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# ESTIMATES OF PERSONAL SECTOR WEALTH FOR SOUTH AFRICA

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## **ABSTRACT**

### **Estimates of Personal Sector Wealth for South Africa\***

In common with many emerging market countries, South Africa's government does not publish balance sheet wealth estimates on a market value basis, as produced in the US, UK, Japan, and elsewhere. Yet without information on the market values of liquid and illiquid personal sector wealth, it is difficult to explain aggregate consumer spending and saving, consumers' demand for credit, and the broad money holdings of households. Behavioural equations for these variables are key components of central banks' macro-econometric models, used in forecasting and policy-making. Understanding the domestic asset value channel of the monetary policy transmission mechanism is especially important for inflation targeting countries.

We construct the first coherent set of aggregate, personal sector wealth estimates at market value for South Africa. Our quarterly estimates derive from published data on financial flows, and various other capital market data, often at book value. Our methods rely, where relevant, on accumulating flow of funds data using appropriate benchmarks, and, where necessary, converting book to market values using appropriate asset price indices. Relating asset to income ratios for various asset classes to asset price movements and rates of return, throws light on the changing composition of personal sector wealth. Most striking are the rise in pension wealth – overtaking gross housing assets in the late 1980s; the rise in household debt; and the relative decline of liquid and housing assets, from the early and mid-1980s, respectively.

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## 1. Introduction

In common with many emerging market countries, neither the central bank nor other government statistical agencies in South Africa publish balance sheet wealth estimates on a market value basis, of the type produced by U.S. Federal Reserve Board, the Bank of England and the Office of National Statistics in the U.K., and comparable organisations in Japan and elsewhere. Yet, without information on the market values of the main components of personal sector wealth, it is difficult to understand the evolution of aggregate consumer spending and saving, consumers' demand for credit, and the broad money holdings of households. Behavioural equations for these variables are key components of central banks' macro-econometric models, used in forecasting and policy-making. But in the absence of liquid and illiquid personal sector wealth measures, the important domestic asset value channel of the monetary policy transmission mechanism is poorly understood. This is of particular concern for those countries, like South Africa, which have adopted inflation targeting.

While wealth estimates on a market value basis are not published, the South African Reserve Bank has published flow of funds data back to 1970<sup>1</sup>, information on households' holdings of local authority and public enterprise bonds, unit trusts (mutual funds), pension and long-term insurance funds, using a mix of book values and market values<sup>2</sup>, and household debt data. From these data and other sources described below, it is possible, with some difficulty, to assemble a profile back to 1970 of the main components of personal sector wealth. We construct what appears to be the first systematic balance sheet for the personal<sup>3</sup> (household) sector holdings of asset and debts for South Africa (Table 1, and Figures 1 and 2).

Our measures exclude assets for three important areas. The first is personal sector ownership of foreign assets, the acquisition of which was made difficult or illegal by South Africa's regime of

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<sup>1</sup> In National Financial Account 1970-91 on an annual basis, and quarterly from 1992 in the Quarterly Bulletin, Reserve Bank, South Africa.

<sup>2</sup> In Capital Market Statistics 1948-92, and the Quarterly Bulletin, Reserve Bank, South Africa.

<sup>3</sup> The definition of "household" includes unincorporated business enterprises.

capital controls. However, with partial relaxation of these controls since 1995, this asset class is becoming more important. The second is the assets of unincorporated businesses. Data limitations have entailed their exclusion in general. The third is personal sector ownership of corporations not listed on the stock exchange. We follow standard practice in excluding unfunded pension rights. The measurement of these rights in state pensions is a difficult problem in all economies, and estimated values of these rights are generally excluded from official wealth estimates. Nevertheless, the assets and debts, which we can measure with reasonable accuracy are the major part of the assets relevant for consumer spending and portfolio decisions. Moreover, the value of unincorporated businesses and unlisted corporations owned by the personal sector is likely to be strongly correlated with the value of included assets.

A persistent problem in South Africa is low saving rates, especially in the personal sector. Gross domestic saving to GDP has fallen sharply since the 1980s, from an average of 24 percent in 1982-89 to 16 percent in 2003. This rate compares poorly with comparable emerging market economies such as Chile. There has been little formal analysis of saving and consumption in South Africa, and in the absence of data, the role of wealth has never been examined.

We demonstrate the importance of our liquid and illiquid wealth measures in modelling consumption and household debt in South Africa from 1970 (Aron and Muellbauer, 2000a,b), and in the demand for broad money in South Africa (Aron and Muellbauer, 2004). We find statistically highly significant long-run propensities to spend of around 0.12 out of liquid assets, and around 0.06 out of illiquid assets. These estimates are somewhat higher than comparable figures for the U.S. (e.g. Poterba 2000) and the U.K., in part reflecting our underestimate of assets.

The changing asset composition from 1970 is of considerable interest and contains clues about saving behaviour in South Africa more generally. The 1980s saw a significant decline in the ratio to disposable non-property income of liquid assets and housing assets, and a rise in the ratios of debt and pensions. South Africa has one of the most unequal income distributions in the world. It seems likely that the wealth distribution is also very unequal. It is to be hoped that our attempt to measure national totals will inspire future research on the distribution of wealth.

The structure of the paper is as follows. Section 2 gives a brief methodological review of the techniques for converting flow of funds and book value asset data into market value estimates, and of the construction of bond price indices. Section 3 summarizes the construction of the estimates for all the different asset classes. Section 4 interprets the estimates, and graphical comparisons with key relative prices and rates of return provide important clues to help account for the changing composition of wealth, as well as changes in individual asset to income ratios. Section 5 summarises and concludes. Two appendices give further details of the methodology.

## 2. Methodology

Over time, each asset balance sheet is linked to the previous period's balance sheet through an identity (e.g. Doggett, 1998, p.139, U.K. Central Statistical Office, 1978). The stock of assets at the end of the accounting period is equal to the stock at the beginning of the accounting period, plus asset acquisitions and less disposals by transactions taking place during the period, plus other changes in volume (e.g. through destruction or discovery of assets), plus the net gains accruing from holding assets through the period (i.e. capital appreciation). Note that interest or dividend income plays a role only insofar as the reinvestment of such income may be funding asset acquisition.

For those financial assets that are not traded in a secondary market and are thus not subject to revaluation through capital appreciation (e.g. bank and building society deposits), this identity simplifies to the following stock-flow identity:

$$(1) \quad BA_t = BA_{t-1} + NPA_t$$

where  $BA_t$  is the end-of-period stock and  $NPA_t$  is the flow of net purchases of assets in the period.

The identity (1) also governs the evolution of stocks defined *at book value* for financial assets, such as equity and bonds, which are subject to revaluation in a secondary market. To derive the corresponding market values, we have to add the net holding gains by the end of the period on the

market value of the stock at the beginning of the period, as well as to add any holding gains on net purchases made during the period.

The revaluation adjustment can be explained as follows. Let  $A_{t-1}$  be the market value of an asset at the end of the period, t-1. Let  $\pi_{t-1}$  be the corresponding price index. Let  $NPA_t$  be net purchases of the asset in the period. Then

$$(2) \quad A_t = A_{t-1}(\pi_t / \pi_{t-1}) + (NPA_t)(\pi_t / \tilde{\pi}_t)$$

where  $(\pi_t / \tilde{\pi}_t)$  is the revaluation adjustment of net purchases made in period t, which would equal 1, if prices remained unchanged over the period, and  $\tilde{\pi}_t$  is the average price paid during the period of purchases, since purchases are spread over the period<sup>4</sup>. Given an asset benchmark at an initial date, data on the net purchases in the period and the corresponding price indices, the revaluation adjustment in equation (2) can be used to convert book to market value data.<sup>5</sup>

The methodology for estimating price indices for fixed interest securities is given in Appendix 1. Historical data on government bond price indices from the Johannesburg Stock Exchange (JSE) - and more recently from the JSE Securities Exchange - begin in 1980, while the Reserve Bank has published a bond price index only from 1999. We therefore use standard price-yield

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<sup>4</sup> A quarterly revaluation adjustment is approximated as follows. Assume that net asset purchases,  $NPA_t$ , are evenly distributed in nominal terms over the three months of the quarter. With monthly price indices, the revaluation adjustment is  $(\sum_{i=1,3} \pi_t / \pi_{ti}) / 3 = \pi_t / H\pi_{ti}$ , where  $H\pi_{ti}$  is the harmonic mean of monthly prices in quarter t, with i representing the month of the quarter. Thus,  $\pi_{t1}$  is the index for the first month of the quarter, and  $\pi_{t3} = \pi_t$  is the end-of-quarter index.

<sup>5</sup> For the 1970-91 period, where the flow of funds is on an annual basis, we assume the quarterly flows are one quarter of the annual flows.

relationships to derive price indices for short and long-duration government bonds before 1980. We hold coupons and the maturity fixed for quarter to quarter comparisons, and chain these indices.

