13,11) 1.59 [0.23]
Serial correlation LM test	F _(9,25) 0.04 [0.96]	F _(9,15) 0.52 [0.69]	F _(9,15) 0.63 [0.55]
Ramsey's RESET test	F _(10,24) 0.87 [0.47]	F _(9,15) 0.96 [0.44]	F _(9,15) 1.08 [0.39]
Ljung-Box test	F _(4,34) 6.18 [0.19]	F _(4,23) 2.38 [0.67]	F _(4,23) 3.69 [0.45]
Wald test	134.79 [0.00]	156.66 [0.00]	164.65 [0.00]
Jarque-Bera test	0.78 [0.68]	0.72 [0.70]	0.00 [0.99]
Sample	1960-1995	1971-1995	1971-1995

Tests for serial correlation or heteroskedasticity were insignificant. Other tests for specification error, and non-normal residuals were also insignificant. The size of the adjusted R² suggests the explanatory power of model (1) in particular could be improved. However, the Ramsey test for specification error was insignificant. To test

the stability of the model, i.e. whether structural change occurred in any of the coefficients, recursive estimation was applied to each short-run model. The results are given in Appendix B. The recursive residuals were stable for equation (1), but displayed excess variability in equations (2) and (3). This is indicated by the residuals exceeding the two standard deviation band. This suggests that there is some parameter instability in the equation. This may explain the change in sign of the interest elasticity in equations (2) and (3). As an additional check on the stability of equation (1), the recursive coefficients were calculated. These are also shown in Appendix B. The plots of the estimates do not suggest instability of the coefficients.

In conclusion, equation (1) is the best representation of the short-run behaviour of consumption based on the diagnostic tests and forecasting ability. Equations (2) and (3) suffer from poor sample size which significantly affects the stability of the results and the sign of the interest elasticity of saving. Because of this, more weight should be placed on the results of equation (1). Nevertheless, the low and insignificant coefficients on the interest elasticity of saving in equations (2) and (3) support the results of equation (1). A plot of the model based on equation (1) is given in the following graph.

Figure 3.2: Real per capita consumption growth: 1960-1995 - actual and estimated



The fit of the model is reasonable, although it did not adequately capture the fall in consumption growth in 1991 and 1992. However, the correlation between the actual and fitted values was 0.86 which is satisfactory.

3.3. Discussion

3.3.1 Disposable income

Disposable income is correctly signed in the short and long-run models, with a marginal propensity to consume between 0.58 and 0.95. The size of the coefficient is not surprising given that consumption as a percentage of disposable income has averaged 94 percent since 1970.

3.3.2 Inflation

There is ambiguity in the sign of the coefficient on inflation in the long-run model. However, inflation negatively influenced saving in the equation which included the real interest rate. Because this equation produced coefficients which are reasonable *a priori* approximations, it is most likely that inflation negatively influences personal saving in the long-run. Surprisingly, changes in inflation did not (statistically) affect consumption growth in the short-run.

3.3.3 Non-pension wealth

Wealth in the long-run model impacted significantly on the coefficients of the other variables. Including wealth tended to increase the absolute size of the other coefficients to implausible levels. However, once the real interest rate was included in the long-run estimation, the inclusion of wealth did not distort the values of the other coefficients. Wealth was also significant in the short-run model. The propensity to consume wealth was low, perhaps due to declining real wealth over the period under study. Moreover, from the life cycle hypothesis the age composition has a significant bearing on the size of the marginal propensity to consume wealth. In South Africa the proportion of the population over 65 has averaged less than 6 percent since 1960.⁴⁵ This suggests that the amount of wealth consumed by the population would be low.

⁴⁵ This figure was derived from data in the Mouton Report (1992).

Therefore, the suggestion that wealth has not been a major determinant of saving is not surprising given the age structure of the population.

3.3.4 Retained earnings

Retained earnings were statistically significant in the long-run equations, and positively related to consumption as expected. From the Johansen long-run equation (4), the marginal propensity to consume disposable income was 0.58, while the marginal propensity to consume retained earnings was 0.52. Thus, if corporations save an extra rand (which reduces disposable income by a rand), total private saving will increase by around 6 cents. This suggests that individuals do see through the corporate veil almost perfectly.

3.3.5 Error-correction term

The error-correction term (Z) was statistically significant (at the 10 percent level) with a negligible coefficient. The statistical significance supports the robustness of the framework used,⁴⁶ but the size of the coefficient is surprising. The coefficient implies that consumers react very slowly to changes in the underlying equilibrium relationship. In other words, consumers remove virtually none of the disequilibrium each year.

3.3.6 Ricardian equivalence

The budget deficit (DEF) was incorrectly signed in the long-run models with coefficients ranging between 0.59 and 300.76. However, the budget deficit did statistically impact on personal saving in the short-run, although it was incorrectly signed. The low coefficient implies that as the budget deficit increases, individuals decrease their saving only slightly. Nevertheless, this result is in stark contrast to the Ricardian Equivalence hypothesis.

3.3.7 Pension wealth

The sign of the coefficient on pension fund wealth depended on the specification of the long-run model. However, it was positively related to consumption in equation (4) of

⁴⁶ Based on Kremers, Ericsson and Dolado (1992).

the Johansen estimation method. This indicates that the wealth effect of expected future pension benefits outweighs the retirement effect.

3.3.7.1 Unfunded pensions

Feldstein (1974) quantified the effect of unfunded social security on total saving by identifying tax and wealth effects. The net effect on saving can be derived using the following expression:

$$\text{Net decrease in saving} = \underbrace{\text{Taxess}_{SS_t} \times (1 - MPC_Y)}_{\text{tax}} + \underbrace{MPC_{PW} \times PW_t}_{\text{wealth}}$$

where Taxess_{SS_t} denotes social security taxes, MPC_Y is the marginal propensity to consume disposable income, MPC_{PW} is the marginal propensity to consume social security wealth, and PW_t is unfunded social security wealth at time t .

Unfortunately, there is no information available in South Africa on the perceived level of future pension benefits from unfunded pension schemes, so a similar exercise cannot be performed.

3.3.7.2 Funded pensions

The available information on funded pension wealth does permit an analysis as above, although clearly there is no tax effect, since any taxes or contributions are left to accumulate in a fund. Any fall in saving will result entirely from the wealth effect. However, with funded pensions, a different derivation of the wealth effect is required. The question which must be asked is: in the absence of retirement funds, would the contributions currently being made to retirement funds be transferred to alternative forms of saving, or would consumption increase? Would *total* saving actually increase? Other studies have analysed the effect of funded pensions by comparing the amount of pension wealth consumed each year with total contributions. If contributions are greater than consumption of pension wealth, then retirement funds are thought to increase total saving (see for instance Munnell, 1976). However, this reasoning ignores the fact that in the absence of retirement funds, consumers would

use the contributions in other ways to generate wealth. Thus, one must look at the relative marginal propensities to consume pension and non-pension wealth.

If there is perfect substitution between pension and non-pension wealth, the coefficients on pension wealth and non-pension wealth will be equal. If the marginal propensity to consume pension wealth (MPC_{PW}) is greater than the marginal propensity to consume non-pension wealth (MPC_W) then retirement funds reduce total saving. If the MPC_{PW} is less than the MPC_W then pension funds increase total saving.

From the long-run equation (4), the MPC_{PW} is 0.018 i.e. for every rand of pension fund wealth, the individual consumes nearly 2 cents. The MPC_W is 0.008 i.e. for every additional rand of non-pension wealth the individual will consume around 1 cent. Thus, pension wealth is an imperfect substitute for other forms of wealth.

This implies that if pension contributions were instead used to increase either housing wealth (e.g. repaying a mortgage); or invested in a self-managed retirement scheme, consumption would fall. This means for every 1 rand of pension fund wealth, total saving falls by 1 cent. This result supports the hypothesis that individuals perceive greater certainty in their contractual wealth than their discretionary wealth. This would induce individuals to consume a larger proportion of pension wealth each period than non-pension wealth i.e. retirement funds depress precautionary saving.

If it is assumed that in the absence of retirement funds, the flow of funds currently being directed towards retirement funds would be allocated to non-pension wealth, in such a way as to leave total household wealth in the economy unchanged (i.e. a 1:1 substitution), then the effect of funded pensions on total saving can be calculated as follows:

$$\text{Net decrease in saving} = PW_t \times (MPC_{PW} - MPC_W)$$

where PW is funded pension wealth, MPC_{PW} is the marginal propensity to consume funded pension wealth, and MPC_W is the marginal propensity to consume non-pension wealth. Table 3.9 shows the net decrease in saving using this calculation.

Table 3.9: The effect of retirement funds on saving

Year	total household wealth (R million)	decrease in personal saving (R million) (1)	total personal saving (R million) (2)	gross domestic saving (R million) (3)	(1)/(2) (%)	(1)/(3) (%)
1960	47,850	48	200	1,127	24.0	4.3
1961	47,926	48	441	1,309	10.9	3.7
1962	48,009	48	565	1,410	8.5	3.4
1963	48,089	48	486	1,614	9.9	3.0
1964	48,202	48	328	1,646	14.6	2.9
1965	48,312	48	370	1,699	13.0	2.8
1966	48,452	48	521	1,902	9.2	2.5
1967	48,600	49	585	2,248	8.4	2.2
1968	48,796	49	730	2,500	6.7	2.0
1969	48,987	49	523	2,576	9.4	1.9
1970	49,196	49	509	2,569	9.6	1.9
1971	52,065	52	1,016	3,119	5.1	1.7
1972	52,670	53	1,220	3,849	4.3	1.4
1973	53,438	53	800	4,826	6.6	1.1
1974	54,334	54	991	6,032	5.4	0.9
1975	55,152	55	1,513	6,761	3.6	0.8
1976	56,739	57	841	6,902	6.8	0.8
1977	58,778	59	2,213	9,151	2.7	0.6
1978	60,263	60	1,608	10,602	3.7	0.6
1979	63,285	63	3,013	14,757	2.1	0.4
1980	67,398	67	3,771	21,163	1.8	0.3
1981	72,263	72	801	19,369	9.0	0.4
1982	76,284	76	774	16,735	9.8	0.5
1983	82,872	83	916	23,177	9.1	0.4
1984	92,004	92	2,707	44,177	3.4	0.4
1985	101,240	101	4,448	30,189	2.3	0.3
1986	115,022	115	2,581	33,711	4.5	0.3
1987	132,089	132	4,500	37,586	2.9	0.4
1988	146,481	146	4,619	45,411	3.2	0.3
1989	164,395	164	4,758	54,301	3.4	0.3
1990	196,125	196	1,764	53,958	11.1	0.4
1991	231,516	231	3,613	58,535	6.4	0.4
1992	275,977	276	8,963	58,043	3.1	0.5
1993	327,149	327	12,768	65,885	2.6	0.5
1994	379,824	380	11,949	74,390	3.2	0.5
1995	394,989	395	6,031	81,038	6.5	0.5
			AVERAGE		6.9	1.3

NB: Total personal saving excludes provision for depreciation. If saving are adjusted for depreciation, the average effect falls to around 2 percent of total saving.

The plausibility of the assumption in the table above that in the absence of pension funds, savers would substitute the equivalent contributions to a self-managed scheme depends on the stage of life of the individual. Recall from chapter two that the Life-

Cycle hypothesis predicts individuals maintain a constant level of consumption over their lifetime. To illustrate the effect of *no* pension funds in this framework, we can use equation (1-2) from chapter one:

$$YD_t - C_t - D_t = DS_t + PC_t = S_t \quad (1-2a)$$

Equation (1-2a) states that total personal saving over period t is equal to total disposable income less consumption and debt repayments. Y , C , PC , and D are disposable income, consumption, pension contributions, and debt repayments as before. DS is total discretionary saving, and S is total personal saving. If the individual is young, then to maintain constant consumption, D will be positive. If there are no pension funds, then (1-2a) becomes:

$$YD_t - C_t - (D_t + \alpha PC_t) = (1 - \alpha)PC_t + DS_t \quad 0 \leq \alpha \leq 1 \quad (1-2b)$$

Equation (1-2b) states that in the absence of managed retirement funds, contributions will either be allocated to a self-managed scheme or used to service debt. If $\alpha=0$ then the pension contributions are completely allocated into a discretionary scheme as in Table 3.9. If $0 < \alpha < 1$, then the pension contributions are partly used to repay existing debt. If $\alpha=1$, then pension contributions are used wholly to repay household debt.

Therefore, the credibility of the results in Table 3.9 depend on the age distribution of the South African population. The proportion of the population aged between 15 and 34 (which would be expected to have $0 < \alpha < 1$) is around 35 percent. The proportion aged between 35 and 64 (which would be expected to have $\alpha=0$) is around 24 percent. Thus, it could be argued that individuals would not allocate all pension contributions into a self-managed scheme. In addition, pension fund mismanagement would have the effect of reducing the marginal propensity to consume pension wealth because of uncertainty regarding the handling of contributions, and therefore future benefits. Therefore, it could be argued that the net decrease in total saving resulting from pension saving in the table would be lower. However, this maybe counteracted by other factors. Firstly, results from the table above exclude unfunded pensions.

Therefore the reduction in disposable income because of the tax and wealth effects of unfunded pensions means that the fall in saving is likely to be greater than the figures given in the table. Secondly, pension fund mismanagement may be offset by a reduction in the marginal propensity to consume non-pension wealth because the future certainty of *total* household wealth is reduced. Finally, there is no way of measuring α , thus the estimates above are as accurate as possible given the available information.

The results produced in Table 3.9 contradict empirical results reviewed in chapter one. Funded retirement funds have decreased total personal saving. The results indicate that personal saving would be approximately 7 percent greater on average in the absence of funded pension funds.

3.3.8 Interest elasticity of saving

The results from the long-run models indicate a negative interest-elasticity of saving of between 0.004 and 0.01. This implies that a 1 percentage point increase in the interest rate will have very little effect on saving. These estimates are lower in magnitude to Pretorius & Knox's (1995) estimates, and different in sign. Their estimates of the interest elasticity ranged from 0.016 to 0.02.

The results from the error correction models were generally the opposite: changes in the interest rate are *positively* related to saving. The interest elasticity is low: around zero to 0.002 in absolute terms. As noted earlier, care should be taken when interpreting the sign of the return on saving in ECM (2) because of the small sample size. It is likely that the small sample size has led to the change in sign. Therefore, the sign of RT should be ignored. Note that the absolute size of the elasticity does not increase greatly if the real after-tax interest rate, or the relative return to saving are used. It is interesting that this elasticity is significantly lower than would be expected based on Ogaki *et al* (1996). Their results suggested that a 1 percent increase in the interest rate would increase the saving rate by around 0.6 percent. However, as noted elsewhere, a different methodology was employed in their paper which may account for the differences. However, the results are generally similar to other studies

reviewed in chapter one which adopted the LCH approach. Thus, changes in consumption are influenced by income rather than interest rate changes.

As outlined in chapter one, a likely cause of the low elasticity is the high degree of contractual saving in South Africa. If households are committed to contractual saving schemes, they are unable to respond to changes in the real interest rate unless they have real income growth which provides additional resources to invest in a discretionary scheme. This is unlikely to have occurred in South Africa because of declining real income growth,⁴⁷ and because there has been no incentive to invest in a discretionary scheme because of the low after-tax rate of return relative to that offered by contractual schemes. The high degree of liquidity constraint is reflected in the relative return elasticity which is lower than the interest elasticity of saving i.e. consumers can respond little to changes in the relative return to discretionary saving.

The policy implications and conclusions based on the results are discussed in the next chapter.