### 3. Asset Data for South Africa's Personal Sector

In the U.K. and the U.S., the personal sector's asset balance sheet is typically divided into financial assets, financial liabilities and tangible assets.<sup>6</sup> Sources for personal sector balance sheet data include surveys of asset holdings of households and of liabilities of financial institutions, accounting data from the financial institutions and share registers.

The South African Reserve Bank, responsible for National Accounts data, does not produce personal sector balance sheets. There are no household surveys of asset ownership; and data on the estates of the deceased have not been used to obtain estimates of personal wealth.<sup>7</sup> However, financial flow of funds data, derived from monthly, quarterly or annual institutional returns, are published in the National Financial Account, available annually for 1970-91 and quarterly thereafter. In Capital Market Statistics, stock data at book value are published for some items, primarily different types of pension assets and holdings of local authority securities, and market values for unit trusts (mutual funds), from December, 1991 for long-term insurers and from March, 1999 for private pension funds.

We have constructed a balance sheet for the personal sector holdings of asset and debts, and for selected years, the various components of wealth and total net wealth, scaled by income, are shown in Table 1. The main asset categories are liquid assets, household debt and various categories of illiquid financial and physical assets, including pension wealth, directly held shares and bonds and

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<sup>6</sup> U.S. Federal Reserve Board statistical releases No. B.100: "Balance Sheets of the Household Sector", and Guide to the Flow of Funds Accounts (2000). "Studies in Official Statistics No. 35", U.K. Central Statistical Office (1978), and Doggett (1998), chapters 9 and 22.

<sup>7</sup> There are two single province studies using data on estates in South Africa, but they give little information on the fractions of wealth held in different asset classes (McGrath (1982) for the Natal province in 1972; and Van Heerden (1996) for the Transvaal province in 1985).

housing. The stock of consumer durables, less marketable than the above assets, is shown as a memorandum item, as in the U.K. and the U.S..

For a few categories, asset stocks at market value are published, or can be fairly easily derived. For instance, estimates of household debt are compiled by the Reserve Bank and published from 1991 (we obtained unpublished data for earlier years). Estimates of gross housing assets can be made from constant price stock estimates for the personal sector (unpublished data from the Reserve Bank) and house prices data. Market values of the stock of consumer durables can be estimated using the perpetual inventory method from constant price purchase data and durables price indices (Appendix 2).

For the remaining assets in Table 1, plausible stock benchmarks are assumed in a base year, and equations (1) or (2) are used to cumulate components of the published flow of funds data into stock estimates. Of these assets, only personal sector liquid asset stocks, other deposits, participation bonds and debt are not traded. All the other assets are traded, and hence are subject to revaluation.

In what follows, for each type of asset, a summary is given of the stock benchmarks assumed, the price indices used and methods for constructing quarterly market value wealth stocks from available data for 1970 to the end of 1997. The benchmarks are given in the 1969 column of Table 1. Technical details are given in Appendix 2.

PLACE TABLE 1 ABOUT HERE

### 3.1 Personal Sector Liquid Asset Stocks

The Reserve Bank's Quarterly Bulletin publishes a quarterly analysis of bank deposits by type of depositor, from 1991Q3. Summing the components for the personal sector<sup>8</sup> provides a series for

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<sup>8</sup> These categories are deposits in banks by individuals, unincorporated enterprises and non-profit organisations, deposits in mutual banks, the Postbank, the Landbank; and notes and coins (half of which we attributed to the personal sector). From 1997, they also include money market funds, see the unit trust table in Capital Market Statistics.

personal broad money holdings and a benchmark for 1991Q3. Prior to 1991Q3, we cumulate the flow of funds using equation (1) - with an adjustment for missing data - to construct personal broad money holdings, with a second benchmark for 1969Q4. Before 1991Q3, the flow of funds understated the growth of broad money because flows for unincorporated businesses were omitted from the personal sector. We assume that a proportion  $\theta_2$  of M3 was left out of the household sector total assets. We combine the two benchmarks to estimate  $\theta_2$  from the following expression for the adjusted stock of liquid assets assumed to hold for 1969Q4 to 1991Q3:

$$(3) \quad stock_t^{adj} = stock_{t-1}^{adj} + FOF_t + \theta_2 \Delta M3_t$$

where FOF refers to the net flow of deposits from the flow of funds, and  $\Delta M3_t$  is the change in broad money, M3. In the absence of other information on the 1969Q4 benchmark, we draw on U.S. and U.K. experience. In 1969, in the U.S. around 80 percent of broad money was held by households, and in the U.K., the comparable figure was 85 percent, figures that remained stable into the mid-1970s<sup>9</sup>. Prior to 1992, only annual flows are available for South Africa. To obtain quarterly FOF data for this period, we assume the ratio of the quarterly flow to the annual flow is the same for household M3 and for total M3, so scaling the annual changes for households by the ratio of the quarterly to annual changes for M3. Table 1 presents estimates of personal broad money holdings based on 80 and 85 percent benchmarks for 1969.

### 3.2 Other Personal Sector Deposits

In the flow of funds, two other types of deposits are listed: ‘deposits with other financial institutions’ (item 13) and ‘deposits with other institutions’ (item 14). These flows are dominated by the former

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<sup>9</sup> The sources for these figures are the Federal Reserve Balance Sheets and the National Income and Expenditure Balance Sheets in *The Blue Book*, U.K. National Accounts.

category, which includes deposits with pension funds and life insurance companies not yet credited as pension assets. There is some difficulty about whether to categorise these deposits as liquid assets, directly held illiquid financial assets, or as pension wealth. Fortunately, until the mid-1990s, the flows are small relative to all three of the alternative categories. We have chosen to group them with directly held illiquid financial assets.<sup>10</sup>

### **3.3 Participation Mortgage Bonds**

These are long-term investment vehicles, used mainly by private individuals, providing pooled mortgages for commercial and other real estate investment. The outstanding assets owned by individuals are reported in Capital Market Statistics.

### **3.4 Government and Public Enterprise Asset Stocks**

Government and public enterprise components of the flow of funds comprise short-term and long-term government stock, and the securities of local authorities and public enterprises. We omitted non-marketable government debt, due to data inconsistencies<sup>11</sup>; but the holdings fortunately are small (for instance, relative to liquid assets).

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<sup>10</sup> However, since money market funds are included in liquid assets from 1997, we therefore remove these from “other personal deposits” from 1997. A further problem concerns the choice of benchmark in 1969Q4. If from 1969Q4 to 1991Q4, the cumulative flow in these two categories is denoted X, while the change in our constructed household broad money measure is denoted Y, the ratio of X to Y is 0.048. A similar figure holds for cumulative flows up to 1980Q4 and 1985Q4. We therefore take this ratio to determine the 1969Q4 benchmark for “other deposits” relative to the benchmark for household broad money.

<sup>11</sup> For non-marketable government debt, largely of short duration, asset revaluation is not relevant, suggesting cumulating the book value data. However, with any plausible assumptions on a 1969

The benchmarks for short-term and long-term government stocks come from data on the ownership of end-1969 stocks<sup>12</sup> in Public Finance Statistics; while quarterly figures on the personal sector ownership of the securities of local authorities and public enterprises are available from 1970 in Capital Market Statistics.

All these figures are on a book value rather than on a current market value basis, and require the revaluation adjustment using equation (2), see Section 2 on the sources for the bond price indices. However, short-term yields are roughly constant during 1965-69, suggesting the 1969 book values are reasonable approximations to the market values.

### 3.5 Equities and other Corporate Securities

Data at market prices of personal sector holdings of unit trusts (mutual funds) published in Capital Market Statistics go back to 1965. The flow of funds measure corporate ‘loan stock and preference shares’, and ‘ordinary shares’, including unit trusts and directly held shares. No data are available on ownership by the personal sector, since surveys of share registers and of household finances carried out in the U.S. and U.K. are not carried out in South Africa. In the U.K., personal sector ownership of the ‘loan stock and preference share’ category in 1969 was estimated to be around 5 percent of the total of its ordinary shares, unit trust and investment trust holdings (U.K. Central Statistical Office, 1978). We adopt the same percentage for the 1969 benchmark for South Africa. This category is a

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benchmark asset figure, the cumulated asset totals obtained using equation (1) become negative after 1991, suggesting serious underestimation of net acquisitions in earlier years. This inconsistency would have come to light if the Reserve Bank had constructed regular balance sheets as well as the flow of funds data. (Note that Treasury bills and other bills are also omitted because the flow of funds record zero transactions for the personal sector – see Table 1.)

<sup>12</sup> We take the category “other owners” to refer to the personal sector for the 1969Q4 benchmark, and use the flow of funds to generate the later data.

mix of corporate bonds and equities, and we use a weighted average of an index of corporate bond prices and of equities for the revaluations in equation (2), see Appendix 1 and 2.

For ordinary shares, finding the appropriate benchmark for 1969 is controversial. In South Africa's sophisticated financial sector these holdings are expected to be sizeable, but could be expected to be in rough proportion to those in the U.K. and the U.S., given a similar culture of share ownership. In the U.S., the ratio of holdings of directly held equities to equities held in mutual funds in 1969 was around 10:1. In the U.K., the corresponding ratio to unit trusts was 16:1, but was closer to 10:1 if investment trusts (closed-end mutual funds) are added to unit trusts. We compare two alternative benchmarks for South Africa in 1969, of 10:1 and 15:1 to unit trusts. These imply that the total value of equities (including unit trusts) held by the personal sector were respectively, 28 percent and 41 percent, of the market capitalization of equities quoted on the JSE at the end of 1969.<sup>13</sup> Equation (2) is used to calculate market values stocks using the JSE all share index, but we adjust this for assumed trading or management costs of 1.6 percent per annum.

### **3.6 Pension stocks**

The largest financial asset class from the flow of funds is 'interest in retirement and life funds'. However, we take the more useful stock data in Capital Market Statistics on asset holdings of private self-administered pension and provident funds<sup>14</sup>, official pension funds (pensions for government and parastatal employees), and also long-term insurers.

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<sup>13</sup> The corresponding figure for the U.K. in 2002 was 25 percent, but was substantially higher in the 1970s.

<sup>14</sup> This category includes privately-administered funds registered in terms of the Pension Funds Act (includes funds similar to Individual Retirement Accounts in the U.S.), foreign funds registered in South Africa, funds established in terms of industrial agreements (typically both employees and employers contribute), and state controlled funds exempted from the requirements of the Act. Funds covered by long-term insurers are excluded.

Some general remarks on pensions are in order. Even in countries where pensions tend to be funded rather than pay-as-you-go, there is a problem matching assets recorded in pension funds (whether public or private) and the obligations or promises made to future pensioners. This affects the expectations of pensioners, and hence the consumer expenditure implications of recorded pension assets. Bulow (1982) discusses the considerable difficulties in valuing such rights or liabilities. Nevertheless, sharp declines in recorded pension assets to income are liable to be followed by higher household contributions, and, in some cases, by dilution of benefits and reduced confidence in the value of previously expected benefits. In the U.K., government statisticians have, on occasion, produced estimates of corporate occupational and state pension rights back to the late 1970s, using demographic information, detailed Inland Revenue information about pension contributions and payments, and company information (Stewart, 1991). A similar exercise might be worth carrying out for South Africa, but is far beyond the scope of this paper<sup>15</sup>.

(i) *Private Self-Administered Pension and Provident Funds*

For private self-administered pension and provident funds, there are quarterly data on the portfolio composition of assets back to 1963, and annual data back to 1958, both on a book value basis. There are seven groups of assets subject to revaluation. We apply equation (2), with 1961Q4 benchmarks, to adjust the book values of the assets to market value, after constructing price indices for each group (details in Appendix 2). In 1999Q1, these funds were required to shift to a market valuation basis, an important check on our methods of adjusting book to market values.

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<sup>15</sup> Pensions paid out by official pension funds tend to be of the defined benefit form (e.g. linked to salaries in the pre-retirement years). Before the early 1990s, according to the Mouton Report (1992), significant under-funding was common. In a series of reforms since 1989, state pension rights, providing a minimum of income support for those over retirement age, have been extended from the white population only, to all races. State pensions are means-tested, and in 1993 were around thrice median adult income for the black population (see Case and Deaton, 1998). The majority of black South Africans of pensionable age are eligible for these benefits.

(ii) *Long-Term Insurers*

Around half the liabilities of long-term insurers represent personal sector pension assets.<sup>16</sup> For long-term insurers, quarterly data on the portfolio composition begin in 1963, and annual data in 1946. The procedure outlined above can be followed using 1961Q4 benchmarks. However, there is one quite serious difficulty. Between the third quarter of 1985 and the third quarter of 1991, some insurers reported at market values and others at book values, while from the fourth quarter of 1991, all insurers were required to switch to the market value basis. Unfortunately, we do not know the proportions, which reported on either basis, and the proportions appeared to alter after the October, 1987 stock market crash. Appendix 2 gives details of the assumptions made which give the most plausible outcomes. In Table 1, we report two variants of these assumptions for 1985 and 1990. Sensitivity to the alternative assumptions is small.

(iii) *Official Pension Funds*

For official pension funds, which provide pension care for public sector employees, there are annual book value portfolio composition data back to 1974. Prior to 1974, there are annual data for total assets at book value, going back to 1948. These funds started investing in ordinary shares, other company securities and fixed property only in 1990, when quarterly data begin. Prior to 1990, government, local authority and public enterprise bonds accounted for more than 85 percent of total assets invested. We use 1961Q4 benchmarks with equation (2) to convert book to market values, but unlike the previous two pension categories, have no market value data to check our assumption.

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<sup>16</sup> In this paper we do not include the non-pension business of long-term insurers as contributing to personal sector assets.

### 3.7 Private Housing Stocks

The Reserve Bank provided unpublished annual estimates of the gross private housing stock for households in constant prices dating from 1960. The constant price stocks require adjustment for the value of the associated land, and conversion to current prices using an appropriate house price series. We assume that in 1995 the underlying land value of a typical home is one third of the value of the building, so that land accounts for one quarter of the total value. Thus, these estimates are scaled up by one third, multiplied by the average price of a medium-sized housing unit, and then divided by the average house price in the base year of 1995.

The robustness of the land value assumption can be tested by applying a similar method to the U.K., where the results can be calibrated against more accurate estimates of personal sector ownership of dwellings. In the U.K. in 1995, at the end of a severe housing recession, the ratio of the market value of residential housing (including land value) owned by the personal sector was 1.25 to gross private capital in dwellings at market prices, and was 1.31 to the gross capital stock of dwellings owned by the personal sector (*The Blue Book*, United Kingdom National Accounts, 2001). The corresponding ratios in the year 2000, after a substantial boom in house prices, were 1.49 and 1.56, respectively.

In South Africa, land is cheap relative to internationally traded goods, but dwellings usually have larger plots. While the assumption of a scaling factor of 1.33 is plausible (i.e. giving land one quarter of the value of a residence), we also present estimates in Table 1 for scaling by 1.25.<sup>17</sup> We tested the sensitivity of the housing wealth estimates to the medium house price index (from ABSA Bank Ltd., South Africa, one of the larger mortgage providers). Since 1990, there has been a small rise in the relative price of small houses to medium and large houses. However, a weighted average

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<sup>17</sup> Note that the underlying land value does not add a constant share to the value of the house over time. These scaling factors apply only to the benchmark year of 1995, and vary as house prices - which reflect land prices - change relative to the construction costs of houses.

of small, medium and large houses, using plausible weights, moves very similarly to the medium house price index, so this is unlikely to be a significant source of bias.

### 3.8 Consumer Durables

The Reserve Bank provides annual data on purchases of four different kinds of durables back to 1946.<sup>18</sup> Following the most recent practice in the U.S. (Katz and Herman, 1997) and U.K. (U.K. Central Statistical Office, 1998), we have assumed different geometric depreciation rates for different durables categories.<sup>19</sup> For the durables categories, only annual price indices and annual investment flows are available, though quarterly data are published for total durables. Constant price stocks were computed from the constant price purchases using the perpetual inventory method, and converted to current prices using the fourth quarter deflator for total consumer durables.

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<sup>18</sup> Categories are given in Table 1. Van der Walt and Prinsloo (1993) assume service lives of 10, 8 and 5 years for categories A, B and D, respectively. Recent U.S. practice (Katz and Herman, 1997, 1997) assumes the following service lives: 10-14 years for category A, 8-10 years for durables comparable to South Africa's in category B (excluding tyres and other accessories), 9 years for category C, and 6-11 years for category D. In the U.K. (U.K. Central Statistical Office, 1978), the service lives are assumed to be 10-25 years for category A, 10 years for category B and 8-10 years for category C. We assume service lives of 12, 9, 8 and 8 years for the categories A-D, respectively, for South Africa.

<sup>19</sup> The geometric depreciation rates are:  $(1/\text{servicelife}) \times \gamma$ , where  $\gamma$  is 1.65 or 1.853, for longer or shorter service life series, respectively. This implies annual depreciation rates respectively of 0.1375, 0.1833, 0.2063 and 0.2063 for categories A-D (see Table 1). We exclude semi-durables, though a service life of 3 years would seem appropriate.

### 3.9 Total Net Wealth

Two measures for total net wealth, scaled by income, are shown in Table 1. Total net personal wealth is defined as the sum of liquid assets minus household debt; plus gross housing assets; plus illiquid financial assets – comprising other deposits, participation mortgage bonds, short-term, long-term and other government bonds, local authority and public enterprise bonds, and ordinary shares and other corporate securities held by the public; plus pension assets - comprising private and official pension assets and long-term insurer pension assets.