⁴⁷ Real disposable income growth averaged 1.5 percent over the 1970s, 0.1 percent over the 1980s, and 0 percent from 1990 until 1995.

Chapter four

Conclusions and Policy Implications

4.1. Analytical conclusions

This study sought to empirically identify and model the key characteristics of personal saving in South Africa. The approach built on earlier models by considering the impact liquidity constraints have on the responsiveness of saving to rates of return. Key analytical conclusions of the analysis can be summarised as follows;

1. Disposable income is the principal determinant of personal saving.
2. The responsiveness of personal saving to interest rates and relative returns to alternative forms of saving is negligible. It appears that interest rates are not a major factor when individuals consider their intertemporal saving decision.
3. Pension funds have a small negative impact on total saving i.e. there is a positive wealth effect on consumption. This is reinforced by the models rejection of Ricardian Equivalence. A possible implication of lack of evidence of Ricardian Equivalence is that individuals do regard bond financed pay-as-you-go social security schemes as net wealth, and do not increase their saving in anticipation of future tax increases. This supports the argument that pension funds have reduced the need for precautionary saving, i.e. pension funds encourage additional consumption. Reductions in public saving due to the implementation of pay-as-you-go pension schemes have therefore not led to increased private saving, thus lowering the future supply of capital.
4. Related to the previous point is the surprising negative relationship between personal saving and budget deficits. An explanation for this, in addition to the reduced precautionary saving argument, is fiscal drag. Fiscal drag has reduced after-tax disposable income. The additional government revenue generated by fiscal drag, however, has been less than government expenditure growth.⁴⁸

⁴⁸ See Annett (1996) for an historical analysis of deficits and public debt in South Africa.

Consequently, if an inherent positive relationship exists between personal saving and budget deficits, it is being distorted by fiscal drag reducing disposable income and therefore personal saving.

5. The econometric analysis showed that shifting 1 rand worth of taxes from firms to individuals would increase personal saving by 6 cents.
6. Inflation is negatively related to personal saving in South Africa.

The policy implications that arise from these conclusions are given in the following section.

4.2. Policy implications

4.2.1 Macroeconomic policy

A strong theme throughout the paper, and supported by the data, is that real income is a key determinant of saving growth. Given that there are feedbacks between saving and economic growth, saving is also a key determinant of growth. This suggests that measures, other than those which affect saving, need to be introduced which stimulate economic growth. A recent positive initiative in this area is the Growth, Employment, and Redistribution (GEAR) macroeconomic strategy.

The analytical conclusions also provide justification for an anti-inflationary monetary policy stance. If inflation continues to decline, then (among other economic benefits) personal saving should increase.

4.2.2 Fiscal policy

4.2.2.1 Saving incentives

The results in the previous chapter imply that the argument against providing saving incentives because of a low interest elasticity of saving must be put in perspective. The findings of Wilkins (1993) were used by the Katz Commission (1994) to conclude that it is "doubtful whether interest rates are important determinants of aggregate personal

saving” (p.246). One reason the elasticity is so low is because of the favourable tax treatment given to retirement funds, which has encouraged increased pension contributions. The increased contractual saving commitment limits the resources available for discretionary saving. This is because the surrender penalties often involved in contractual schemes impose a form of liquidity constraint i.e. individuals cannot respond to a change in the interest rate because of their commitment to a contractual saving scheme. Had after-tax rates of return been comparable between bank deposits and retirement funds in the past, then fewer contractual commitments would have been undertaken, thus freeing up resources for discretionary saving. Therefore, the interest elasticity of saving may be inherently greater than estimated but has been distorted by the favourable tax treatment retirement funds have received.

Owing to the composition of personal saving, saving incentives aimed at boosting the personal saving rate are likely to be ineffective. Moreover, the use of tax incentives to stimulate personal saving may be counter-productive as the increase in private saving may be less than the fall in government saving resulting from the loss in potential tax revenue.

The empirical results also suggest that measures to encourage retirement funds *solely* for the purpose of boosting total saving will not work. This contrasts the argument of the Mouton Report (1992) that extending social security schemes would not have undesirable side effects on personal saving. This is not to say that retirement funds are unimportant from a social welfare perspective, merely that encouraging retirement funds with the aim of generating a higher saving rate will not be successful.

4.2.2.2 Taxation

Taxation of pensions increases the relative return to discretionary saving. But the results show that this will not encourage a dramatic change in the composition of personal saving because the interest and intra elasticities of saving were negligible. As mentioned earlier, this is due to liquidity constraints caused by low income growth and contractual saving commitments. Of course, any change in composition will only occur if taxation reduces the return to pension funds below the return to discretionary saving. Ironically, if taxation of pension funds did result in a shift in composition of

regarding the government's commitment to creating a stable economic environment. This will help attract foreign direct investment necessary to complement domestic saving, and finance capital inputs essential for economic development.

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Appendix A

The Johansen method

The Johansen method can best be explained using an example. Following Holden and Thompson (1990), a simple consumption-income dynamic model with 2 lags, produces the following system:

$$\begin{aligned} C_t &= \Pi_{11}C_{t-1} + \Pi_{12}Y_{t-1} + \Pi_{13}C_{t-2} + \Pi_{14}Y_{t-2} + \mu_1 + \varepsilon_{1t} \\ Y_t &= \Pi_{21}C_{t-1} + \Pi_{22}Y_{t-1} + \Pi_{23}C_{t-2} + \Pi_{24}Y_{t-2} + \mu_2 + \varepsilon_{2t} \end{aligned} \quad (\text{A-1})$$

where it is assumed that C_t and Y_t are $I(1)$. Expressing these equations in error-correction form gives the following:

$$\begin{bmatrix} \Delta C_t \\ \Delta Y_t \end{bmatrix} = \begin{bmatrix} -(1-\Pi_{11}) & \Pi_{12} \\ \Pi_{21} & -(1-\Pi_{22}) \end{bmatrix} \begin{bmatrix} \Delta C_{t-1} \\ \Delta Y_{t-1} \end{bmatrix} + \begin{bmatrix} -(1-\Pi_{11}-\Pi_{13}) & (\Pi_{12}+\Pi_{14}) \\ (\Pi_{21}+\Pi_{23}) & -(1-\Pi_{22}-\Pi_{24}) \end{bmatrix} \begin{bmatrix} C_{t-2} \\ Y_{t-2} \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (\text{A-2})$$

Rewriting this equation in matrix notation yields:

$$\Delta Z_t = \Gamma \Delta Z_{t-1} + \Pi Z_{t-2} + \mu + \varepsilon_t \quad (\text{A-3})$$

where $\Gamma = \begin{bmatrix} -(1-\Pi_{11}) & \Pi_{12} \\ \Pi_{21} & -(1-\Pi_{22}) \end{bmatrix}$; and

$$\Pi = \begin{bmatrix} -(1-\Pi_{11}-\Pi_{13}) & (\Pi_{12}+\Pi_{14}) \\ (\Pi_{21}+\Pi_{23}) & -(1-\Pi_{22}-\Pi_{24}) \end{bmatrix}$$

Equation (A-3) is an ECM and Π is an equilibrium matrix. Three cases can now be considered which relate to the rank (i.e. the number of linearly independent rows or columns) of Π ;

1. Rank(Π)=0. In this case (A-3) can be written as:

$$\Delta Z_t = \Gamma \Delta Z_{t-1} + \mu + \varepsilon_t$$

which is a vector autoregression (VAR) in first differences. There is no cointegration because C and Y are both $I(1)$, and ΔZ is $I(0)$.