Current United Nations guidelines recommend that consumer durables should be shown only as a memorandum item, and not be included in personal sector net wealth estimates. However, we also present an alternative net wealth total that includes durables. This adds of the order of one sixth to the net wealth total, and produces a slightly more stable series overall.

Foreign assets are largely omitted from our net wealth measures. Long-term insurers' assets include small elements of foreign assets, but there are no estimates of personal sector ownership of foreign assets. Despite stringent domestic exchange controls, there were inevitable loopholes. Several authors have attempted to estimate the extent of capital flight from South Africa (Fedderke and Liu 2002; Smit and Mocke, 1991). Even if such estimates were accurate, they would need to be converted into stocks without knowing their portfolio composition. Yet more difficult would be to apportion the personal sector share of these assets. We have not attempted any such estimates.

As mentioned above, there is no coverage of assets of unincorporated businesses in our measures of personal sector assets, except for their inclusion in liquid assets. Neither capital formation estimates nor profit figures are published which separate out the unincorporated business sector from private enterprises as a whole. Yet, given South Africa's large farming sector, one might expect this sector to be of significant size, and the exclusion of most of the tangible assets owned by this sector

therefore to lead to a significant underestimation of personal sector net wealth.<sup>20</sup> However, it seems likely, given changes in corporate and personal tax systems during the 1970s and 1980s, that there has been a tendency towards the incorporation of previously unincorporated businesses. Thus, the share of the assets of unincorporated businesses in total assets of the personal sector may have fallen in this period.

There is probably some overlap between this category and that of unquoted securities. For comparability, in the U.K. in 2002, personal sector ownership of unquoted securities was estimated at around 4 percent of its gross financial assets, close in value to the personal sector's ownership of unit trusts (mutual funds).

#### **4. The Changing Composition of Personal Wealth**

The considerable fluctuations in total net personal wealth (excluding consumer durables) are shown in Figure 1, relative to a four quarter moving average of personal disposable income<sup>21</sup>. The relatively high wealth-to-income ratio in the early 1970s, associated with strong economic growth and high gold prices, declined in the mid to late 1970s as the world economy faltered and as domestic political difficulties increased (e.g. the schools boycott in 1976). The ratio rose following a large gold price boom around 1980, when high share values were followed by house price and investment booms. When economic and political difficulties increased in the 1980s, and the debt crisis of 1985 and

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<sup>20</sup> One indication is given by the size of bank deposits by unincorporated businesses. At the end of 1997, the ratio of these deposits to those of individuals was around 18 percent, while the ratio to total bank deposits was around 6 percent.

<sup>21</sup> In modelling household expenditure or portfolio decisions in the current quarter, one would normally use asset data at the end of the previous quarter, and current quarter personal disposable *non-property* income rather than the moving average of personal disposable income (PDI), see Aron and Muellbauer (2000a,b). However, PDI is more comparable internationally, while its non-property variant is subject to approximations of varying complexity, see Blinder and Deaton (1985).

international trade and financial sanctions severely constrained access to capital and trade, growth weakened and real house prices began a long-term decline. A gold price recovery in the late 1980s brought a temporary rise in the wealth-to-income ratio; but since 1988, the ratio has fluctuated in a relatively narrow range, despite the positive political changes in South Africa.

PLACE FIGURES 1 AND 2 ABOUT HERE

We now turn to some of the compositional changes in wealth. Figure 1 also shows debt and liquid asset to income ratios, while Figure 2 shows pension assets, gross housing assets, directly held financial assets and consumer durables, relative to income. Most striking are the rise in pension wealth - overtaking gross housing assets in the early 1990s; the rise in household debt; and the relative decline of liquid and housing assets, from the early and mid-1980s, respectively. Directly held securities (including unit trusts or mutual funds) appear to have declined since the early 1970s, but have moved in a relatively small range since the mid- 1980s.

#### 4.1 The Debt to Income Ratio

Total household debt data have been published by the Reserve Bank since 1991Q3. Van der Walt and Prinsloo (1995) and Prinsloo (2002) publish detailed charts of total household debt and its main components, and information on the institutional framework, data sources and determination of household debt. Table 1 includes entries on consumer credit and mortgage debt (using unpublished data).

Figure 3c displays the real prime interest rate, followed closely by mortgage rates<sup>22</sup>. The positive correlation between the real interest rate on borrowing and the debt to income ratio (Figure 1), particularly since 1980, is striking. This is likely to be the result of two factors. The first factor is inflation, which historically tended to be correlated with negative real returns, and also with a fall in the value of nominal debt outstanding relative to nominal income. The second factor is financial

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<sup>22</sup> The ex-post real interest rate is measured by  $r - \Delta_4 \ln pc$  where  $r$  is the four quarter moving average of the nominal prime interest rate and  $pc$  is the consumer expenditure deflator.

liberalisation. The removal of quantitative controls over credit in the early 1980s, associated with a move to controlling credit expansion via higher interest rates, induces a positive correlation between a supply-driven credit expansion and higher interest rates. This phenomenon has also been observed in other countries, such as the U.K., and in Scandinavia, which underwent financial liberalisation in the 1980s (see Berg, 1994, and Lehmusaari, 1990).

The determination of the debt to income ratio was the subject of a detailed econometric investigation by Aron and Muellbauer (2000a,b). Interest rates, financial liberalisation and the housing, pension and liquid assets components of wealth are the key determinants, and we find that the role of gross housing assets increased with financial liberalisation. The rise in the debt to income ratio occurred despite the decline after 1983 in the ratio of housing assets to income, and high real interest rates in the mid-1980s and the 1990s. Note that there is no tax relief on mortgage interest and floating rate mortgages are the norm.

PLACE FIGURE 3 ABOUT HERE

#### **4.2 The Liquid Asset to Income Ratio**

The decline in the ratio of liquid assets to income is partly accounted for by financial liberalisation from 1983, extending into the 1990s (Aron and Muellbauer, 2000a,b). As access to credit improved, the precautionary, buffer-stock and consumption smoothing motives for holding liquid assets, see Deaton (1992), declined. It is likely that there was also an overall wealth effect, with the net wealth to income ratio influencing the liquid asset ratio - see Thomas (1997) for such an effect in the U.K..

Political credibility effects, inducing currency substitution away from domestic assets and toward illegal foreign assets, may also have been a factor in the declining liquid asset to income ratio from 1976, and again after the debt crisis of September, 1985, reversing with the successful democratic elections of 1994.

However, the main factor is that for an average tax-payer, the real after-tax return on liquid assets has been negative from the early 1970s to the early 1990s - apart from a brief spell in 1984-5

(see Prinsloo, 2000, p.17). The weighted average of marginal tax rates rose from around 10 percent to over 30 percent from 1970 to the 1990s.

### **4.3 The Gross Housing Assets to Income Ratio**

Figure 3a plots the gross housing asset to income ratio against the house price index divided by the overall consumption deflator. Most of the rise in the early 1980s and subsequent decline in housing assets relative to income is due to the rise and then decline in the real house price index: real housing stocks have expanded approximately in line with real household income.

Fluctuations in the real price of South Africa's principal mining export, gold, between 1970 and the late 1980s, explain some of these changes. It is well-known that positive temporary terms of trade shocks raise (with a lag) the relative prices of non-traded goods (both services and capital goods) to tradables (Collier et al, 1999). Housing assets experienced a boom and then bust in the early 1980s, after gold prices rose temporarily from around \$300 to over \$800 dollars per ounce.

Borrowing costs obviously also have an impact on the housing market, in part because they are such an important ingredient in the user cost of housing. The latter depends on the interest rate minus the expected rate of house price appreciation. Figure 3c shows the prime rate of interest to which mortgage and other borrowing rates are closely linked. Some of the rise from 1983 to 1985 could have been associated with financial liberalisation (Aron and Muellbauer, 2000a,b).

Our detailed econometric work on house prices in South Africa, Aron, Muellbauer and Smit, 2003, suggests plausible long-run income effects on house prices, in line with international evidence, of an elasticity in the range 1.5 to 2. Further, we find a small financial wealth effect, and powerful interest rate effects from the nominal borrowing rate, and the long rate-short rate spread, as a measure of interest rate expectations. The rate of growth of real domestic credit has a positive effect, while inflation volatility has a strong negative effect on real house prices. In the longer-run, the evolution of demography and international migration, income distribution, the political environment and crime

rates, are likely to have been important. Our model captures such hard to measure influences through a stochastic trend, which reveals a strong decline from 1983 to 1998, after which it stabilises.