2. Rank(Π)=2. This occurs when the vector Z is stationary which contradicts the assumption that C and Y are $I(1)$.
3. Rank(Π)=1. In this case, there is one independent row and the determinant of Π is zero i.e.:

$$-(1 - \Pi_{11} - \Pi_{13})[-(1 - \Pi_{22} - \Pi_{24})] - (\Pi_{12} + \Pi_{14})(\Pi_{21} + \Pi_{23}) = 0 \quad (\text{A-4})$$

A further requirement is that one of the elements of Π must be non-zero. From (A-4), each of the terms in brackets is the long-run (equilibrium) coefficient on C or Y in (A-4), requiring at least one of these variables to be included in the equilibrium relationship. In this example there are two variables. Because the rank is one, there can be only one cointegrating vector.

As Holden and Thompson (1990) note, in the general case where rank (Π)= r , there are r cointegrating vectors. Two additional ($n^{54} \times r$) matrices, α and β , can be defined such that $\Pi = \alpha\beta'$ where α represents the speed of adjustment to equilibrium, and β' is a matrix of long-run coefficients. The rows of β provide the rows of the r cointegrating vectors. Estimates of α and β are obtained by estimating the space spanned by β from the r largest canonical correlation coefficient between the residual of Z_{t-k} and ΔZ_t derived from regressing the respective variables on their lagged differences. Johansen's method uses a maximum likelihood method to estimate a 'reduced rank regression' which estimates n eigenvalues and their eigenvectors. These eigenvalues measure how strongly the cointegrating relations (now denoted as $\hat{\beta}'_i Z_t$) correlate with the stationary part of the model.

⁵⁴ n is the number of variables in the model.

To test for the number of cointegration vectors, the null hypothesis that there are at most r cointegration vectors is tested against the alternative that $r+1$ exist:

$$H_0: \lambda_i = 0 \quad i = r+1, \dots, n$$

The log of the restricted maximum likelihood function is compared to the maximum likelihood function of the unrestricted model, and a likelihood ratio test computed.⁵⁵

The likelihood ratio test (or trace statistic) for there to be at least r cointegrating equations is given by:

$$\lambda_{trace} - 2 \ln(Q) = -T \sum_{i=r+1}^n \log(1 - \hat{\lambda}_i)$$

where Q equals the restricted maximum likelihood divided by the unrestricted maximum likelihood. Tests can also be performed to establish whether the estimates produced are unique.⁵⁶

It is important to note that if $I(0)$ variables are included in the long-run estimation, then for every stationary variable included, the number of cointegrating equations will increase. The rationale for this is that each $I(0)$ forms a cointegration relation on its own, and thus forms a linearly independent column of Π . Therefore, inclusion of $I(0)$ variables in the long-run model will increase the number of cointegrating equations by the number of $I(0)$ variables.

⁵⁵ See Appendix B for the tables which determine the number of cointegrating vectors.

⁵⁶ This arises because the reduced rank regression provides information on the number of cointegrating vectors. Since any linear combination of the stationary vectors is also stationary, the estimates produced by any particular vector may not be unique.

Appendix B

Econometric tests and diagnostics

B.1. Unit root tests

The standard test for stationarity is the unit root test. The Dickey Fuller (DF) approach is the most widely used. The basic form of the test is:⁵⁷

$$Y_t = \rho_a Y_{t-1} + u_t$$

or

$$(1-L)Y_t = \Delta Y_t = (\rho_a - 1)Y_{t-1} + u_t$$

The null hypothesis of the test is $H_0: \rho_a = 1$ (there is a unit root) against the alternative $H_1: \rho_a < 1$. The distribution used to determine the critical values does not follow a standard normal but a Dickey Fuller distribution.

One should also allow for the data generating process (d.g.p.) having an intercept and trend. Often the d.g.p. is unknown. When this is the case a recommended testing strategy can be summarised by the following table.

Table B.1: Testing procedure using the DF test when the data generating process is unknown

Step and model	Null hypothesis	Test statistic	Critical values
(1) $\Delta Y_t = \mu_c + \gamma_c t + (\rho_c - 1)Y_{t-1} + \mu_t$	$(\rho_c - 1) = 0$	τ_t	Dickey and Fuller (1981)
(2) $\Delta Y_t = \mu_b + (\rho_b - 1)Y_{t-1} + \mu_t$	$(\rho_b - 1) = 0$	τ_μ	Dickey and Fuller (1981)
(3) $\Delta Y_t = (\rho_a - 1)Y_{t-1} + \mu_t$	$(\rho_a - 1) = 0$	τ	Dickey and Fuller (1981)

Source: Harris (1995)

⁵⁷ See Harris (1995) for an excellent review of the techniques of unit root testing.

If a Dickey Fuller model is used when in fact the variable follows an AR(p) process, then autocorrelated error terms invalidate the use of the DF test (Harris, 1995). If the underlying process is AR(p), then the Augmented Dickey Fuller (ADF) test should be used. This test is equivalent to the Dickey Fuller test except that it adds a number of lagged first differences of the dependent variable to capture the effect of autocorrelated omitted variables. In the DF test, the omitted variables would automatically enter the error term. To illustrate the ADF test, assume Y_t follows a pth order autoregressive process:

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + u_t$$

or

$$\Delta Y_t = \phi^* Y_{t-1} + \phi^* \Delta Y_{t-1} + \phi^* \Delta Y_{t-2} + \dots + \phi^* \Delta Y_{t-p} + u_t \quad u_t \sim IID(0, \sigma^2)$$

where $\phi^* = (\phi_1 + \phi_2 + \dots + \phi_p) - 1$. If $\phi^* = 0$, against the alternative $\phi^* < 0$, then Y_t contains a unit root. The test can be extended to allow for deterministic components (constant and trend).

Choosing the appropriate lag size in the ADF test is an important consideration. Too few lags may result in over-rejecting the null when it is true, while too many lags reduces the power of the test because of the loss in sample size. Because of the relatively small number of observations available for the analysis (35), 1 or 2 lags were used. This was based on the *a priori* assumption that any autocorrelation would be removed after a lag of one year. If quarterly or monthly data was used then the lag length would have been increased. Using 1 lag also minimises the loss in test power caused by a small sample size.

The results of the unit root tests are given below. The usual method is a testing down procedure, beginning at the highest hypothesised unit root. For example, if the null hypothesis that the variable is I(2) is rejected, then testing moves down to testing the null that the variable is I(1).

Table B.2: Unit root tests: dependent variable $\Delta^2 Y_t$

Variable	Lag length	τ_c	τ_μ	τ
C	1 ⁵⁸	-4.69*	-3.80*	-3.35*
Y _D	2	-3.76**	-2.38***	-2.63*
W	1	-3.73**	-3.60**	-3.55*
W _H	1	-3.77**	-3.54**	-3.59*
INFL	1	-5.59*	-5.31*	-5.29*
SSW	1 ⁵⁹	-4.94*	-4.98*	-5.05*
U	2	-5.86*	-3.78*	-3.44*
RE	1	-4.28*	-4.19*	-4.07*
R	1	-5.34*	-5.27*	-5.35*
RT	1	-3.69**	-3.65**	-3.67*
RP	1	-6.81*	-7.05*	-7.24*
DEF	1	-4.89*	-4.97*	-4.76*

* denotes rejection of the null hypothesis at the 1 percent level

** denotes rejection of the null hypothesis at the 5 percent level.

*** denotes rejection of the null hypothesis at the 10 percent level.

The results in Table B.2 strongly indicate that none of the variables are $I(2)$ since the null hypothesis of the variables being $I(2)$ is rejected at the 1 and 5 percent levels.

Whether the data is stationary in first differences, $I(1)$, or stationary in levels, $I(0)$, can be determined from Table B.3.

The results in Table B.3 from the null hypothesis that the data are $I(1)$ suggest that the real pre-tax interest rate and the relative return to saving are stationary in levels. All other variables are non-stationary in levels. U and DEF are possibly stationary in levels. Therefore, in the error-correction model to be estimated, all variables except the real pre-tax interest rate and relative return to saving should be specified in first differences (or log growth rates). The unemployment rate and budget deficit can possibly also be modelled in levels.

⁵⁸ This variable was also significant at 2 lags at the 5 percent level.