#### **4.4 The Durables to Income Ratio**

The 1970s are characterised by an upward trend in the durables to income ratio, despite the decline in relative prices of durables. Figure 3b shows the market value of the stock of consumer durables relative to income and the real price of durables<sup>23</sup>. It seems likely that income growth, net wealth and relatively low real interest rates help to explain the relatively strong accumulation of durable stocks at this time. The temporary decline in 1980 is largely explained by the surge in disposable income given the gold price boom, and the lagged response of stocks to durable purchases. Stocks rose strongly subsequently relative to income, with low real interest rates in 1981-82 a contributing factor; this was reversed around 1985, with the rise in real interest rates and fall in asset prices.

Trade sanctions between 1985 and 1990, help to account for the rise in the relative price of durables, raising the valuation of the existing stock. This was reversed from 1990, when the economy was opened to international competition. Real per capita household income in the 1990s and net wealth to income ratios show no sustained increases, while real interest rates rose, so providing little stimulus for rises in real purchases. Overall, the decline in the durable stock to income ratio in the 1990s, and its correlation with the relative price of durables, can be readily understood.

#### **4.5 The Ratio to Income of Pension Assets and Directly Held Securities**

The striking rise in the pension assets to income ratio relative to that of directly held securities to income, was illustrated in Figure 2. In Figure 4, the log pension ratio is plotted against the log total

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<sup>23</sup> This is measured as the durables deflator relative to the deflator for total consumer expenditure.

return indices in equities and long bonds. It also shows the rising proportion of pension assets invested in equities - from 20 percent in the early 1970s to over 50 percent by the 1990s.<sup>24</sup>

It is notable that the correlation between the pension to income ratio and the total returns index for equities increases, as should be expected, with the proportion of pension assets in equities. The correlation with the total return index in bonds is therefore higher in the 1970s. Indeed, a substantial part of the rise in the log ratio of pension assets to income can be explained by a simple, weighted average of the two total returns indices. This correlation is likely to be even greater for a more sophisticated weighted total returns measure, giving cash, short term bonds, real estate and other asset classes their due. Thus, a fairly passive investment strategy of holding securities and reinvesting the income in the same securities could account for a considerable part of trends in the pension ratio, and its short-term fluctuations.

#### PLACE FIGURE 4 ABOUT HERE

Regulatory changes have also played an important role, however. The early 1980s saw a relaxation of government-prescribed asset ratios applying to private pension funds and pensions invested with insurance companies, making it possible to expand the proportion invested in equities, on which rates of return were higher. From 1990, official pension funds were no longer restricted to invest only in public fixed interest securities. And, the concern to move official pension funds to an approximately fully funded basis, raised contribution rates into these funds.

Relative, after-tax returns in alternative assets are probably also part of the explanation for the rise in pension wealth relative to income. Except for a brief exception in the mid-1980s, and until the 1990s, real returns on liquid assets, particularly after tax, were poor, while returns in the housing market have, until recently, been weak since 1983. Furthermore, tax incentives favoured investment in pensions over directly held financial securities. South Africa had no capital gains tax until the

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<sup>24</sup> The quarterly total return index is defined as  $(P_i/P_{i-1}) \times (1 + QY_i)$ , where  $P_i$  is the price index of an asset,  $i$ , and the per-quarter yield is  $QY_i$ . Cumulating quarterly log return indices gives cumulative log total return indices. While the equity and bond yields are assumed free of tax in the case of pensions, this would not be the case for private households holding these assets directly.

Budget of 2000. Before 1996, pension funds were exempt from dividend tax, while directly held securities were not.<sup>25</sup> In Figure 5, the rise in the pensions and the directly held securities ratios are plotted against the differentials between taxed and untaxed total return indices for bonds and for equities: for pensions there are no taxes on dividends or interest, while for directly held securities, dividend income is taxed<sup>26</sup>.

PLACE FIGURE 5 ABOUT HERE

## 5. Conclusions

We have constructed the first set of reasonably comprehensive estimates at market values of aggregate personal sector wealth holdings in South Africa. Our estimates play an important role in explaining variations in consumer expenditure, debt and demand for broad money in South Africa from 1970, as demonstrated in Aron and Muellbauer (2000a,b, 2004).

We have discussed changes in the main asset to income ratios. Most striking are the rise in pension wealth - overtaking gross housing assets in the early 1990s; the rise in household debt; and the relative decline of liquid and housing assets, from the early and mid-1980s, respectively. Directly held securities (including unit trusts or mutual funds) declined since the early 1970s, but have moved in a relatively small range since the mid-1980s.

Our analysis in Section 4 suggests that variations in pension assets and in directly held securities relative to income can be understood in terms of the total return indices primarily on equities and bonds, relative after-tax returns and regulatory changes. Variations in housing assets

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<sup>25</sup> Following the Katz Commission (1996), pension fund income began to be taxed. Pension payments, apart from tax-free lump sums paid out at retirement, are taxed at the respective tax rate of the individuals in receipt of pensions. These tend to be low since other income is usually low during retirement. Also, a substantial part of the pension is paid out as a tax-free lump sum at retirement.

<sup>26</sup> For equities, we apply the tax factor  $(1 - mtd)$ , where  $mtd$  is the average of marginal tax rates on dividends; and for bonds, the factor  $(1 - mt)$ , where  $mt$  is the highest marginal income tax rate.

relative to income are driven largely by variations in real house prices. In turn, these are very sensitive to interest rates, income, credit expansion, inflation volatility and longer run forces likely to include housing supply, demography, the terms of trade, the economy's access to foreign capital, income distribution, the tax regime, crime and political factors. Many of these forces are also likely to have influenced returns on equities and bonds. Variations in the market value of durables relative to income are also sensitive to the relative price of durables, driven largely by trade openness and technology. Interest rates, income and wealth appear to have their expected effects on the demand for durables. Both debt and liquid asset to income ratios are very interest rate sensitive, as well as responding to wealth and credit market liberalisation, and buffer-stock motives linked to uncertainty.

The biggest lacunae in the personal sector wealth estimates concern ownership of foreign assets - made difficult or illegal by capital controls, the assets of unincorporated business enterprises, and of companies not listed on the stock market. More work is needed in these areas, as well as in improving estimates of directly held securities from surveys of households and of share registers.

It would be highly desirable for the Reserve Bank to construct and publish market value wealth estimates. The effort is likely, for some assets, to improve the accuracy of the flow of funds estimates. It should also focus the attention of policy-makers on the macroeconomic wealth effects of both interest rate policy and fiscal policy, which in the past, may not have been given their full due. In turn, this will improve understanding of South Africa's low personal sector saving rate and policy options for raising it.

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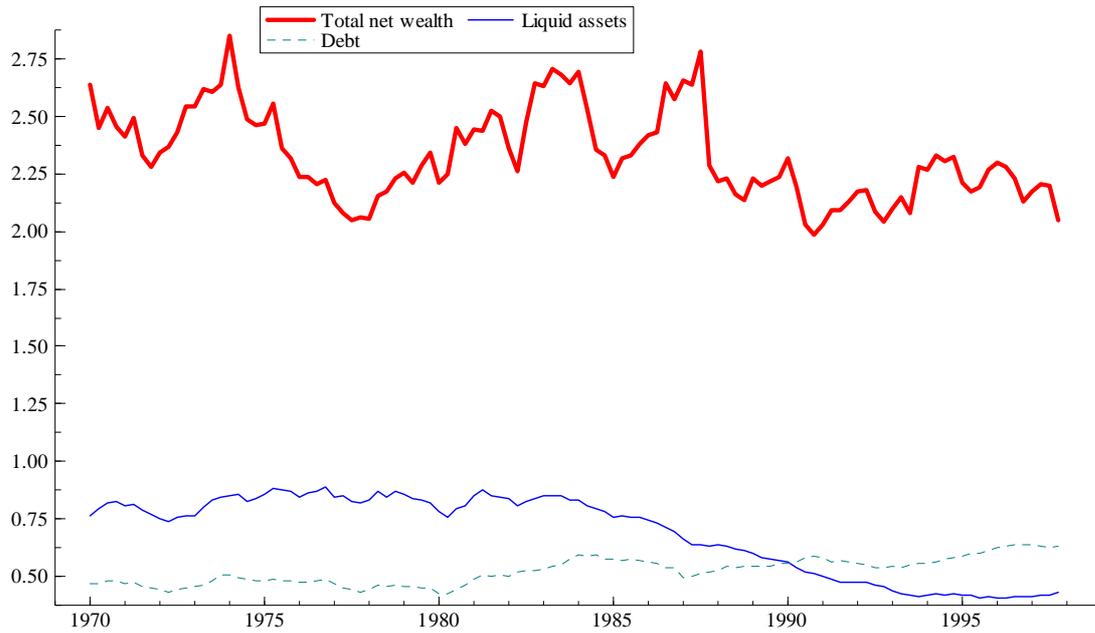
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Figure 1: Ratios to Annual Personal Disposable Income of Net Wealth, Liquid Assets and Debt.



Note: Net wealth excludes durables; and assumes the first of pairs of alternative assumptions (Table 1).

Figure 2: Ratios to Income of Pension Assets, Housing Assets, Directly held Illiquid Financial Assets and Stocks of Consumer Durables.

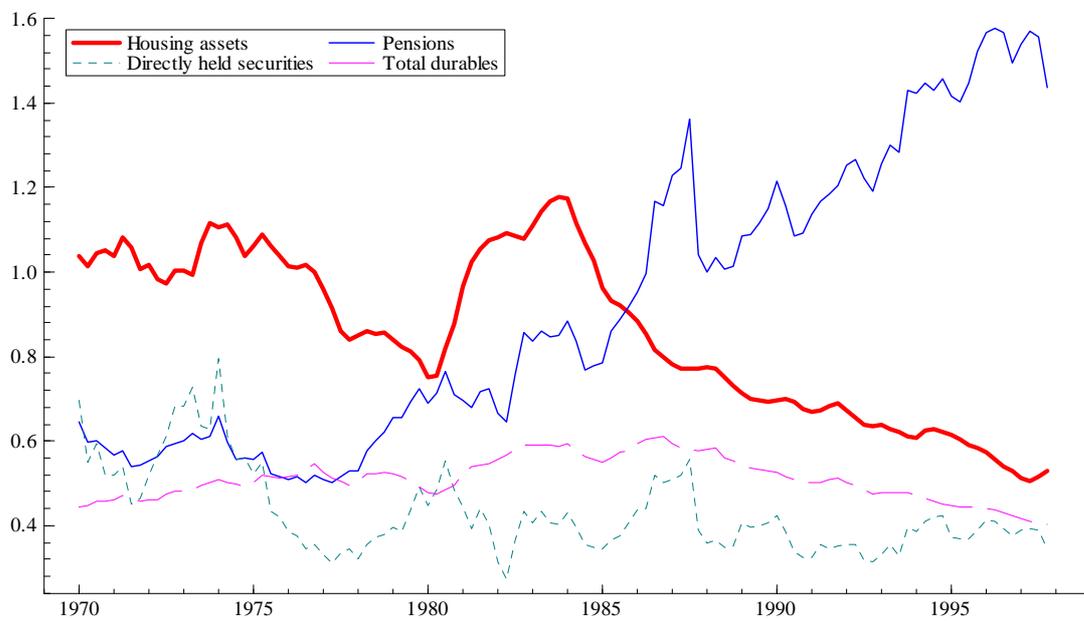


Figure 3abc: Ratios to Income of Housing Assets and Consumer Durables versus Relative Prices

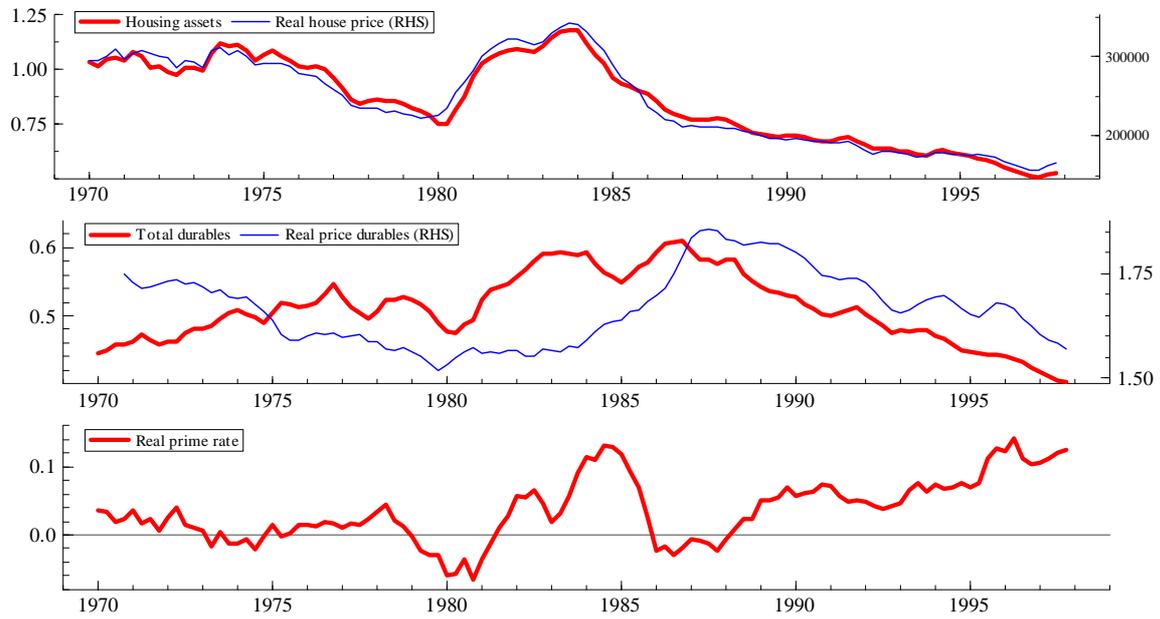
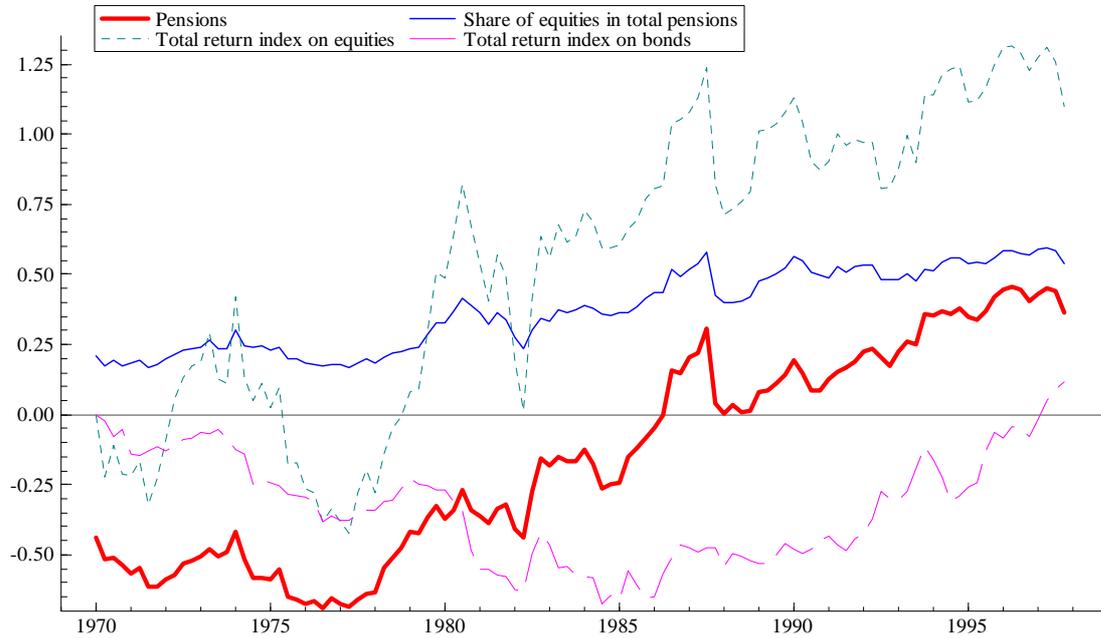
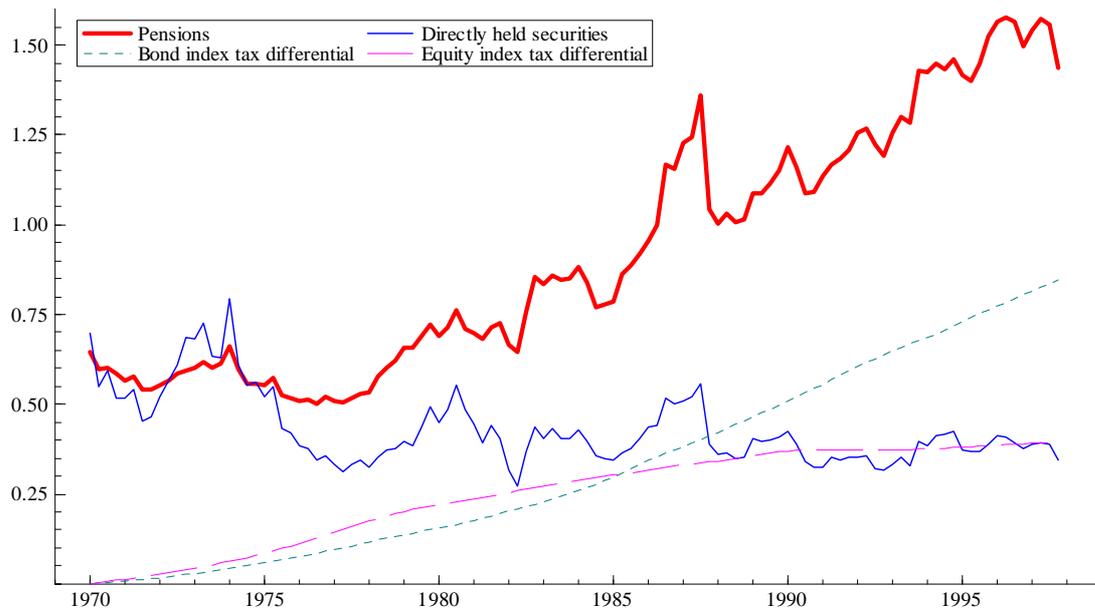


Figure 4: Ratios to Income of Pension Assets versus Total Return Indices for Equities and Bonds and Proportion of Equities in Pension Assets.