⁵⁹ This variable was also significant at 2 lags at the 1 percent level.

Table B.3: Unit root tests: dependent variable ΔY_t

Variable	Lag length	τ_α	τ_μ	τ
C	1	-1.75	-2.30	-3.35
Y_D	1	-1.18	-2.21	1.13
W	1	-3.25	-1.13	-1.01
W_H	1	-2.90	-2.14	-0.85
INFL	1	-1.29	-1.69	-0.31
SSW	1	-2.51	-2.56	0.05
U	2	-3.61**	-0.15	0.45
RE	1	-1.23	-1.47	0.52
R	1	-3.47***	-3.62**	-3.55*
RT	1	-3.23	-2.8	-1.19
RP	1	-5.54*	-4.31*	-2.50**
DEF	1	-3.94**	-1.25	0.86

* denotes rejection of the null hypothesis at the 1 percent level

** denotes rejection of the null hypothesis at the 5 percent level.

*** denotes rejection of the null hypothesis at the 10 percent level.

B.1.1 Testing for structural breaks

Harris (1995) cautions that if a series has undergone a permanent shift (slope and/or intercept) during the period covered, “failure to take account of this change in the slope will be mistaken by the usual ADF unit root test as a persistent innovation to a stochastic trend” (p.40), i.e. a unit root test which does not allow for the structural break will have reduced power.

If the breaks in the series are known, then the procedure to take account of the shift is to include appropriate dummy variables. The critical values to use are given in Perron (1989, 1990). If the date of the break is unknown, it is necessary to test for the possibility of a break. Two series, *SSW* and *INFL* were suspected to possibly have structural breaks. *SSW* shows a large jump in 1971 caused by a change in measurement of retirement assets.⁶⁰ A dummy variable is included to take account of this break. A dummy variable was also included for *INFL* to allow for the effect of the

⁶⁰ Prior to 1971, retirement assets excluded industrial and insured funds.

oil price shocks in 1973-74 and 1979. The results of the unit root test allowing for these breaks are given below.

Table B.4 Results of tests for structural breaks

Variable	Lag length	τ_t	τ_p	τ_c
<i>Dependent variable $\Delta^2 Y_t$</i>				
SSW	1	-4.77*	-4.85*	-4.96*
INFL	1	-5.99*	-6.12*	-6.14*
<i>Dependent variable ΔY_t</i>				
SSW	1	-1.50	-1.57	-0.22
INFL	1	-2.58	-2.65	-1.41

* denotes rejection of the null hypothesis at the 1 percent level
 ** denotes rejection of the null hypothesis at the 5 percent level.
 *** denotes rejection of the null hypothesis at the 10 percent level.

The table shows that structural change in either variable has not influenced their order of integration.

B.2. Tests for cointegrating rank (Johansen method)

The following section displays tables of tests of cointegration rank. Note that the real interest rate (R) is included in Tables B.8 to B.11 which is a stationary variable. Thus, one cointegrating equation is accounted for by the inclusion of this variable. Similarly, one of the cointegrating equations in Table B.11 is accounted for by DEF .

Table B.5: Johansen test - equation (1)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.696307	99.63782	94.15	103.18	none *
0.494286	59.11876	68.52	76.07	at most 1
0.355449	35.93807	47.21	54.46	at most 2
0.308023	21.00521	29.68	35.65	at most 3
0.186712	8.48633	15.41	20.04	at most 4
0.042019	1.459539	3.76	6.65	at most 5

NB: test assumes a linear deterministic trend in the data. Number of observations is 34. Variables are C , Y_D , W , SSW , $INFL$, RE .
 *(**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 1 cointegrating equation at 5 percent significance level.

Table B.6: Johansen test - equation (2)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.689459	98.85544	94.15	103.18	none *
0.490654	59.09453	68.52	76.07	at most 1
0.355892	36.15720	47.21	54.46	at most 2
0.297866	21.20095	29.68	35.65	at most 3
0.191654	9.17750	15.41	20.04	at most 4
0.055558	1.94349	3.76	6.65	at most 5

NB: test assumes a linear deterministic trend in the data. Number of observations is 34. Variables are C, Y_D, W_H, SSW, INFL, RE. *(**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 1 cointegrating equation at 5 percent significance level.

Table B.7: Johansen test - equation (3)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.561109	74.553446	68.52	76.07	none *
0.472493	46.554290	47.21	54.46	at most 1
0.307082	24.808068	29.68	35.65	at most 2
0.177558	12.335346	15.41	20.04	at most 3
0.154076	5.689089	3.76	6.65	at most 4*

NB: test assumes a linear deterministic trend in the data. Number of observations is 34. Variables are C, Y_D, SSW, INFL, RE. *(**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 1 cointegrating equation at 5 percent significance level

Table B.8: Johansen test - equation (4)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.716645	134.0288	109.99	119.80	none **
0.676064	91.15290	82.49	90.45	at most 1**
0.445431	52.82775	59.46	66.52	at most 2
0.346046	32.78260	39.89	45.58	at most 3
0.321229	18.34218	24.31	29.75	at most 4
0.134780	5.16813	12.53	16.31	at most 5
0.007207	0.24593	3.84	6.51	at most 6

NB: the test assumes no deterministic trend in the data. Number of observations is 34. Variables are Y_D , W , SSW , $INFL$, RE , R .
 (**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 2 cointegrating equations at the 1 percent significance level.

Table B.9: Johansen test - equation (5)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.681021	104.2433	82.49	90.45	none **
0.625632	65.39392	59.46	66.52	at most 1*
0.352071	31.98838	39.89	45.58	at most 2
0.300637	17.23328	24.31	29.75	at most 3
0.134307	5.07539	12.53	16.31	at most 4
0.005038	0.17173	3.84	6.51	at most 5

NB: the test assumes no deterministic trend in the data. Number of observations is 34. Variables are C , Y_D , W , SSW , RE , R .
 (**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 2 cointegrating equations at the 5 percent significance level.

Table B.10: Johansen test - equation (6)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.698190	112.5350	94.15	103.18	none **
0.641405	71.80445	68.52	76.07	at most 1*
0.388536	36.93536	47.21	54.46	at most 2
0.268219	20.21080	29.68	35.65	at most 3
0.204939	9.59346	15.41	20.04	at most 4
0.051453	1.79602	3.76	6.65	at most 5

NB: the test assumes no deterministic trend in the data. Number of observations is 34. Variables are Y_D , W , SSW , $INFL$, RE , R .
 *(**) denotes rejection of the hypothesis at 5%(1%) significance level.

Likelihood ratio test indicates 2 cointegrating equations at the 5 percent significance level

Table B.11: Johansen test - equation (7)

Eigenvalue	Likelihood ratio	5% critical value	1% critical value	Hypothesised number of cointegrating equations
0.862604	221.28590	141.20	152.32	none **
0.827172	153.79970	109.99	119.80	at most 1**
0.701473	94.11414	82.49	90.45	at most 2**
0.452380	53.01167	59.46	66.52	at most 3
0.343235	32.53778	39.89	45.58	at most 4
0.304555	18.24320	24.31	29.75	at most 5
0.154922	5.894297	12.53	16.31	at most 6
0.005022	0.171190	3.84	6.51	at most 7

NB: the test assumes no deterministic trend in the data. Number of observations is 34. Variables are Y_D , W , SSW , $INFL$, RE , R , DEF .

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.