Note: Pensions and the return indices are in logs.

Figure 5: Ratio to Income of Pension Assets and Directly held Illiquid Financial Assets versus the Differential between Taxed and Untaxed Log Total Return Indices.



**Table 1: Household balance sheet of assets and liabilities relative to personal disposable income for selected years**

Selected Dates	Sensitivity analysis	1969	1970	1975	1980	1985	1990	1995	1997
<b><i>Liquid assets</i><sup>1</sup></b>									
Liquid assets total	$\theta = 80\%$	0.788	0.825	0.870	0.804	0.755	0.509	0.413	0.433
	$\theta = 85\%$	0.837	0.869	0.891	0.813	0.758	0.509	0.413	0.433
<b><i>Other deposits</i><sup>2</sup></b>									
<b><i>Participation bonds</i></b>									
<b><i>Government and public enterprise assets</i><sup>3</sup></b>									
(19) Short-term government stock		0.003	0.003	0.003	0.006	0.002	0.002	0.002	0.001
(20) Long-term government stock		0.027	0.021	0.006	0.002	0.005	0.005	0.003	0.002
(22) Securities of local authorities		0.005	0.005	0.003	0.002	0.000	0.000	0.000	0.000
(23) Securities of public enterprises		0.003	0.003	0.003	0.004	0.017	0.014	0.008	0.006
<b><i>Corporate bonds and equities</i></b>									
(24) Other loan stock and preference shares	10-fold	0.035	0.026	0.019	0.011	0.005	0.007	0.005	0.004
	15-fold	0.050	0.038	0.025	0.015	0.007	0.008	0.006	0.004
(25) Ordinary shares	10-fold	0.690	0.419	0.283	0.402	0.311	0.255	0.331	0.262
	15-fold	1.004	0.614	0.414	0.589	0.456	0.371	0.459	0.360
<b><i>Equity in unincorporated businesses</i><sup>5</sup></b>									
<b><i>Equity in other unlisted securities</i><sup>5</sup></b>									
<b><i>Pension funds</i><sup>4</sup></b>									
Private self-administered pension funds									
Pensions with long-term insurers	{0, 0.15, 0.30}	0.192	0.171	0.156	0.265	0.367	0.463	0.536	0.517
	{0, 0.25, 0.50}	0.192	0.171	0.156	0.265	0.357	0.450	0.536	0.517
Official pension funds									
<b><i>Foreign assets</i><sup>5</sup></b>									
<b><i>Liabilities</i><sup>6</sup></b>									

Selected Dates	Sensitivity analysis	1969	1970	1975	1980	1985	1990	1995	1997
Total household debt		0.456	0.479	0.480	0.464	0.571	0.589	0.614	0.632
Consumer credit		0.164	0.167	0.174	0.180	0.260	0.264	0.241	0.248
Mortgage debt		0.252	0.269	0.269	0.249	0.250	0.279	0.339	0.347
<b><i>Tangible assets</i></b> <sup>7</sup>									
Residential buildings	25%	1.005	1.050	1.037	0.878	0.904	0.677	0.583	0.528
	20%	0.945	0.987	0.975	0.825	0.850	0.636	0.548	0.496
Tangible assets in unincorporated businesses		-	-	-	-	-	-	-	-
<b><i>Consumer durables (total)</i></b> <sup>8</sup>		0.435	0.458	0.513	0.494	0.577	0.502	0.443	0.403
<b><i>Total net wealth</i></b> (including consumer durables) <sup>9</sup>		3.184	2.913	2.831	2.878	2.957	2.491	2.709	2.453
<b><i>Total net wealth</i></b> (excluding consumer durables)		2.749	2.455	2.318	2.384	2.380	1.988	2.266	2.051
Personal disposable income (seasonally adjusted, annualised)		7490	8309	16858	35860	76213	181531	349252	438336

Continued Table 1

SOURCES: Household debt data (published from 1991) and income data from the Quarterly Bulletin, South African Reserve Bank. Pensions with long-term insurers from Capital Market Statistics, South African Reserve Bank (market value data reported from 1991). Unit trusts data from Capital Market Statistics, South African Reserve Bank. Unpublished data on total household debt (pre-1991), household mortgage debt, consumer credit (after 1992) – see also Prinsloo (2002), and constant price housing stock, were kindly provided by the South African Reserve Bank. All other data: authors' calculations, as explained in the text.

1. Liquid assets up to 1991 comprise categories: (10) Cash and demand monetary deposits, (11) Short/medium-term monetary deposits, (12) Long-term monetary deposits, where numbers in parentheses refer to flow-of-funds categories from the National Financial Account, South African Reserve Bank. A correction was made for missing data on unincorporated businesses (see section 3.1). Note that money market funds have been added to this category (see section 3.1). After 1991, stock data on bank deposits are used directly to construct liquid assets.

2. Other deposits comprise categories: (13) Deposits with other financial institutions, and (14) Deposits with other institutions. Note that money market funds have been subtracted from this category (section 3.2).
3. Government and public enterprise assets also include categories: (15) Treasury bills, (16) Other bills and (21) Non-marketable government bonds. Category (21) became negative and the series was omitted. Categories (15) and (16) are omitted because the flow of funds record zero transactions for the personal sector.
4. Pension funds comprises category: (29) Interest in retirement and life funds, from Capital Market Statistics, South African Reserve Bank, which combines private self-administered pension funds (reported at book values until 1998Q4), pensions with long-term insurers (reported at book values before 1985, at a mix of book values and market values between 1985 and 1991, and at market values from the end of 1991), and official pension funds (still reported at book values). The assumptions in column 2 refer to the proportions of funds (prop) reporting at market value in the following periods:  
 (i) 1961:4 1985:2: prop=0; (ii) 1985:3 1986:4: prop=0.15; (iii) 1987:1 1987:3: prop=0.3; and (iv) 1987:4 1991:3: prop=0.15.
5. Unavailable data include foreign assets, equity in unincorporated businesses and in other unlisted securities, and tangible assets in unincorporated businesses.
6. Liabilities categories are (17) Bank loans and advances, (18) Trade credit and short-term loans, (27) Long-term loans, and (28) Mortgage loans, from estimates for total household liabilities and private sector loans, Quarterly Bulletin, South African Reserve Bank.
7. Tangible assets employ private housing stock estimates, Quarterly Bulletin, South African Reserve Bank, and the ABSA Bank Ltd., South Africa, house price index.  
 There are no available data on the other tangible assets categories: agricultural land holdings, commercial, industrial and other buildings, plant and machinery, vehicles (excluding personal transport), and stocks and work in progress.
8. Consumer durables comprise categories: (A) furniture, household appliances, etc; (B) personal transport equipment; (C) recreational and entertainment goods; (D) other durable goods (jewellery etc). There are published figures for consumer semi-durable goods.
9. Total net wealth sums the above categories (assuming the first of each pair of assumptions listed in column 2).
10. Quarterly data are available from 1970.

## Appendix 1: Construction of Bond Price Indices

Data on bond price indices are available from the South African Bond Exchange from 1980, for government bonds in the long duration classes of 3-7 years, 7-12 years, and 12 or more years to maturity. For short duration bonds (under 3 years to maturity), and for long bonds before 1980, we constructed bond price indices using yield and coupon data for short bonds and for bonds with 10 or more years to maturity.

The construction of our bond price indices from yield and coupon data is shown first for a representative short bond and then for a representative long bond. Suppose a two-year stock pays in currency units a coupon of  $c/2$  percent halfway through each year, as well as at the end of each year, and pays 100 currency units at the end of the two years. The price-yield relationship (see Malkiel, 1966) is defined by

$$(A1.1) \quad \pi^S_t = (c_t/2)/(1+r_t/2) + (c_t/2)/(1+r_t) + (c_t/2)/(1+r_t/2) (1+r_t) + (100+c_t/2)/(1+r_t)^2$$

where  $r$  is the annual percentage yield divided by 100, and  $\pi^S$  is the price of the short-term bond.