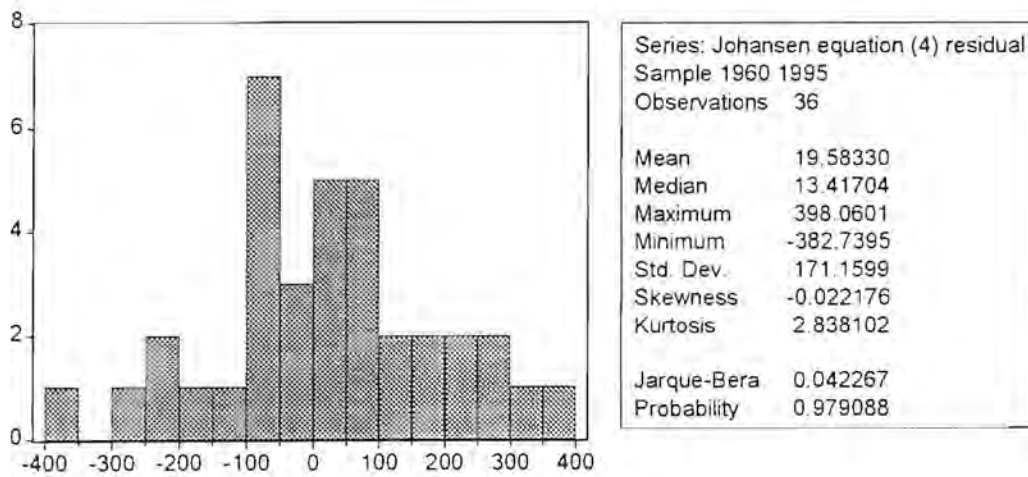
Likelihood ratio test indicates 3 cointegrating equations at the 5 percent significance level.

B.3. Normality tests of residuals

The figures below show a histogram of the residuals of the long-run equation (4) from the Johansen method and the short-run error-correction models. The Jarque-Bera statistic indicates the null hypothesis that the residuals are normally distributed is accepted at the 5 percent level.

B.3.1 Long-run cointegrating equation (Johansen method)

Fig. B.1 Histogram of equation (4) residuals



The null hypothesis is not rejected.

B.3.2 Short-run ECMs

Figure. B.2 Histogram of equation (1) residuals

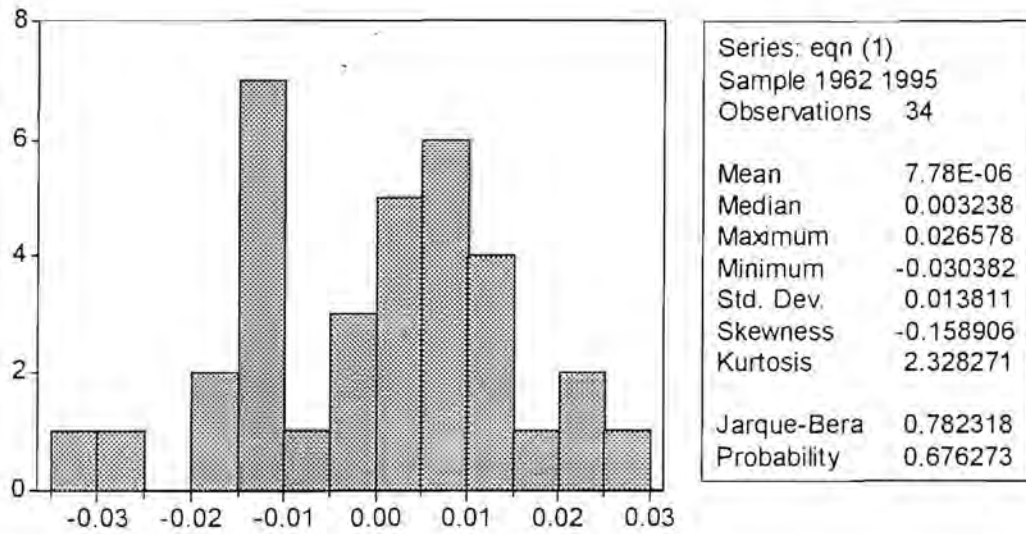


Figure. B.3 Histogram of equation (2) residuals

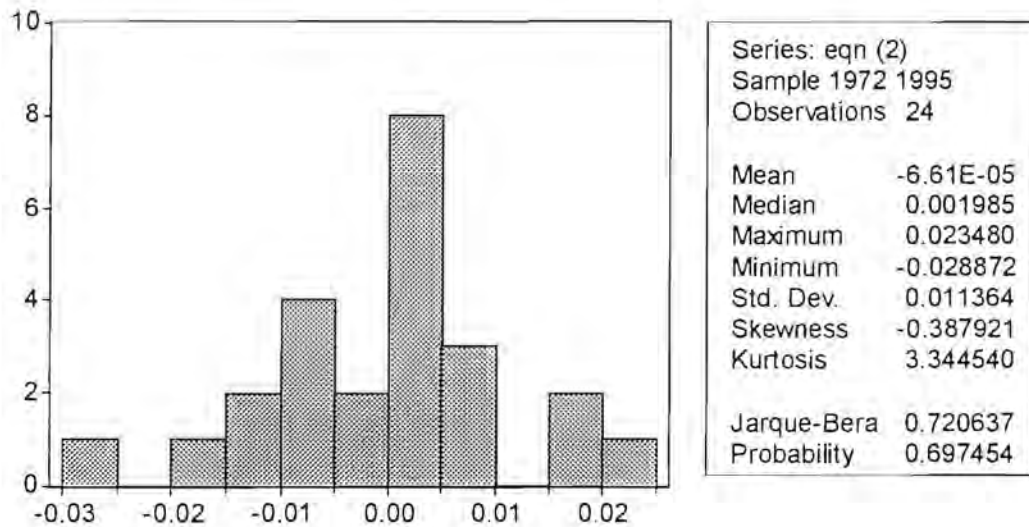
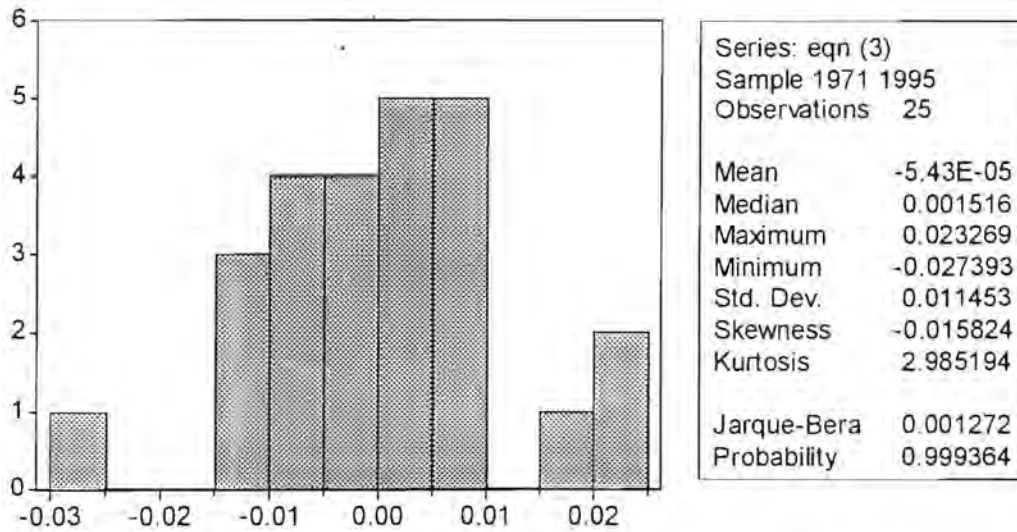


Figure. B.4 Histogram of equation (3) residuals



The null hypothesis is not rejected for any equation.

B.4. Stability tests - recursive estimation of short-run ECMs

Recursive least squares repeatedly estimates the equation using increasing subsamples of the data. Initial estimates of the coefficients are calculated. The next observation is then added and another estimate of the coefficient is calculated. This process is repeated until all observations are used. At each step, the coefficients are used to estimate the value of the dependent variable in the next period. The forecast error is the recursive residual.

A valid model has recursive residuals which are independently and normally distributed with zero mean and constant variance. Residuals outside the two standard error bands suggest parameter instability.