The analogous formula holds for stocks of longer duration. For long-term government bonds of  $n$  years duration (e.g. for South Africa, the average duration of long bonds is about 13 years), and where for simplicity we ignore the fact that the coupon is paid twice a year, rather than once a year, the price is approximately given by

$$(A1.2) \quad \pi^L_t \approx (\sum_{i=1,n} c_t/(1+r_t)^i) + 100/(1+r_t)^n = (c_t/r_t) [1-1/(1+r_t)^{n+1}] + 100/(1+r_t)^n$$

Using equations (A1.1) and (A1.2), we construct ratios of bond price indices of the form

$\pi_t(c_{t-1})/\pi_{t-1}(c_{t-1})$ . This makes explicit the fact that coupons evolve over time and that we hold them fixed for quarter-to-quarter comparisons. For the quarterly revaluation adjustment for net purchases, we use  $\pi_t/H\pi_t$ , where  $H\pi_t$  is the harmonic mean for quarter  $t$ , see footnote 4, again holding the coupon at its  $t-1$  level.

We build in the gradual evolution of coupons as follows. For the coupon on short-term government bonds, we assume, as above, that two years is the representative maturity of government stock, and take the evolving coupon to be determined by the moving average of the short-term yield in the previous 24 months. For the coupon on long-term government bonds, we calculate the average coupon on outstanding government stock with 10 or more years to run, from data on the maturity structure of government bonds in Public Finance Statistics, for years beginning in 1970. For the preceding years, and a few missing observations, we interpolate the coupons using the moving average of the long-term government bond yield in the previous 10 years.

As a check on the methodology, we compare the results for the long bond price index with the Bond Exchange bond price indices for maturities of 7-12 years, and 12 or more years, for 1980-2000. The match is very close, though the Bond Exchange data are based on end of month observations, while our yield data are available only as monthly averages.

For the period since 1980, we take the long bond price index to be a weighted average of the bond price indices from the Bond Exchange for 3-7, 7-12 and 12 or more years duration classes, with weights of 0.4, 0.4 and 0.2, respectively, derived from information on the maturity structure of government debt for selected years in the 1980s and 1990s.

For the years before 1980, this index is spliced to our yield-based index for bonds with 10 or more years to run. Unfortunately, yields for bonds with 3-10 years maturity were not published before the mid-1980s, so that our pre-1980 price index for all bonds with maturity greater than 3 years is based on yields for bonds with 10 or more years to run.

To compute the relevant price indices for revaluing *government securities*, when creating market priced wealth data for all three pensions categories in the paper, we use the ownership proportions of long-term government securities (duration of 3 years or more), and of short-term government securities (duration up to 3 years) for each type of asset holder.

Price indices for securities used by *local authorities* and *public sector enterprises* are derived using the price-yield relationship in equation (A1.2), on the assumption that the representative stocks have a duration of, respectively, six and ten years. Coupons for local authorities are approximated by taking the 6 year moving average of past yields. For public enterprises, we take coupons on long-term government stock, calculated above, as representative. Missing data before 1981, for local authorities' yields, are derived by fitting a regression relationship using yields on short-term and long-term government stock on the years for which the data exist. Pension funds' holdings of local authority stock are typically small - under 5 percent of holdings in government stock - so errors of approximation will be unimportant. Our methodology was found to be robust, when comparing our estimated market values with the actual market values when published: we compared data for long-term insurers in 1991Q3 and 1991Q4, and private pension funds in 1998Q4 and 1999Q1, making plausible assumptions on net purchases for the quarter in which book value data are discontinued and market value data begin.

## Appendix 2: Benchmarks and Revaluation Adjustments for Pensions Categories

### (i) Private Self-Administered Pension Funds

The benchmarks are based on 1961Q4 data. We assume that for fixed interest securities, the 1961 market values are close to book values, given that yields and hence bond price indices had been fairly stable in the previous eight years<sup>27</sup>. For equities, this is a less satisfactory assumption with prices around 25 percent higher in 1961 than on average for the previous eight years. Thus, we adjusted up the 1961Q4 equities book value by 25 percent to obtain the market value benchmark.

Construction of price indices for “government stock” and for “local authority”, “public enterprise” and “corporate” bonds were described in Appendix 1.

The Johannesburg Stock Exchange (JSE) index of all share prices at the end of each quarter is used to adjust the “ordinary shares” category. The revaluation factor used is  $(p_{it}/p_{it-1}) - 0.004$ , on the assumption that trading and management costs lead private pension equity investments to under-perform the index. This assumption (under-performance of 1.6 percent per annum) produces a good match between our book value series converted into market values in 1998Q4 and the market valuation published first in 1999Q1.

For the category “loan stock, preference shares etc”, we assume that the relevant price index is an average of the corporate bond price index and the ordinary share price index and tune the weights to produce a good match between estimated and actual market values in 1998Q4 and 1999Q1. This gives weights of 0.4 for the equity component and 0.6 for the bond component. The category “other assets”, making up around 5 percent of total assets, includes some foreign

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<sup>27</sup> Yields were marginally higher in December 1961, and hence market values a little below book values. By 1970, from when we report our estimates, this slight bias is likely to have become negligible.

assets. Evidence on this category from revaluation into market prices in March 1999 suggests a substantial rise compared with the 1998Q4 book value. We therefore assume that a given percentage of these holdings are subject to revaluation and use the JSE share price index for this purpose, which typically rises in locally currency terms when the Rand depreciates. The assumption that 50 percent of assets are subject to this revaluation gives a good match between our 1998Q4 conversion of book to market value and the reported 1999Q1 market value.

The house price index for medium-sized houses (ABSA Bank Ltd., South Africa) is used, with some adjustment, to revalue “fixed property” from 1966.<sup>28</sup> For 1961-65, in the absence of other data, this is chained to the South African consumer price index (CPI). However, for private pensions (and for long term insurers, see below), the house price index produces book to market value conversions which are clearly too high. To tune our book to market conversion to the actual market value data, we take  $(p_{it}/p_{it-1} - 0.0125)$  as the appropriate quarterly revaluation. This is consistent with a mixture of transactions and management costs and under-performance by the commercial property component of fixed property relative to owner-occupied residential property, of 5 percent per annum.

## **(ii) Long-term insurers**

Before 1985, long-term insurers all reported assets at book value to the Registrar of Insurance. Between the third quarter of 1985 and the third quarter of 1991, some insurers reported at market values and others at book values, while, from the fourth quarter of 1991, all insurers were required

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<sup>28</sup> It seems likely that the cyclical characteristics of residential and commercial real estate valuation are similar, even if, as in the UK, the latter have a weaker trend.

to switch to the market value basis.<sup>29</sup> Unfortunately, we do not know the proportions, which reported on either basis, though there are some clues. For example, for ordinary shares, there is a jump from R8,647 million at book value in June, 1985 to R11,252 million in September, 1985, on a mixed reporting basis. We do not know net acquisitions between these dates, but on plausible assumptions, around 15 to 25 percent of ordinary share holdings may have switched to being valued at market prices. However, between September, 1987 and December, 1987, when the JSE all share price index fell from 106 to 71 (a 33 percent fall), reported ordinary share holdings fell by 43 percent, which seems inconsistent with only about 15 to 25 percent of insurers reporting at market value. The puzzle deepens when we find that between September, 1991 and December, 1991 - when the switch to full market valuation occurred - the reported ordinary share holdings rose from R54,662 million to R104,532 million, while the market rose 4 percent, suggesting that only a small proportion were reporting at market value in September, 1991.

Unless there is some other gross data inconsistency, only one hypothesis seems able to explain these paradoxes. Suppose that in the first quarter of 1987, more insurers switched to the market value basis. Then more of the 40 percent rise in ordinary share holdings from March to September 1987 could be explained by the 25 percent rise in the JSE index. However, after the October, 1987 world stock-market crash, the market valuation basis would have seemed much less attractive. This suggests that some insurers, having only recently adopted the market value basis, switched back to book value in reporting to the Registrar of Insurance.

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<sup>29</sup> Market value data were also reported for the end of 1990, but not for the first three quarters of 1991. However, the reported figures for 1990 look too low. For example, ordinary share holdings of R62,305 million are reported, compared with R104,532 million at the end of 1991, a rise of 68 percent. However, the JSE all shares index rose only by 26 percent, while the flow of funds data record a net acquisition of shares for *all* insurers and retirement funds of only around R9,000 million.

We assume the following pattern (an alternative to check sensitivity is shown in parentheses): 15 (25) percent of assets switch to market value in the third quarter of 1985; this rises to 30 (40) percent in the period between the first quarter of 1987 and the third quarter of 1987; it then falls back to 15 (25) percent in the fourth quarter of 1987, where it remains until the fourth quarter of 1991, when it jumps to 100 percent. Given movements in the JSE index, this results in an implied pattern of net acquisitions which is not too improbable. With these assumptions, quarterly market value estimates of the total assets of long-term insurers were constructed from 1962 to 1997 - making assumptions about the 1961Q4 benchmarks similar to those for private self-administered pension funds, and apportioned to pensions using the ratio of pensions to total liabilities.