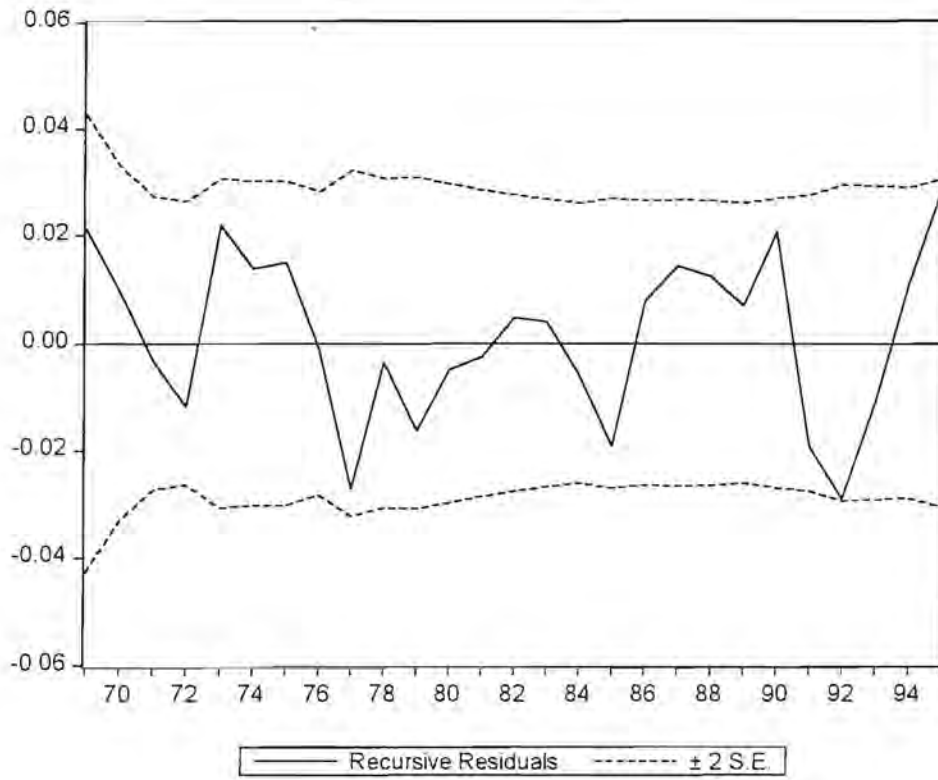
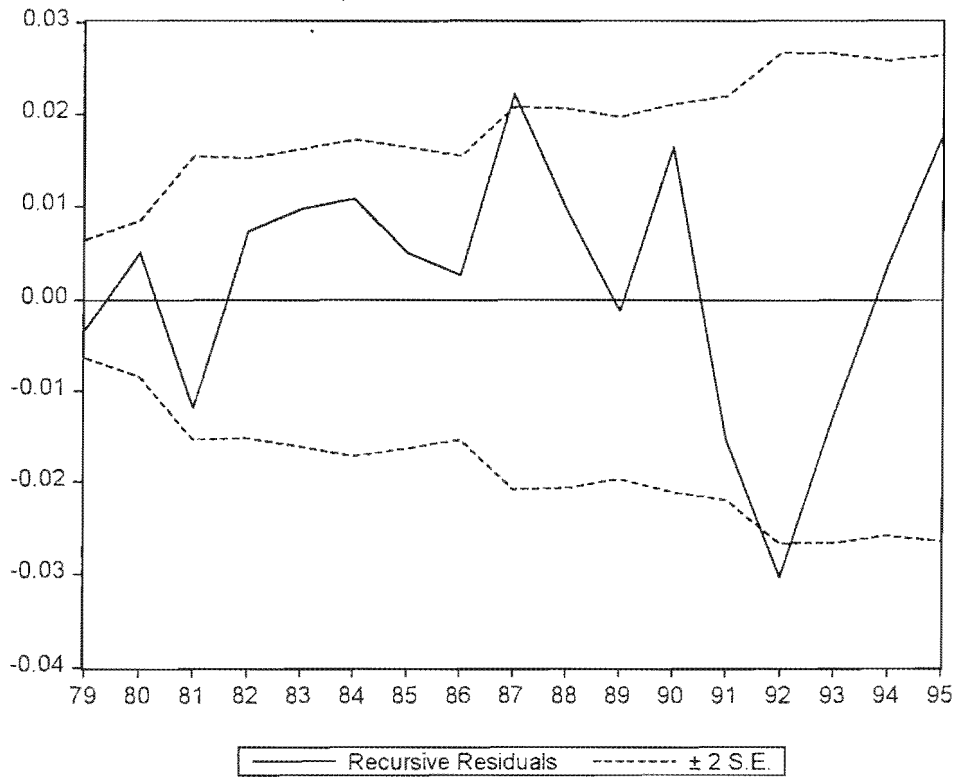
Figure B.5 Recursive residuals: equation (1)

Figure B.6 Recursive residuals: equation (2)



saving, total personal saving may increase because the marginal propensity to consume non-pension wealth is less than pension wealth

Because of liquidity constraints, taxation of pension funds appears to be a better route to increasing total saving than saving incentives, provided the tax revenue adds to government saving. The extent of the tax revenue generated under the current tax structure⁴⁹ will depend on the extent that fund managers substitute away from bonds towards equities.

Furthermore, the taxation of pension funds, combined with a reduction in corporate taxation, would increase total private saving by the corporate and personal sectors, without a corresponding fall in public sector saving. Reduced corporate taxation may help in stimulating investment because of increased retained earnings reducing the need for capital market borrowing.

4.2.2.3 Government debt reduction

Smith (1990:45) makes the important point that government debt is related to unfunded social security. Social security in the form of pension benefits can be regarded as a future claim on the government, comparable to the claim represented by a government bond. Their similarity implies that if social security adversely affects private saving, then government debt should do the same,⁵⁰ thereby refuting the Ricardian Equivalence theorem. This proposition is in contrast to the long-run policy implications of the LCH. Recall that under the LCH, private wealth is independent of national debt. Which view is correct depends on one's convictions as to the accuracy of the LCH. Both views are possible in the South African case because the Ricardian Equivalence proposition was not supported by the data.

The implication of this is that increasing total saving may be best achieved by increasing government saving. This will reduce the level of debt in South Africa,

⁴⁹ Currently a 17 percent tax on interest income of retirement funds.

⁵⁰ Smith does acknowledge the differences between government debt and social security. Government debt "obligations are much less open to change, are marketable, are more easily measured, and are less uncertain... changes in government debt are more apparent and certain than those in social security wealth, and there will probably be greater agreement on their likely effects" (p.45)

which may boost the private saving rate.⁵¹ Although public debt is not high by world standards, current debt-servicing obligations demand around 18 cents of every rand available in the budget (Annett, 1996). Thus, creating an environment conducive to attracting foreign direct investment, combined with public debt reduction will aid in reaching economic growth targets.⁵² This argument is supported by the analysis identifying an inverse relationship between personal saving and the budget deficit.

Increasing government saving will also have a number of desirable side effects. The lack of support for Ricardian Equivalence strongly suggests that bond financed government deficits increase interest rates,⁵³ and thus crowd out private investment. Related to this point is that reducing budget deficits makes monetary policy more manageable. If the Reserve Bank is targeting interest rates, then, in response to a bond financed deficit, it may increase the growth rate of the money stock to prevent interest rates from rising. This puts upward pressure on inflation. Reducing budget deficits will therefore enable the Reserve Bank to have more control over inflation. As the results in chapter 3 showed, if inflation can be lowered, personal saving will be stimulated. Reducing budget deficits will also have positive effects on the trade balance. When the government runs a deficit, aggregate demand is stimulated, increasing the demand for imports and therefore worsening the trade balance.

4.3. Research implications

This study has attempted to answer many pertinent questions regarding personal saving in South Africa, and analysed issues previously not dealt with in the literature. It has also established an avenue for future research. Future research should look to confirm or refute the conclusions reached in this paper. In particular;

1. Compile demographic and industry-wide data in order to estimate a Feldstein-type pension wealth variable. This would permit simulations to be performed in which key variables could change, e.g. tax rates and income growth. It would also allow

⁵¹ Public debt in South Africa as at December 1995 was 57 percent of GDP.

⁵² See GEAR (1996) for details of the integrated macroeconomic strategy to be implemented in South Africa.

⁵³ This is because the increased supply of bonds is not met by increased demand by individuals. This lowers the price of bonds which increases the interest rate.

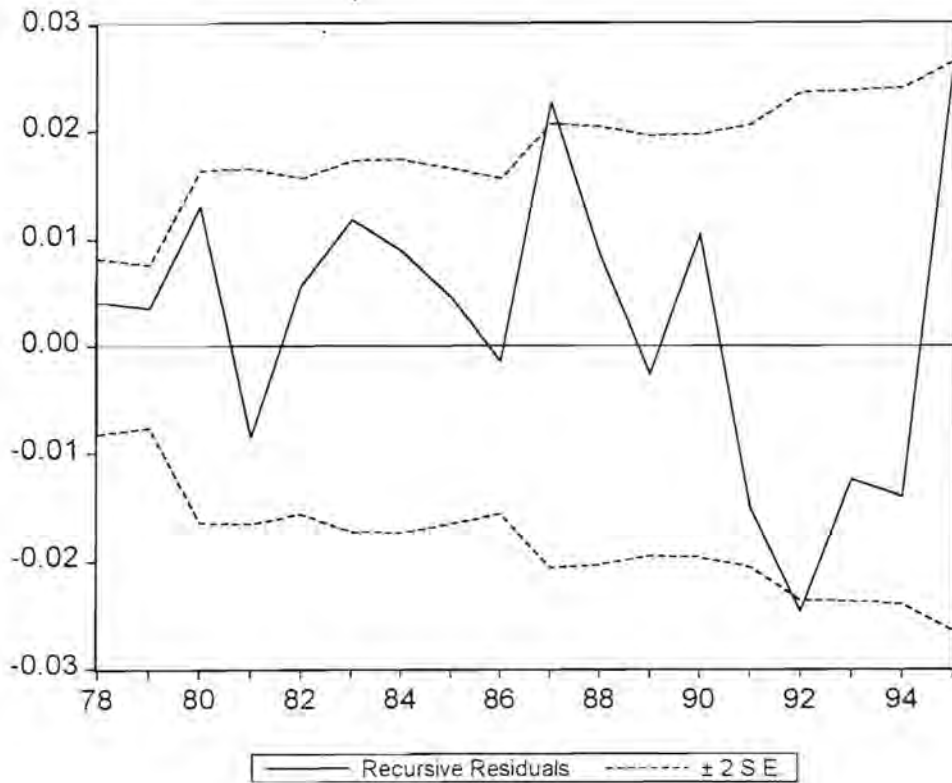
a derivation of unfunded pension wealth. This would be useful in estimating the net effect of all retirement schemes on total saving as opposed to analysing just funded schemes. Estimating the extent unfunded pensions have impacted on the saving rate would also enable an analysis of the impact of government debt on private saving.

2. Conduct a comprehensive cross-section survey or compilation of demographic and industry-wide data on fund members. This would allow alternative quantitative techniques to be used (probit/logit estimation) to compare with the time series estimates in this paper.
3. Compile accurate personal wealth data. This is essential for macroeconomic analysis and policy formulation. An official wealth series would also confirm whether the wealth proxy used in this paper is a fair approximation of household wealth in South Africa. Given that the marginal propensity to consume non-pension wealth is an integral part of the analysis of pensions funds on saving, a representative wealth series is crucial.
4. Future research should re-estimate the model using quarterly data. Quarterly wealth data (pension and non-pension) is unavailable, at least historically. Quarterly indicators should be obtained and reconciled to the annual benchmarks. Quarterly estimation of the model would determine whether the reasonably low sample size in this study has affected the accuracy of the estimates.

4.4. Summary

Because of the nature and composition of personal saving in South Africa, the extent that government policy can influence the personal saving rate is limited. To increase the supply of capital necessary for economic growth, policy should rather be directed towards increasing government sector saving, and attracting foreign direct investment. Policy directed towards increasing government sector saving, and attracting foreign direct investment is a better route to increasing the supply of capital necessary for economic growth. Increasing public saving, and reducing public debt levels will also indirectly stimulate private saving. The ideal method to increase public saving is fiscal discipline. This will produce positive spinoffs via its impact on interest rates, inflation, and the trade balance. It will also convey positive signals to economic agents

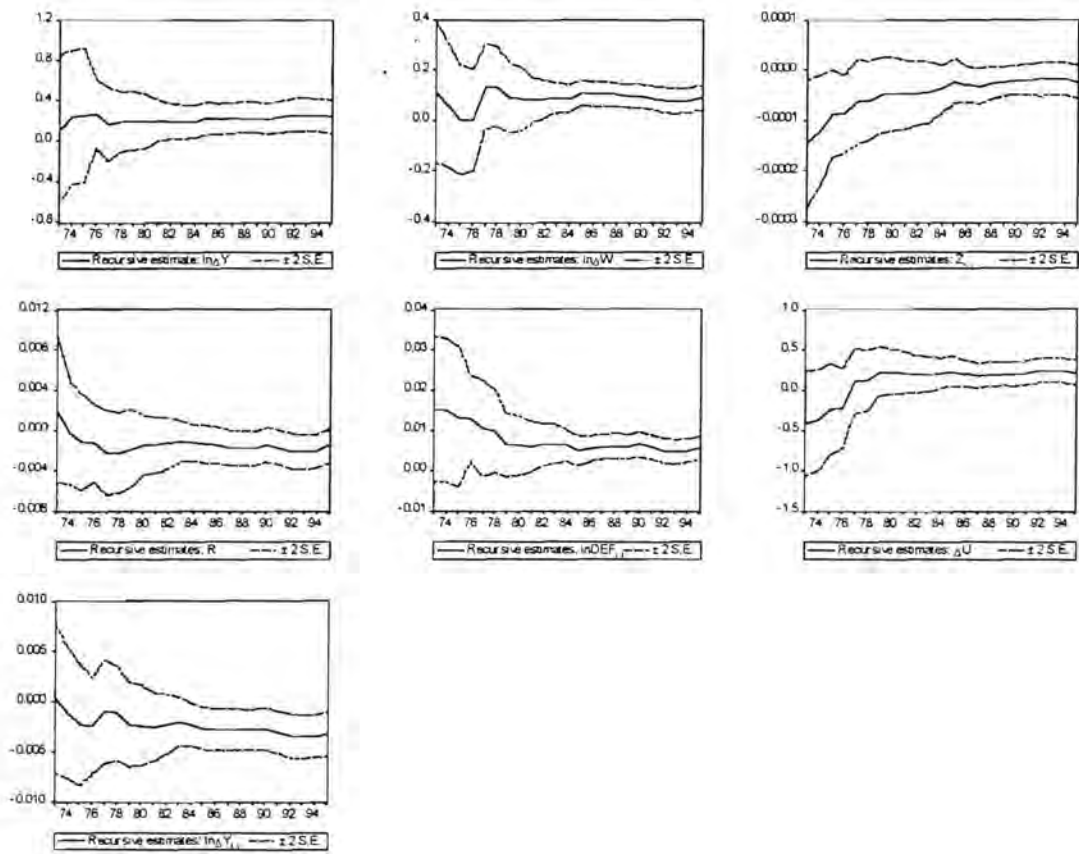
Figure B.7 Recursive residuals: equation (3)



From the figures, equations (2) and (3) appear to display parameter instability.

Recursive coefficients trace the evolution of the coefficients as more observations are added. Significant variation in the path is an indication of instability. The two standard error bands act as a guide for determining instability.

Figure B.8 Recursive coefficients: equation (1)



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